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FINAL ENVIRONMENTAL ASSESSMENT

JOHN SEVIER FOSSIL PLANT UNITS 1 THROUGH 4 CONTROL SYSTEMS FOR REDUCTION OF NITROGEN OXIDES

Hawkins County, Tennessee

TENNESSEE VALLEY AUTHORITY

MARCH 2006

Final Environmental Assessment **March 2006**

Proposed project: John Sevier Fossil Plant Units 1 Through 4
Control Systems for Reduction of Nitrogen Oxides
Hawkins County, Tennessee

Lead agency: Tennessee Valley Authority

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Abstract: The Tennessee Valley Authority (TVA) is evaluating options for the further removal of nitrogen oxides (NO_X) from coal combustion flue gases at John Sevier Fossil Plant (JSF), which is located in Hawkins County, Tennessee, about 2.5 miles southeast of Rogersville, Tennessee. NO_X emissions are a factor in the formation of acid rain and high ground-level ozone concentrations. NO_X is produced in motor vehicle and industrial combustion processes, including electric power generation such as at TVA's JSF. In 1995, TVA installed low-NO_X burners at JSF, which have reduced NO_X emissions, but further reductions of NO_X emissions at JSF would assist in TVA's efforts to reduce NO_X emissions systemwide.

TVA is considering use of four alternative technologies either alone or in combination (six total alternatives) to achieve substantial additional reduction of NO_X emissions from JSF. In addition to no action, these alternatives include boiler optimization; selective noncatalytic reduction (SNCR); low-dust selective catalytic reduction (SCR); and high-dust SCR. The two SCR options would be expected to reduce emissions of NO_X from the plant by up to 90 percent; lesser reductions would be expected from SNCR and boiler optimization. All NO_X reduction systems under consideration would be primarily installed within the existing plant structure. An ammonia storage facility located within the plant site would be included for either of the two SCR options. The SNCR process could include either ammonia storage facilities or urea storage and handling facilities. TVA is considering a technology testing phase so as to reduce uncertainty regarding performance and which of the effective mitigations to implement. Under the proposed SNCR option, design of equipment could begin as early as 2006 and as late as 2009. Installation of SNCR could possibly be completed as early as 2006 and as late as 2011. Installation of low-dust SCR or high-dust SCR would require more time to accommodate equipment design, procurement, and installation.

In accordance with the National Environmental Policy Act, TVA has prepared a Final Environmental Assessment (FEA) on the No Action and five proposed alternative actions to reduce NO_X emissions from JSF. The Draft Environmental Assessment was distributed in December 2005. TVA received comments from two federal agencies on the Draft, as well as determination from the Tennessee State Historic Preservation Officer that there are no national register or historic places or eligible properties affected by this undertaking and concurrence of the U. S. Fish and Wildlife Service about findings on potential effects to listed species. Comments received are addressed in the Final Environmental Assessment.

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CHAPTER 1

1. PURPOSE OF AND NEED FOR ACTION

1.1 The Decision

In 1995, Tennessee Valley Authority (TVA) installed low-nitrogen oxides (NO_X) burners at John Sevier Fossil Plant (JSF), which have reduced NO_X emissions, but further reductions of NO_X emissions at JSF could assist in TVA's efforts to reduce NO_X emissions systemwide. TVA is considering installation of additional NO_X emissions reduction systems at JSF and evaluating options for technology and mitigation through an adaptive approach to provide increased flexibility in meeting systemwide goals of reducing NO_X emissions. Four technologies either alone or in combination are under consideration for NO_X emissions reductions for Units 1 through 4 at JSF. A No Action Alternative is also under consideration. TVA must decide (1) whether to install such systems at JSF, and if installed, (2) which system or combination of systems, described herein as alternatives, to install in a manner that reduces operational uncertainties and provides the information to support an effective decision for full implementation.

1.2 Background

The following discussion of NO_X air pollution and control technologies was primarily taken from U.S. Environmental Protection Agency (USEPA) sources and *Pollution Engineering* (USEPA, 2003; Sandell, 1998).

1.2.1 Air Pollution from Nitrogen Oxides

NO_X includes nitric oxide (NO) and nitrogen dioxide (NO_2) and is produced in motor vehicle and industrial combustion processes. NO_X emissions are a major factor in causing air pollution, including acid rain and high ground-level ozone concentrations. In 2001, 40 million Americans lived in counties where monitored outdoor air quality exceeded EPA air quality standards because of high ground-level ozone concentrations. NO_X also plays a role in elevated levels of fine particulate, a pollutant, the effects of which the USEPA is attempting to address by revising the National Ambient Air Quality Standards (NAAQS) to regulate concentrations of particulate matter with aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

1.2.2 NO_X Control Technologies

Numerous technologies are used to control NO_X. These can predominantly be divided into two main categories: NO_X prevention and NO_X removal. A more detailed description of these technologies are found in the Colbert NO_X Reduction Systems Environmental Assessment (TVA, 2003), which is incorporated by reference. Common prevention alternatives include low-NO_X burners and furnace modifications (e.g., boiler optimization). Low-NO_X burners can reduce NO_X emissions 20 percent to 60 percent compared to older generation burners and generally have low to moderate capital equipment costs and low maintenance costs. Furnace modifications such as overfire air, staged combustion, and gas reburning can prevent the formation of NO_X. With gas reburning, natural gas is injected near the primary combustion zone to reduce the availability of oxygen.

Selective noncatalytic reduction (SNCR) and selective catalytic reduction (SCR) are considered post-combustion removal methodologies, even though SNCR can be installed within the boilers, because the equipment is usually installed after the main combustion stage. With SNCR, a nitrogenous compound, typically ammonia or urea is injected directly into the hot flue gases. At suitably high temperatures (1600 degrees Fahrenheit [°F] to 2100°F), NO_X is reduced to form molecular nitrogen and water. The temperature of the hot flue gases is the primary driving force for the reaction, and a catalyst is not needed. Although 20 percent to 40 percent reductions of uncontrolled NO_X levels are common, SNCR operation can result in large amounts of ammonia slip (the emission of unreacted ammonia and ammonia compounds). SCR uses a catalyst to promote the chemical reaction between NO_X and a nitrogenous compound, generally ammonia, to produce molecular nitrogen and water. In the SCR process, the catalyst allows the chemical reaction between NO_X and ammonia to occur at substantially lower temperatures (350^{o}F to 1100^{o}F) and with greater reagent utilization than does the simple SNCR process. With SCRs, NO_X removal as high as 90 percent can be achieved. The drawbacks of SCR technology include the difficulty of storing and transporting ammonia, the high capital cost of the catalyst, the difficulty of thoroughly mixing the injected ammonia prior to the catalyst, maintenance of the required reaction temperatures, and disposal of spent catalysts.

SNCR and SCR may be used as a hybrid system. The SNCR process would provide a substantial portion of the NO_X removal, and the SCR process would both control ammonia slip and perform the remaining treatment. A possible advantage of a hybrid SNCR/SCR system would be a reduction in capital cost, since the amount of expensive catalyst required would be reduced.

1.2.3 John Sevier Fossil Plant

TVA's John Sevier Fossil Plant (JSF) is located on 750 acres (300 hectares) of rolling land south of the Holston River near Rogersville, Tennessee (Figure 1-1). The plant is located on Cherokee Reservoir near Holston River Mile (HRM) 106. Most nearby land is agricultural, but residential and recreational areas are in close proximity. The closest residences are located on land immediately adjacent to the plant reservation.

Plant construction began October 14, 1952. The first generating unit went into operation on July 12, 1955. John Sevier currently uses low-sulfur coal from mines in Virginia. Exhaust gases from JSF are emitted through two 350-foot (106-meter) stacks. Between May and December 1995, the four units at JSF were equipped with burners designed to reduce emission of nitrogen oxides . Installation of the low-NO_X burners reduced the NO_X emissions by approximately 20 percent.

1.3 Other Pertinent Environmental Reviews or Documentation

The following National Environmental Policy Act (NEPA) documents prepared by TVA relate to TVA management of water resources in the area, the JSF site, regional NO_X emissions reduction, and strategies for meeting customer electric power needs. This EA is tiered from the Energy Vision 2020 EIS noted below.

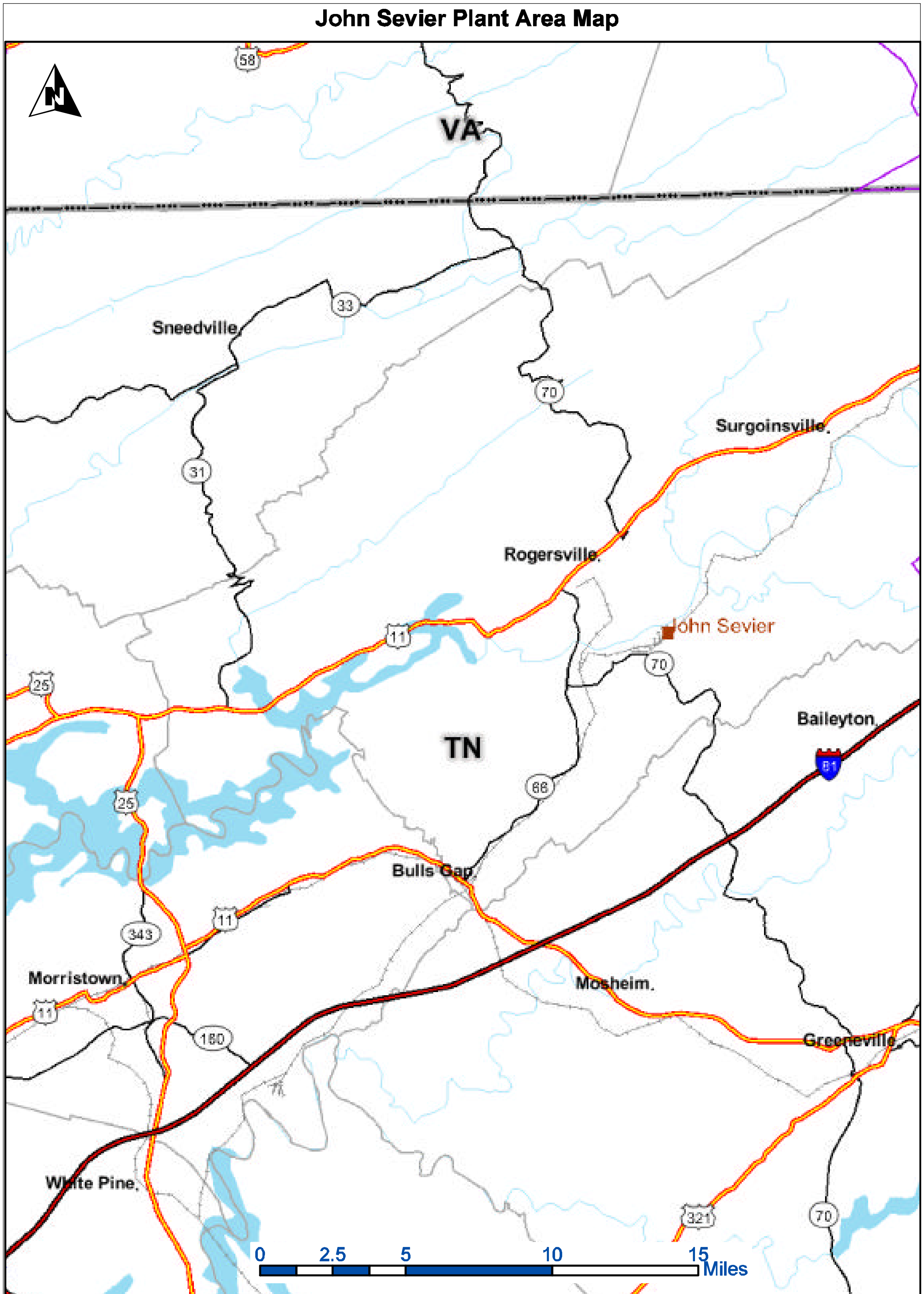


Figure 1-1. John Sevier Plant Area Map

- Reservoir Operations Study Final Programmatic Environmental Impact Statement, February 2004
- Kingston Fossil Plant Units 1 Through 9 Reduction Systems for Control of Nitrogen Oxides Supplemental Environmental Assessment, March 2003
- Colbert Fossil Plant Units 1 Through 5 Reduction Systems for Control of Nitrogen Oxides Environmental Assessment, February 2003
- Kingston Fossil Plant Units 1 Through 9 Reduction Systems for Nitrogen Oxide Control Environmental Assessment, May 2002
- Bull Run Fossil Plant Unit 1 Selective Catalytic Reduction System for Nitrogen Oxide Control Environmental Assessment, April 2002
- Widows Creek Fossil Plant Units 7 and 8 Selective Catalytic Reduction Systems for Nitrogen Oxide Control Environmental Assessment, July 2001
- Cumberland Fossil Plant Units 1 and 2 Selective Catalytic Reduction Systems for Nitrogen Oxide Control Environmental Assessment, December 2000
- John Sevier Fossil Plant Soil Borrow Sites Environmental Assessment, May 1998.
- Energy Vision 2020 - Integrated Resource Plan Environmental Impact Statement, December 1995

1.4 The Scoping Process

In a series of seven initial scoping meetings, an interdisciplinary team of TVA staff identified the following areas as needing detailed review:

- Air Resources
- Surface Water Resources
- Groundwater Resources
- Floodplains and Flood Risk
- Coal Combustion Byproduct Generation, Marketing, and Handling
- Terrestrial Ecology
- Aquatic Ecology
- Threatened and Endangered Species
- Managed Areas
- Wetlands
- Transportation
- Socioeconomics and Environmental Justice
- Visual Resources
- Recreation
- Cultural Resources
- Safety and Health
- Seismology
- Tornado Risk

Since the changes anticipated in conjunction with any of the action alternatives in this Environmental Assessment (EA) would be located within an existing operating coal-fired electric generating plant and none of the changes would be expected to increase noise levels above present operating levels, no additional analysis of noise concerns was considered necessary. As part of the scoping and evaluation process TVA identified that an adaptive approach to testing of technology(ies) and implementation of mitigation was advantageous to ensuring that the desired levels of technology performance were attained and that the appropriate level of mitigation was implemented from the suite of effective mitigations identified.

CHAPTER 2

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Alternatives for compliance with NO_X reduction regulatory requirements are described in this chapter. For the purpose of evaluating environmental impacts, all of the action alternatives (Alternatives B through G below) are assumed to run continuously year-round, unless otherwise stated as for the cases of potential single-unit tests and technology demonstrations included in Alternatives C and D.

2.1 Alternatives

TVA is considering six alternatives including the No Action Alternative and five action alternatives for reducing NO_X emissions, i.e., boiler optimization, installation of SNCR systems, installation of low-dust SCR systems, installation of high-dust SCR, and a final action alternative that includes combinations of the other action alternatives (i.e., use of multiple NO_X reducing methods). It is anticipated that alternatives involving SNCR technology would involve testing phases that could provide performance information leading to sequential decisions about which NO_X reduction technology(ies) are chosen for full implementation.

2.1.1 Alternative A – The No Action Alternative

Under the No Action Alternative, TVA would not install additional NO_X reduction equipment at JSF. Under this alternative, NO_X emissions reductions would be achieved by installation and optimization of NO_X reduction equipment at other TVA facilities, by load reductions, and if necessary, TVA would purchase NO_X emission credits. Under this alternative, TVA would not gain the benefit of operational knowledge learned from testing of technology, nor that regarding the suite of mitigations to control surface water impacts to insignificance.

2.1.2 Alternative B – Optimize Boilers to Reduce NO_X Formation on Units 1 Through 4

Under Alternative B, NO_X monitors, temperature monitors, computer control systems, and other equipment would be installed, interconnected, and programmed to reduce NO_X formation in the boilers at JSF. NO_X reductions of 30 percent could possibly be achieved with relatively low capital expenditures and no anticipated negative environmental impacts. An evaluation of boiler optimization was conducted in 2005, and results are still being evaluated. If monitoring devices require installation during outages, full implementation of boiler optimization may depend on outage schedules.

2.1.3 Alternative C – Installation of SNCR on Units 1 Through 4

Under Alternative C, SNCR would be installed on one to four units at JSF, pending the results of a test case. In Phase 1, an SNCR system would be installed on one unit at JSF as a pilot, as early as 2006. For the purposes of this EA, the maximum duration of SNCR testing on one unit at JSF will be assumed to be one year. Upon review and evaluation of monitoring data, TVA may elect to extend the test for a second year.

If the results of the tests of SNCR on one unit at JSF were favorable, TVA could elect to proceed to Phase 2, whereby SNCR would be installed on the remaining units at JSF sometime during 2007 and 2008. If SNCR system test results are less favorable, installation on additional units may be delayed several years pending optimization studies on the initial installation, or TVA may elect to install other NO_X emissions reductions technologies on the other units. Installation of SNCR on a unit can be expected to reduce NO_X emissions from 20 percent to 40 percent.

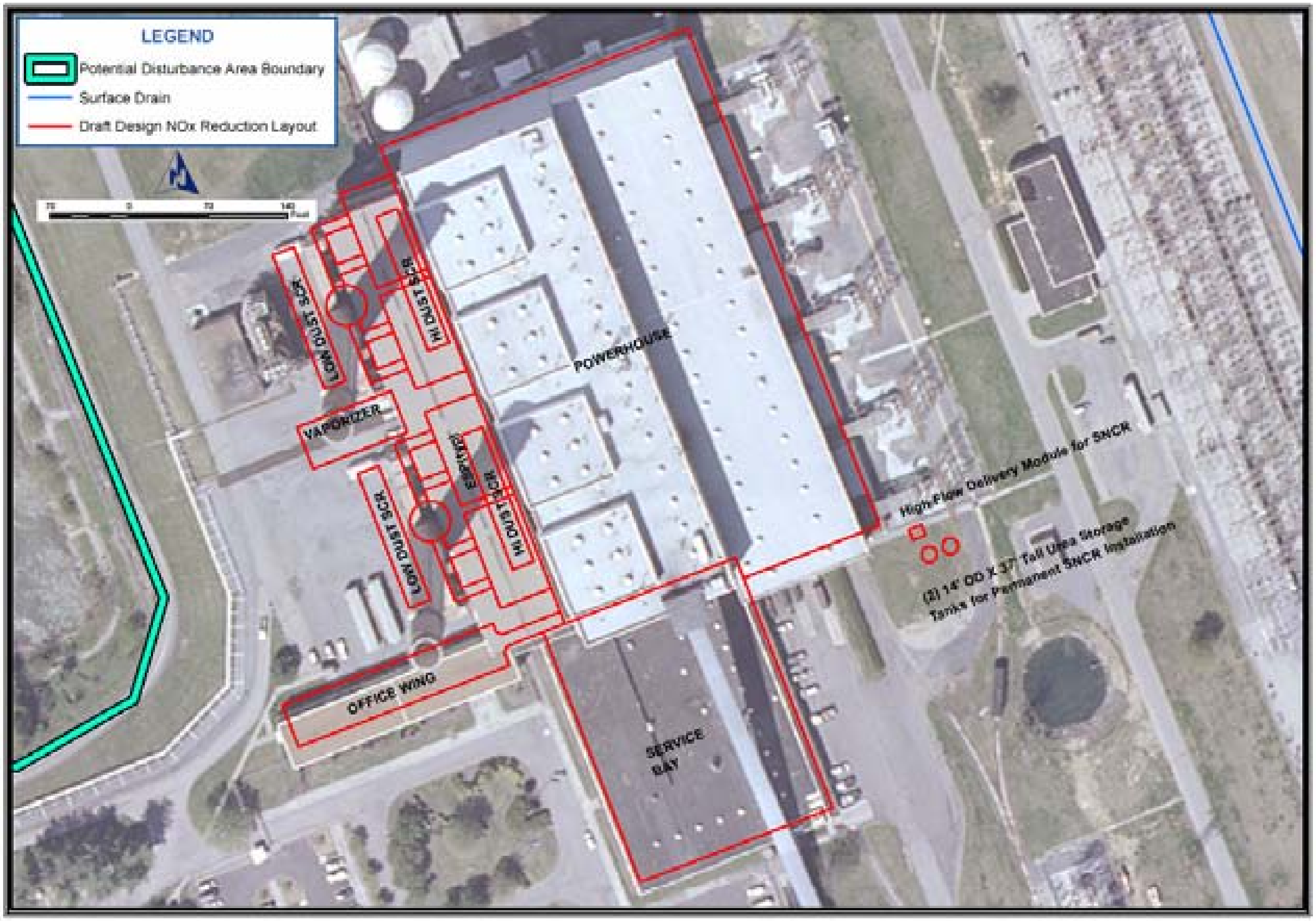
The implementation of SNCR would involve installation of supply lines, nozzles, and devices within the plant structure to inject controlled amounts of ammonia or urea solution into each of the individual boilers. Each of the injection grids consists of a number of lances installed at the entry to the particular injection cavity. Laydown areas for the SNCR system would be in the vicinity of the boilers and possibly some of the open areas on the eastern side of the plant. Modifications to the SNCR installation may occur due to design refinements resulting from tests at other plants. If modifications were made that would add substantive environmental concerns, TVA would conduct the appropriate additional environmental review at that time. The supporting ancillary infrastructure necessary for this alternative is further described in Section 2.2. Most of these areas have been previously disturbed for construction of the existing plant structure. A diffuser system could possibly be installed (see commitments section) on storm water outfall F-16A (the discharge from the dry fly ash stack stilling pond) to reduce the effects of rainwater leaching of ammonia compounds deposited on fly ash by the SNCR. The riverbank in the vicinity of the proposed diffuser and feed pipe (or pipes) has been graded to stabilize the slope and covered with riprap, but the parts of the feed pipe and diffuser that may traverse the main river channel would cross relatively less disturbed areas (TVA, 1969).

TVA tested a proprietary variant of SNCR technology at Kingston Fossil Plant (KIF) Unit 9, Kingston, Tennessee, from January to May 2002. Another test of this technology occurred at Colbert Fossil Plant (COF) Unit 4, Tuscumbia, Alabama, from May 2004 through February 2005. The SNCR technology tested at KIF and COF used propane or natural gas to facilitate the reactions of the NO_X reduction processes. TVA tested another type of SNCR at Johnsonville Fossil Plant and Shawnee Fossil Plant during the ozone season of 2005. Analyses of operating data from these tests will be used to assist in determining feasibility and likely effectiveness of the SNCR technology in conjunction with the proposed one-unit test at JSF. Installation of SNCR technologies would require substantially less construction and modification to existing plant flue gas ductwork than installation of SCRs (see Figure 2-1).

In addition to the supply lines, nozzles, and devices installed to inject controlled amounts of ammonia and natural gas into each of the individual boilers for SNCR technology, use of the proprietary variants of SNCR technology would additionally require installation of supply lines and controls for propane. Since economic evaluation indicated construction of a natural gas pipeline was not economical, propane would be used to facilitate the reaction for the NO_X reduction processes to work. Propane would be piped from tanks located on the eastern side of the plant to the powerhouse. The propane supply lines would run within the green and black area identified as the potential project footprint area in Figure 2--3.

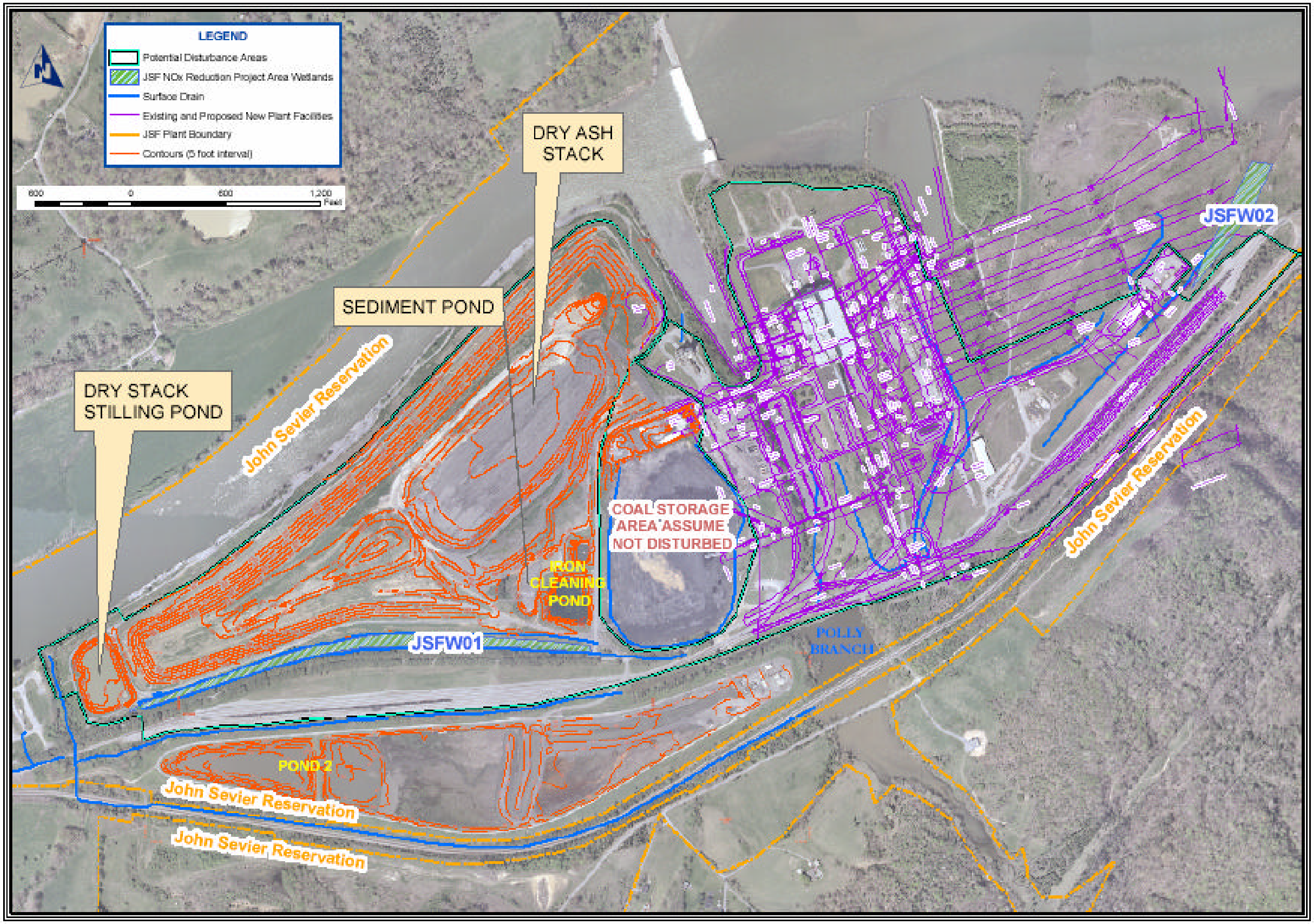
2.1.4 Alternative D – Installation of Low-Dust SCRs on Units 1 Through 4

Under Alternative D, two low-dust SCRs would be installed at JSF, pending the results of SNCR testing at JSF or other TVA plants. Each low-dust SCR would service two boiler units.



Map and orthophotograph created by RSO&E, Geographic Information & Engineering.
Orthophotograph as of April 14, 2003.

Figure 2-1. Possible Equipment Locations for Alternatives C through F



Map and orthophotograph created by Geographic Information & Engineering, RSO&E. Orthophotograph as of April 14, 2003. Contours provided and created by Surveying and Project Services, TPS as of May 2004.

Figure 2-2. John Sevier Fossil Plant NO_X Reduction Project Footprint

The proposed low-dust SCR system(s) includes a reactor housing and ductwork, catalyst and unloading, storage, vaporization, dilution, injection, and control systems for anhydrous ammonia. Construction of ammonia tanks and one or more propane tanks would be needed. The reactor would be installed downstream of the precipitators within the flue gas stream. Since the reactor housing, catalyst bed, and ductwork would take up more space than the equipment needed for SNCR, more construction disturbance would occur. Laydown areas for the low-dust SCR system would be in the vicinity of the boilers and possibly some of the open areas on the eastern side of the plant. Most of these areas have been previously disturbed for construction of the existing plant structure. The supporting ancillary infrastructure necessary for this alternative is further described in Section 2.2. Since low-dust SCR would not result in ammonium compound deposition on the fly ash, the potential mitigation measure for a diffuser on Outfall F-16A would not be needed.

2.1.5 Alternative E – Installation of High-Dust SCR on Units 1 Through 4

Under Alternative E, four high-dust SCRs would be installed at JSF. The proposed high-dust SCR system includes a reactor housing and ductwork, catalyst and unloading, storage, vaporization, dilution, injection, and control systems for anhydrous ammonia. The reactor would be installed upstream of the precipitators within the flue gas stream. Since the reactor housing, catalyst bed, and ductwork would take up more space than the equipment needed for SNCR, more construction disturbance would occur. Laydown areas for the high-dust SCR system would be in the vicinity of the boilers and possibly some of the open areas on the eastern side of the plant. A diffuser system could possibly be installed on Storm Water Outfall F-16A, the discharge from the dry fly ash stack stilling pond, to mitigate the effects of ammonia compounds deposited on fly ash by the SCR process dissolving in rainwater. Most of these areas have been previously disturbed for construction of the existing plant structure. The supporting ancillary infrastructure necessary for this alternative is further described in Section 2.2.

2.1.6 Alternative F – Possible Combinations of Alternatives B Through E

Under Alternative F, TVA would maintain a flexible approach to reducing NO_X emissions at JSF, selecting various combinations of the available technologies to achieve desired results in a cost-effective manner. TVA may choose to use various combinations of technology and/or to deploy those technologies in sequence over time. Any information gained and lessons learned during testing and demonstration phases would assist in this selection. For example, Alternative B – Boiler Optimization could be combined with Alternative C – SNCR. In addition, the noncatalytic technologies could eventually be replaced with Alternative D – Low-Dust SCR or Alternative E – High-Dust SCR. TVA is installing NO_X emissions reduction equipment at up to seven other coal-fired power plants. This approach additionally acknowledges that operating data for NO_X reduction equipment at other TVA plants may also lead to adjustments in assumptions for NO_X reduction project economics at JSF.

Because it encompasses all potential technologies, Alternative F will be used to quantify the potential worst-case environmental impacts that could result from combinations of the other action alternatives and from the possibility of the action alternatives being conducted sequentially. This alternative also would likely entail the most robust adaptive testing and demonstration phases to achieve reductions in NOx emissions and ensure selection and deployment of effective mitigations for adequate protection of surface water resources. The supporting ancillary infrastructure necessary for this alternative is further described in Section 2.2.

2.2 Infrastructure Project Components Associated With Alternatives C, D, E, and F

2.2.1 NO_X Reduction Systems

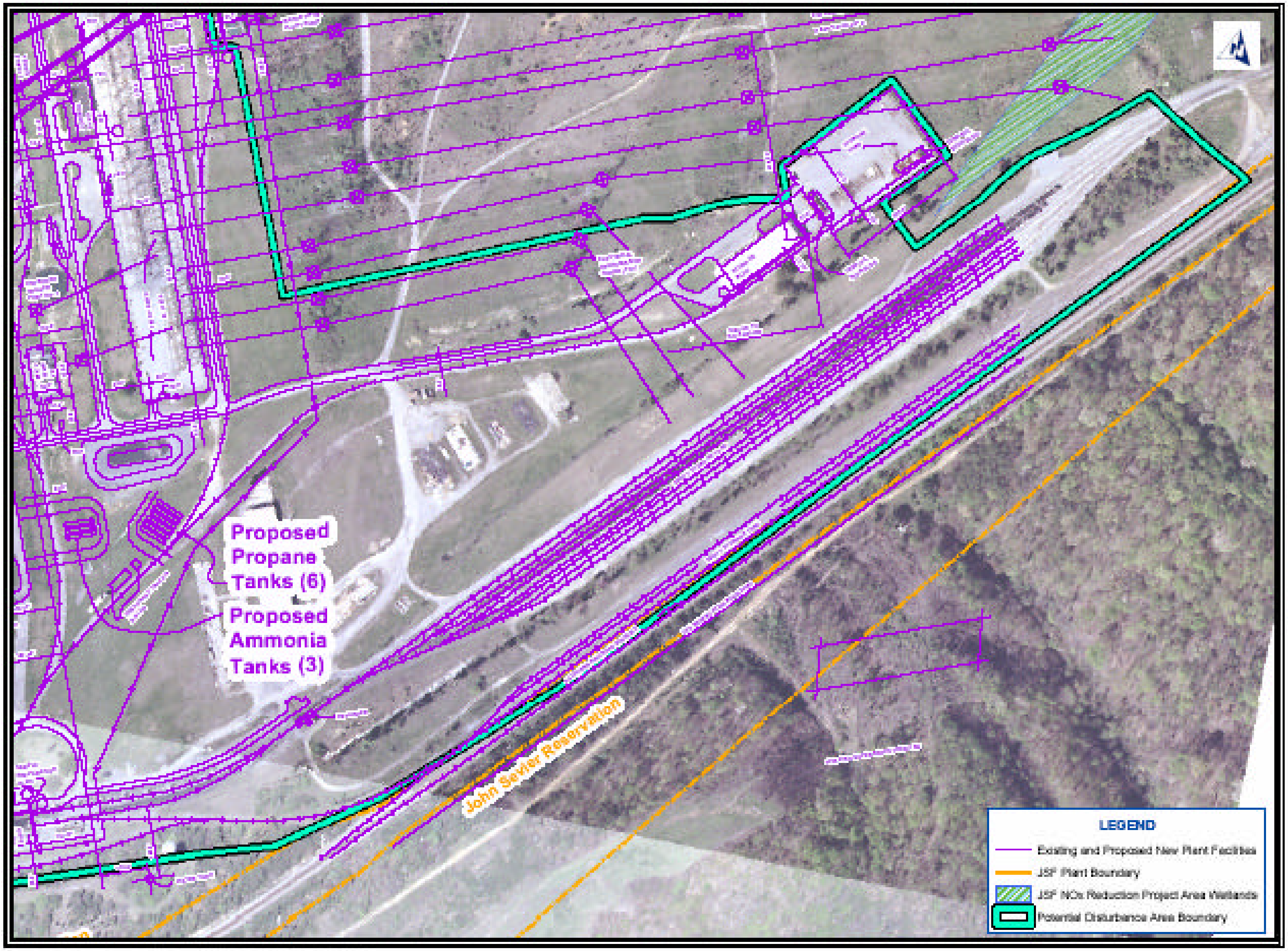
Installation of SNCR, low-dust SCR, or high-dust SCR systems would all entail some construction in the vicinity of the JSF powerhouse. Figure 2-1 shows preliminary estimates of approximate equipment layouts for SNCR, low-dust SCR, and high-dust SCR in the vicinity of the powerhouse. SNCR systems would likely have somewhat similar equipment lay outs. Alternative F could include some or all of the equipment needed for SNCR and potentially all of the equipment associated with one of the SCR options.

2.2.2 Ammonia Storage, Handling, and Safety System

The SNCR, low-dust SCR, and high-dust SCR systems under consideration in this EA could all use anhydrous ammonia, although the more likely scenario for SNCR systems is for the use of liquid urea solutions. The ammonia storage and handling system would consist of storage tanks (preliminary estimates are for three tanks with nominal capacity of 30,000 gallons each), feed pumps, vaporizers and dilution air mixing units, and necessary controls, as well as areas for truck parking and unloading and rail car unloading. Although the preliminary design sketch, which overlays the aerial photos in Figure 2-3, shows one potential location for ammonia storage tanks on the eastern side of the plant, the tanks could be located on any open area in that vicinity within the green and black boundary. An alternate location under consideration was eliminated due to safety concerns.

The SNCR systems would require an ammonia usage rate approximately 2.5 times that of the SCRs. Rail or truck deliveries of ammonia would be proportional. Table 2-1 lists the estimated ammonia storage capacity, use, and delivery rates for the action alternatives. If the SNCR systems use urea solutions, the hazards of anhydrous ammonia would be eliminated, but larger volume tanks would be needed to store the urea solutions. Mix tanks for diluting the urea solutions, pumps, and freeze protection for the urea solution tanks would also be needed. Since urea is manufactured by an energy-intensive process that uses ammonia as a feedstock, it is more expensive than anhydrous ammonia.

Infrastructure to support an ammonia storage and handling system would include the necessary utility supply lines for electrical power, potable water, raw water, instrumentation, and controls. These would be routed through and along areas previously highly disturbed for plant construction. Some ammonia storage and handling facilities at other TVA plants have used 480-volt power sources. Preliminary design has not progressed enough to identify the most feasible potential power source for the ammonia storage/unloading area. However, the electrical power, potable water, raw water, instrumentation and control lines, and ammonia pipelines would be located within the green and black project footprint boundary shown in Figure 2-2 and considered in the EA analysis as disturbed by the proposal.



Map and orthophotograph created by Geographic Information & Engineering, RSO&E.
Orthophotograph as of April 11, 2003. Contours provided and created by Surveying
and Project Services, TPS as of May 2004.

Figure 2-3. Probable Area for Locating Ammonia, Propane, or Urea Storage or Spill Retention Facilities

Table 2-1. Ammonia or Urea Solution Tank Configurations and Usage Rates for Action Alternatives

Ammonia or Urea Solution Tank Configurations				
Alternative	**Description**	**Approximate Number of Tanks**	**Estimated Volume per Tank (Gallons)**	**Total On-Site Ammonia or Urea Solution Storage (Gallons)**
A	No Action	0	0	0
B	Boiler Optimization	0	0	0
C-1	SNCR using urea as per preliminary design	2	40,000	80,000
C-2	SNCR using anhydrous ammonia	3	30,000	90,000
D	Low-Dust SCR	1 to 2	30,000	30,000 to 60,000
E	High-Dust SCR	1 to 2	30,000	30,000 to 60,000
F	Combinations of B through E	3	30,000	90,000
Usage Rates (Calculated based on ammonia supplied to process)				
Alternative	**Description**	**lb NH_3 / Hour**	**NH_3 Rail Tank Car Deliveries per Week**	
A	No Action	0	0	
B	Boiler Optimization	0	0	
C-1	SNCR using urea as per preliminary design	1100	2 to 6	
C-2	SNCR using anhydrous ammonia	1100	4	
C-3	SNCR using aqueous ammonia	1100	20	
D	Low-Dust SCR	400	1 to 2	
E	High-Dust SCR	400	1 to 2	
F	Combinations of B through E	1100	4	

lb = Pounds
NH_3 = Ammonia

A water fogging system that would be activated both automatically and manually would be installed to limit the hazard from any accidental release of anhydrous ammonia from either the storage tanks, an unloading rail tank car, or a tank truck. The fogging system would combine water with a portion of the anhydrous ammonia vapor (the remainder would off-gas) to form aqueous ammonia liquid. This liquid along with any runoff from the unloading operations area would be contained within the compacted-earth catch basin surrounding the storage tank and unloading area. The containment area would be sized for storm water runoff from a 10-year, 24-hour event, one tank's contents, and deluge system associated with catastrophic release. Following pH testing, spilled material would then be released to one of the metal cleaning treatment ponds (MCTPs), the ash pond at a rate sufficient to maintain compliance with the National Pollutant Discharge Elimination System (NPDES) permit requirements for Discharge Serial Number (DSN) 001, or may be disposed off site. In a similar manner, routine storm water accumulations in the secondary containment would also be released to the ash pond.

2.2.3 *Propane Storage and Handling System*

Propane would be used with some variants of SNCR to facilitate the reaction or with low-dust SCR systems to heat exhaust gases to sufficiently high temperatures for NO_X removal to occur. Table 2-2 lists the estimated propane usage rates. The proposed location for the propane storage and handling system is shown in Figure 2-3.

Table 2-2. Propane Usage Rates

Alternative	Description	Propane Rail Tank Car Deliveries per Week
A	No Action	0
B	Boiler Optimization	0
C-1	SNCR using urea as per preliminary design	0
C-2	SNCR with flue gas reheating	1 to 2
D	Low-Dust SCR	7
E	High-Dust SCR	0
F	Combinations of B through E	7

2.2.4 *Offices, Warehouses, and Laydown Areas*

Installation of SNCR, low-dust SCR, or high-dust SCR systems may all involve use of temporary office portable buildings, equipment laydown areas, or require dedication of areas for construction parking or construction of new offices or warehouse space. The most likely locations for equipment laydown and staging areas are in the vicinity of the powerhouse (Figure 2-2) and in the open spaces on the east side of the plant as shown in Figure 2-3. Existing office space and warehouses may be used or new structures may be built in open spaces within the bounds of the project footprint map (see Figure 2-2). Similarly, existing office space, or open areas would most likely be used for locating portable buildings for temporary offices.

2.3 Comparison of Alternatives

The features and potential environmental effects of the various alternatives are compared in Table 2-3. The levels of environmental impacts identified are with identified mitigations implemented.

2.4 The Preferred Alternative

Because the economic feasibility and operational practicalities of NO_X emissions reduction systems are subject to change as: 1) more operating data are obtained on various NO_X reduction technologies; 2) as the technology is further developed; and 3) as more is learned through the adaptive approach; TVA prefers to maintain the flexibility to select among any single or combination of the most cost-effective options for NO_X reduction at JSF and considered in this EA. With the various project designs and environmental commitments described herein, the potential environmental impacts of any of the action alternatives would be insignificant.

Table 2-3. Comparison of Potential Sources of Impacts and Environmental Effects of Alternatives for NO_X Reduction at JSF

Sources of Potential Disturbance & Resources	Alternative A: No Action	Alternative B: Optimize Boilers Units 1 through 4	Alternative C: Install SNCR Units 1 through 4	Alternative D: Install Low-Dust SCR Units 1 through 4	Alternative E: Install High-Dust SCR Units 1 through 4	Alternative F: Combinations of Alternatives B-E
Sources of Potential Disturbance						
Physical disturbances (location of project construction activities)	No change related to NO_X reduction project	All activities occur inside or within immediate vicinity of the powerhouse; sensors and controllers would be installed in the boiler	Ammonia injection lances installed in flue gas train; anhydrous ammonia or urea solution storage facilities	New ductwork installed to route post-electrostatic precipitator (ESP) flue gas to common plenums for Units 1-2 and Units 3-4; two low-dust SCRs installed, including catalyst beds, ammonia-injection equipment, and propane burners for heating flue gas to reaction temperature; ammonia and propane equipment installed on east side of the plant	Roughly twice as much ductwork as Alternative D to support four SCRs, one for each unit; SCRs include catalyst beds and ammonia-injection equipment; ammonia equipment installed on east side of plant	Ductwork and catalyst beds same as Alternative D near powerhouse and plus most cluttered option for ancillary facilities (i.e., urea handling facilities of Alternative C)
Physical disturbances (ancillary infrastructure activities, i.e., road and rail construction and modifications)	Construction necessary to support outages, and equipment deliveries would continue	Same as Alternative A	Some modifications in the vicinity of southeast side of "project footprint"	Some modifications in the vicinity of southeast side of "project footprint"	Some modifications in the vicinity of southeast side of "project footprint"	Same as Alternative C or Alternative D
Ammonia accumulation on fly ash	No impact beyond existing operations	Same as Alternative A	Possible accumulation of 13 to 500 milligrams per kilogram (mg/kg) NH_3 on the fly ash	No anticipated ammonia accumulation on fly ash	Possible accumulation of 13 to 500 mg/kg NH_3 on the fly ash	Same as Alternatives C and E
Ammonia releases to surface water from startups and shutdowns	No impact	Same as Alternative A	Periodic (12-32 times per year) ammonia-contaminated fly ash would be sluiced to the ash pond, with pH control on ash pond effluent, and elimination of urea or ammonia injection 8 hours prior to planned unit shutdowns, the ash pond discharge should stay in compliance with anticipated NPDES limits	No impact beyond existing operations	Same as Alternative C	Same as Alternatives C and E

Table 2-3. Comparison of Potential Sources of Impacts and Environmental Effects of Alternatives for NO_X Reduction at JSF

Sources of Potential Disturbance & Resources	Alternative A: No Action	Alternative B: Optimize Boilers Units 1 through 4	Alternative C: Install SNCR Units 1 through 4	Alternative D: Install Low-Dust SCR Units 1 through 4	Alternative E: Install High-Dust SCR Units 1 through 4	Alternative F: Combinations of Alternatives B-E
Ammonia releases to surface water from dry fly ash landfill leachate	No impact	No impact	Negligible construction impacts; without the identified mitigations, potential impacts from release of NH_3-N contaminated leachate from the dry fly ash landfill to Holston River are insignificant.	No impact	Similar to Alternative C	Similar to Alternative C
Ammonia releases to surface water from air preheater (APH) washing	No impact	No impact	Approximately every 6 to 36 months APH washes would be routed to the MCTP, sampled and analyzed for ammonia, then either slowly released to the ash pond at rates that would keep ash pond discharge in compliance with anticipated NPDES limits or treated as described in Section 4.2.3	None	Same as Alternative C	Same as Alternatives C and E
Ammonia releases to surface water from storm water runoff	No impact	No impact	Rain =0.58 inch may result in NH_3 in waters entering the dry stack stilling (DSS) pond; mitigations described in 4.2.3 so that resulting discharge to the Holston River protects surface water quality.	None	Same as Alternative C	Same as Alternatives C and E
Ammonia releases to surface water from ammonia tank releases	No impact	No impact	Ammonia (NH_3) tanks would have spill detention pond and deluge system for capturing NH_3 release to air; if a release occurs, resulting deluge water would be neutralized, then either hauled away by waste disposal contractor or pumped to the MCTP or the ash pond at a controlled rate to ensure compliance with permit limits	Same as Alternative C	Same as Alternative C	Same as Alternative C

Table 2-3. Comparison of Potential Sources of Impacts and Environmental Effects of Alternatives for NO_X Reduction at JSF

Sources of Potential Disturbance & Resources	Alternative A: No Action	Alternative B: Optimize Boilers Units 1 through 4	Alternative C: Install SNCR Units 1 through 4	Alternative D: Install Low-Dust SCR Units 1 through 4	Alternative E: Install High-Dust SCR Units 1 through 4	Alternative F: Combinations of Alternatives B-E
Ammonia releases to surface water due to ammonia blowdown line	No impact	No impact	Ammonia blowdown line flow would be routed to the MCTP and then slowly transferred to the ash pond as appropriate	Same as Alternative C	Same as Alternative C	Same as Alternative C
Resources						
Air Resources	No Change in JSF NO_X emissions	Beneficial 10 to 30 percent reduction in JSF NO_X emissions; minor transient, insignificant construction impacts	Beneficial 20 to 40 percent reduction in JSF NO_X emissions; minor transient, insignificant construction impacts	Beneficial 80 to 90 percent reduction in JSF NO_X emissions; minor transient, insignificant construction impacts	Beneficial 80 to 90 percent reduction in JSF NO_X emissions; minor transient, insignificant construction impacts	Beneficial 10 to 90 percent reduction in JSF NO_X emissions; minor transient, insignificant construction impacts
Surface Water Resources	None beyond existing conditions	None beyond existing conditions	Among Alternatives C, D, E, and F, Alternative C would produce the greatest ammonia loading to surface waters; with implementation of design features (Section 2.1) and commitments (Section 2.5), NPDES permit requirements for JSF would be met; construction and operational impacts to Holston River and Polly Branch would be insignificant	Similar to Alternative B	Similar to Alternative C except that ammonia loading to surface waters would be less than for Alternative C	Similar to Alternative C
Groundwater Resources	None	None	Negligible construction impacts; without the identified mitigations, potential contamination of groundwater flux from the dry fly ash landfill with NH_3. No impacts to present or future groundwater users, since downgradient property between source and Holston River is on JSF site.	Similar to Alternative A	Similar to Alternative C	Similar to Alternative C
Floodplains and Flood Risk	None	None	Minor repetitive actions in floodplains	Similar to Alternative C	Similar to Alternative C	Similar to Alternative C

Table 2-3. Comparison of Potential Sources of Impacts and Environmental Effects of Alternatives for NO_X Reduction at JSF

Sources of Potential Disturbance & Resources	Alternative A: No Action	Alternative B: Optimize Boilers Units 1 through 4	Alternative C: Install SNCR Units 1 through 4	Alternative D: Install Low-Dust SCR Units 1 through 4	Alternative E: Install High-Dust SCR Units 1 through 4	Alternative F: Combinations of Alternatives B-E
Byproduct Generation and Marketing	None	Fly ash marketing may be reduced if fly ash loss on ignition (LOI) exceeds 4 percent	Variable, at worst all marketing of fly ash would cease due to ammonia deposition on fly ash	None	Same as Alternative C	Same as Alternative C
Terrestrial Ecology (Plants)	None	None	Some insignificant disturbance of common plant communities	Same as Alternative C	Same as Alternative C	Same as Alternative C
Terrestrial Ecology (Animals)	None	None	Minor, insignificant disturbance of habitats	Similar to Alternative C	Similar to Alternative C	Similar to Alternative C
Aquatic Ecology	None	Beneficial reduction in NO_X; no detrimental impacts	With implementation of best management practices (BMPs), minor, temporary and insignificant construction impacts; with mitigation, insignificant operational impacts	Similar to Alterative C	Similar to Alternative C	Similar to Alternative C
Threatened and Endangered Species (Plants)	No impacts to federally or state-listed plant species or their habitats	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Threatened and Endangered Species (Animals)	No impacts to federally or state-listed terrestrial animal species or their habitats	No impacts to federally or state-listed terrestrial animal species or their habitats; possible beneficial effects from reduction of NO_X	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B
Threatened and Endangered Species (Aquatic)	No impacts to federally or state-listed aquatic animal species or their habitats	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Managed Areas	None	Beneficial effects from reduction of NO_X; no significant detrimental impacts	Same as Alternative B	Same as Alternative B	Same as Alternative B	Same as Alternative B

Table 2-3. Comparison of Potential Sources of Impacts and Environmental Effects of Alternatives for NO_X Reduction at JSF

Sources of Potential Disturbance & Resources	Alternative A: No Action	Alternative B: Optimize Boilers Units 1 through 4	Alternative C: Install SNCR Units 1 through 4	Alternative D: Install Low-Dust SCR Units 1 through 4	Alternative E: Install High-Dust SCR Units 1 through 4	Alternative F: Combinations of Alternatives B-E
Wetlands	Existing plant runoff to identified wetlands would continue	Same as A	With implementation of construction BMPs, no direct effects to any wetland; impacts insignificant; no adverse effects from ammoniated ash runoff	Similar to Alternative C for construction effects; similar to Alternative A for operational impacts	Similar to Alternative C	Similar to Alternative C
Transportation	None	Minor, insignificant impacts to federal, state, and county roads due to increased traffic; no decline in LOS	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B
Socioeconomics and Environmental Justice	None	None	Minimal, temporary changes to employment, income, population, and community services and infrastructure; slightly disproportionate impact to minority or low income population is possible	Similar to Alternative C	Similar to Alternative C	Similar to Alternative C
Visual Resources	None	None	Construction would create minor, temporary visual discord; overall impacts would be negligible, insignificant, and compatible with existing landscape	Similar to Alternative C	Similar to Alternative C	Similar to Alternative C
Recreation	None	Beneficial effects from reduction in NO_X	Minor, insignificant, and temporary effects for bank access to fisherman during construction; brief restriction to boating access during installation of diffuser	Similar to Alternative B	Similar to Alternative C	Similar to Alternative C
Cultural Resources	None	None	None	None	None	None
Safety & Health	None	Beneficial effects to public health from reduction in NO_X	With implementation of commitments for handling of ammonia or any other compounds used, no detrimental effects to public health; limited beneficial effects from reduction in NO_X	Similar to Alternative C	Similar to Alternative C	Similar to Alternative C

Table 2-3. Comparison of Potential Sources of Impacts and Environmental Effects of Alternatives for NO_X Reduction at JSF

Sources of Potential Disturbance & Resources	Alternative A: No Action	Alternative B: Optimize Boilers Units 1 through 4	Alternative C: Install SNCR Units 1 through 4	Alternative D: Install Low-Dust SCR Units 1 through 4	Alternative E: Install High-Dust SCR Units 1 through 4	Alternative F: Combinations of Alternatives B-E
Seismology	None	With commitment for adherence to provisions of the International Conference of Building Officials (ICBO), no hazard to structures	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B	Similar to Alternative B

2.5 Summary of Environmental Commitments

2.5.1 Applicability of Commitments

The following environmental commitments and mitigation measures were identified as necessary to ensure that environmental impacts are insignificant. As noted for each commitment, not all commitments apply to all action alternatives. Commitment 1 would apply to all alternatives involving use of ammonia on site (C, D, E, and F). Commitment 2 would apply to all alternatives potentially involving use of propane on site (C, D, and F). The Routine and Compliance Commitments 3 through 8 and 10 apply to both test phases and full implementation for each individually identified action alternative. Commitments 9 and 12 apply to both test phase and full implementation for those action alternatives (SNCR and high-dust SCR) producing ammonia on ash. Commitment 11 applies only to those action alternatives involving SCR technology.

Under an adaptive approach to decision-making, Commitments 14 and 15 would be initiated under testing or full implementation for any alternative that could result in ammonium compounds on fly ash. Commitment 15 addresses mitigation for potential impacts to both surface water and groundwater resulting from the presence of ammoniated ash on the dry fly ash stack, and consequently applies only to those alternatives resulting in production of the ammoniated fly ash. Commitments 16 and 17 are applicable only to action alternatives that result in ammonia on fly ash when (a) mitigation is determined necessary per evaluation of monitoring and sampling data (Commitment 14) and (b) if a diffuser is chosen as the mitigation of choice.

2.5.2 Adaptive Approach for Decision-Making on Environmental Commitments to Mitigation

The wide range of potential concentrations of ammonia on ash and in the characteristics of the ammonia entering the river from leachate or discharges leads to some uncertainty about the potential for environmental impacts. As a consequence, TVA is proposing an adaptive approach to decision-making for (a) the demonstration/test/implementation of SNCR technology or other technologies, (b) multi-unit implementation of alternatives that may involve that technology and implementation of mitigative measures. As an initial part of this approach, TVA is proposing a one-year (potentially extended to two years) test/demonstration of SNCR technology on one unit at JSF to gather both operational performance and environmental data. Information gained from this initial testing would aid in decision-making on selection of technology, sequencing of installation, and selection among the suite of effective mitigations identified.

The range of potential impacts from the test and each alternative action are, however, bounded and, based upon the best available information, analyzed in this EA. Additionally, the present assessment has identified a clearly defined process, conditions for implementation of mitigations, and clearly identified avoidance or mitigative actions that TVA would undertake under the specified conditions. As the range of potential mitigations and their associated costs are wide and numerous combinations of effective mitigations are possible. The information gained during the test period would aid TVA in determining which, if any, mitigation would be appropriately implemented at JSF for either continuing the testing phase or for full four-unit implementation of SNCR. The mitigations for SNCR would also be applicable to high-dust SCR if TVA elects to use it alone or in combination with SNCR. Near the end of the one-year test, TVA would expeditiously evaluate the data and information collected per the sampling and monitoring plan of Commitment 14 of the Summary of Commitments to decide upon continuing the test and/or selecting NO_X reduction technology(ies) for full implementation at JSF. The evaluation of environmental data at that point is expected to result in:

- Refined knowledge of the actual amounts of ammonium compounds accumulating on fly ash.
- Refined numerical modeling results incorporating actual operational data of ammonium compound accumulations on fly ash to refine estimates of ammonia-nitrogen leachate concentrations, which may result from single-unit operation for more than one year or for full implementation on all four units.
- Data to indicate whether the test should be stopped immediately and mitigation measures put in place or the one-unit installation should continue operating without such mitigation.
- Information for realigning, if necessary, sampling and monitoring until adequate process knowledge is obtained to confirm that operational impacts are insignificant.
- Information to decide whether to stop or severely scale back the SNCR or high-dust SCR operation and implement the identified mitigation measures of Commitment 14, 16, 17, 18, and 19.
- A basis for determining whether the full four-unit installation can proceed unmitigated (but per the monitoring action plan) or whether TVA would need to proceed with selecting and implementing mitigation measures identified in the EA, and the monitoring action plan (Commitment 14) and this Summary of Environmental Commitments.

At the end of this initial one-year test period, based upon the performance outcome and determination of need for mitigation, TVA may decide to continue testing an additional year, perform testing of additional technologies bounded herein, or to implement one of the alternatives identified in this EA.

The reasons for TVA proceeding along this adaptive path are: (1) robust monitoring and timely evaluation of information gained; (2) a step-wise approach with the ability and commitment to curtail or stop actions and/or implement mitigations prior to significant impacts occurring or accruing; (3) current analyses that “bound” the range for TVA actions and resulting potential environmental impacts; (4) defined trigger levels for actions to avoid or mitigate environmental impacts; and (5) identified, clearly defined, and effective mitigations to which TVA has committed to implement should the agency decide to proceed under conditions that, without mitigation, could, as potentially indicated by comparison of monitoring data and standards, criteria, and USEPA guidelines for whole effluent toxicity (WET) limits, result in significant environmental impacts. This approach would lead to confirmation of current estimates of potential ammonia nitrogen concentrations from discharges from the JSF wastewater treatment systems, including ash pond discharges and leachate from the dry fly ash stack, or, if needed, implementation of these measures would limit impacts, particularly those to surface waters, to insignificance.

Routine and Compliance Commitments:

1. If Alternative C (including test phase), D, E, or F were selected, TVA would comply with the provisions of:

   (a) 40 Code of Federal Regulations (CFR) 68 prior to filling of the ammonia storage tanks or transport on site of ammonia in a quantity exceeding 10,000 pounds

   (b) 29 CFR 1910.38 (Employee Emergency Plans and Fire Protection Plans)

   (c) 29 CFR 1910.111 (Storage and Handling of Anhydrous Ammonia)

   (d) 29 CFR 1910.119 (Process Safety Management of Highly Hazardous Chemicals)

   (e) 29 CFR 1910.1000 (Air Contaminants)

   (f) American National Standard Institute Standard K61.1 (Compressed Gas Association [CGA] Standard G-2.1)—Storage and Handling of Anhydrous Ammonia

   Adherence to standards such as CGA G-2.1 or OSHA 29 CFR 1910.111 would result in safe equipment design. Compliance with 40 CFR 68 and 29 CFR 1910.119 ensures proper hazard assessment, operating procedures, employee training, and emergency planning have been provided.

2. If C were selected and propane were used, or if either D or F were selected, TVA would comply with 29 CFR 1910.110 (Storage and Handling of Liquefied Petroleum Gases) and National Fire Protection Association 58, which specifies minimum required separation distances for tanks of liquefied gases.

3. Seismic hazards to the NO_X emissions reduction equipment, if installed, would be addressed by compliance with the seismic provisions of the 1997 version of the International Conference of Building Officials Uniform Building Code and the 1997 National Earthquake Hazards Reduction Program or more recent building codes as appropriate.

4. During construction, areas subjected to soil disturbance and/or vegetation removal would be stabilized or revegetated as soon as practicable. Planting with native plant species is preferred.

5. During construction, portable toilets would be provided and appropriately maintained for the construction workforce.

6. Appropriate best management practices (BMPs) for erosion control and stabilization of disturbed areas, including dust suppression, would be utilized, and all construction activities would be conducted in a manner to ensure that waste materials are contained and that introduction of polluting materials into receiving waters is minimized.

7. No materials subject to flood damage would be stored within the 100-year floodplain.

8. Ammonia slip would be limited as necessary for optimum NO_X removal, optimum equipment performance, and to maintain compliance with all federal and state regulations. This commitment applies to Alternatives C, D, E, and F.

9. If a diffuser for mitigation of storm water runoff from the dry stack stilling (DSS) pond is installed by boring beneath the riverbed, environmentally acceptable drilling lubricants

would be selected as per Chemical Management Control and Tracking Fossil Power Group Standard Programs and Processes (SPP) 05.009, Hazardous Material and Waste Management Plan; Technical Instruction JSF.TI.05.000.005 and Chemical Management Control and Tracking; Technical Instruction JSF.TI.05.000.006 Acquire Material Environmental Approval.

10. The Storm Water Pollution Prevention Plan (SWPPP), Integrated Pollution Prevention Plan, and Risk Management Plan for JSF would be revised as necessary to include procedures for containing and controlling an accidental spill of ammonia or urea solution and for handling of storm water accumulations in secondary containment around ammonia, urea, or propane tanks. This commitment would apply to Alternatives C, D, E, and F.

11. Spent catalyst disposal would be managed by TVA or a catalyst contractor in compliance with applicable regulations. This commitment applies to Alternatives D, E, and F.

12. Ammonia-contaminated ash or spills entering the JSF wastewater treatment systems by means of APH wash water, ammonia line condensate, wet sluicing of ammonia-contaminated ash, or accidental releases would be routed and handled consistent with procedures discussed in this EA (section 4.2.3 for ammonia-contaminated ash and section 4.2.4 for accidental spills) and per protocols of the monitoring action plan in order to maintain compliance with NPDES permit limits. This commitment applies to Alternatives C, D, E, and F.

Special Mitigation Commitments

13. The maximum area of exposed ash at any particular time during the stacking period would not exceed 10 acres (4.05 hectares). This commitment applies to Alternatives C, D, E and F,

14. A monitoring action plan (Appendix B of this EA), to be initiated with testing and continued until such time that adequate process knowledge is obtained, and including sampling protocols, action levels, and trigger points for identified mitigations to be undertaken, would be implemented to measure concentrations of NH_3 compounds in flue gas, fly ash, wastewater, groundwater, storm water runoff, and APH wash water. In the event of a single-unit implementation of a NO_X reduction technology at JSF, data and analyses from the monitoring plan would be used to design appropriate mitigation measures for full four-unit implementation. If single-unit implementation is not done at JSF, monitoring data from other facilities may be used to design appropriate mitigation measures. This commitment applies to Alternatives C, D, E, and F.

    If, or when, monitoring indicates that concentrations of NH_3-N in storm water runoff or DFA Landfill Leachate seepage for the monitoring points described in the monitoring plan meet the action levels prescribed therein and within section 4.2.3 of this EA under the subheading, *Management of Potential Ammonia Nitrogen Loading to Surface Water From Storm Water Mobilization and Transport of Ammonium Compounds on Fly Ash in DFAL*, TVA would ensure that potential impacts to surface waters are not adverse by undertaking one or more of the mitigation actions described in the EA (e.g., reduce or cease operations of SNCR or high dust SCR; implement measures to enhance ammonia removal in the sediment pond, wetland JSFW01 and/or the DFAL Stilling pond; capture and route part of storm water runoff to the WSP; and/or re-route outfall F-

16A through diffuser pipe(s) to the Holston River), or other mitigation actions that are equally effective.

15. For placement of ammonia-contaminated fly ash on the existing dry fly ash landfill, TVA would:

    (a) For one-unit implementation (test period) of Alternatives C, E, or F, limit exposed ammonia-contaminated fly ash by daily cover with a minimum of 6-12 inches of uncontaminated ash or other appropriate materials as necessary, or employ comparably effective mitigations to meet USEPA's Water Quality Criteria for Ammonia for storm water; and

    (b) Limit duration of testing of SNCR or High Dust SCR alternatives to one year and isolate ammoniated fly ash produced during one unit testing to a maximum 10-acre area located on the south side of dry ash stacking facility until additional evaluation at the one-year mark establishes that operating limits are appropriate or need revision ; and

    (c) Baseline monitoring of ammonia-related constituents in groundwater would be conducted as described in the monitoring plan. Additional control points or observation wells as described in the monitoring plan would be constructed, sampled, and evaluated to provide adequate time for design and implementation of mitigation measures as described in this EA. Review by TVA staff would continue as per the monitoring plan (Appendix B). If early warning concentrations were detected, TVA would have one year to implement a remediation system to prevent ammonium compound contaminated fly ash leachate from reaching the Holston River at concentrations exceeding 2.09 mg/L.

    This applies to Alternatives C, E, and F (If SNCR or high-dust SCR is included).

16. For the full 4-unit installation of SNCRs or High Dust SCRs, TVA would install a diffuser unless monitoring data demonstrate that it is not needed, or that other mitigation measures identified in section 4.2.3 of this EA under the subheading, *Management of Potential Ammonia Nitrogen Loading to Surface Water from Storm water Mobilization and Transport of Ammonium Compounds on Fly Ash in DFAL*, were adequate to ensure that discharges from Outfall F-16A meet EPA water quality criteria protective of aquatic life.

    (a) If a diffuser noted as an option for mitigation of storm water runoff from the DFAL stilling pond were installed above the grade of the bottom of the Holston River channel, the location of the pipes would be identified with buoys installed above the route of the pipes at intervals of 75 to 100 feet. A sign indicating the presence of submerged pipes would be installed on the bank in a location that would be at all times visible to the public.

    (b) If a diffuser noted as an option for mitigation of storm water runoff from the DFAL stilling pond is installed by boring beneath the riverbed, floating booms would be placed around the boring operation to limit the spread of potentially mobilized sediments or boring lubricants, and TVA would notify Olin of the timing of the boring operation to avoid inadvertently biasing possible sample collection activities by Olin.

17. A pH control system (likely CO_2) would be designed, installed, and operated to control pH of the ash pond discharge (DSN 001) to levels that reduce the impacts of ammonia on Polly Branch to insignificant levels.

18. An operating plan for mitigating ammonia-contaminated APH washes would be developed and implemented. As part of this plan, APH wash water would be routed to the MCTP and recirculated and sampled prior to release to the ash pond. Based upon evaluation of operational monitoring data and comparison of the results with the established action triggers, additional mitigations as identified in section 4.2.3 under the subheading *Ammonia Accumulation in Air Preheaters (APHs) and Resulting Concentration in APH Wash Water*, may be implemented.

19. Per monitoring plan, TVA would install observation and control wells immediately downgradient of ammonia-contaminated ash disposal area.

20. Operational guidelines would be developed and implemented to ensure that for planned unit shutdowns, when wet sluicing of fly ash is anticipated, injection of urea or ammonia would be discontinued 8 hours prior to shutdown.

2.6 Necessary Permits or Licenses

New or modified environmental permits that would have to be obtained for the proposed project are listed in Table 2-4.

Table 2-4. Permits
Modification to Tennessee NPDES permit TN0005436 for Outfall(s) DSN 001, DSN 002, and F-16A, as required.
Modification to Tennessee Air Permit 548473 may be needed when the permits are updated. The Tennessee Department of Environment and Conservation (TDEC) exempts air quality improvement projects from special modification of the air quality permits prior to construction.
NPDES general permit for discharge of storm water from construction activity may be required depending upon acreage disturbed
U.S. Army Corps of Engineers (USACE) 404 permit would be needed for the installation of the proposed diffuser on storm water Outfall F-16A.
A Tennessee Aquatic Resource Alteration Permit (ARAP) would be needed for the installation of the proposed diffuser on Storm Water Outfall F-16A.

CHAPTER 3

3. AFFECTED ENVIRONMENT

This chapter describes the existing conditions for resources potentially affected by the range of proposed alternatives.

3.1 Air Resources

Regionally in the power service area of TVA, air quality is generally good. The air quality in the vicinity of JSF is also generally good; the area complies with all ambient air quality standards, except for the new 8-hour ozone standard. USEPA recently designated Hawkins County as nonattainment for ozone. The new 8-hour ozone standard is more stringent than the old ozone standard, and many areas are having difficulty meeting attainment of the new 8-hour ozone standard. In addition, some areas—including Hawkins County—could experience periods when fine particulate concentrations will be above the recently adopted annual $PM_{2.5}$ standard.

Recent results of computer modeling studies of JSF's current emissions with the CALPUFF model predicted annual deposition of nitrogen trioxide (NO_3) from JSF in the Great Smoky Mountains National Park of about 0.02 kg/ha-y. For perspective, measured NO_3 deposition from all sources is about 10 kg/ha-y, so JSF's contribution is about 0.2 percent of that amount, an insignificant contribution. Figure 3-1 illustrates model predicted NO_3 deposition from current JSF operations (Gautney, 2005).

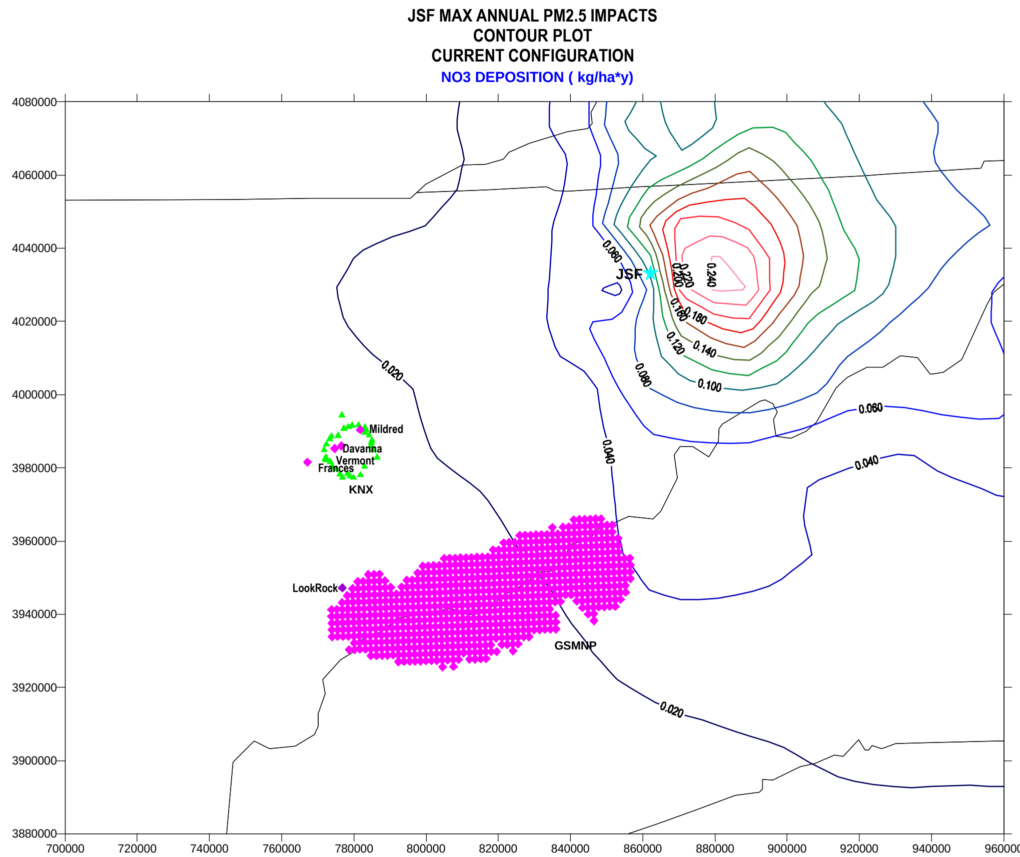


Figure 3-1. Current JSF Regional NO_3 Deposition

3.2 Surface Water Resources

3.2.1 Holston River Designated Uses and Existing Environmental Issues

Adjacent Stream Designated Uses - JSF is located near HRM 106 on the Cherokee Reservoir, the most downstream and largest impoundment of the Holston River. Cherokee Dam is located at HRM 52.3, approximately 54 miles downstream of JSF. The average flow of the Holston River at Cherokee Dam is 4,500 cubic feet per second. Drainage from the JSF site leads to the Holston River, either directly or via a zero (low) flow stream called Polly Branch. Of the use classifications for surface waters in the State of Tennessee, the Holston River qualifies for domestic and industrial water supply, fish and aquatic life, recreation, livestock watering and wildlife, and irrigation. Polly Branch is classified for the same uses, except it is not classified as a domestic or industrial water supply. Neither stream is classified for navigation (TDEC, 2004).

Domestic Water Supply - The nearest major city downstream of the site is Morristown, which operates a municipal water intake 31 miles downstream at HRM 75. The utility serves approximately 60,000 people in Morristown, Bean Station, Rutledge, Russellville, Whitesburg, Bulls Gap, White Pine, and Mooresburg. The plant design capacity is 24 million gallons per day (MGD) with 9 MGD being the average daily demand. The intake design has two separate systems. The primary system is a variable stage intake that allows water to be drawn from lake stages between 1,020 and 1,070 feet. The secondary system is a standby intake that projects into the original riverbed and can be activated during outages of the primary system. The plant is equipped with conventional equipment for potable water treatment including equipment for chlorinating water. Morristown Utilities does not have a secondary source of water should an environmental event occur that would force the intake to discontinue operation for more than 24 hours (Mike Howard, Morristown Utility Systems, personal communications, November 2, 2004).

Reservoir Water Quality Issues - Like most TVA reservoirs, stratification during summer months occurs for Cherokee Reservoir. Recent concerns have included occasional low dissolved oxygen in the reservoir forebay and in releases from Cherokee Dam. Approximately 27 miles of river downstream of the dam are reported as impaired due to low dissolved oxygen and flow alterations from Cherokee Dam in the proposed Tennessee 2004 303(d) List (TDEC, 2005).

TVA currently mitigates (increases) dissolved oxygen and maintains a minimum release flow from Cherokee Reservoir. In 1995, as part of the Reservoir Releases Improvements Program, TVA installed an oxygen addition system on the upstream side of Cherokee Dam. TVA typically injects 2100 tons per year of pure oxygen into the water impounded behind Cherokee Dam. This system, in addition to surface water pumps and turbine venting, maintains the dissolved oxygen concentrations of Cherokee Dam releases at 4 milligrams per liter (mg/L) or more. These systems have improved the aquatic habitat downstream for the last 10 years.

Another water quality issue in the watershed is mercury historically released from the Saltville, Virginia, chlor-alkali plant into the North Fork of the Holston River for an extended period of time until the plant was closed in 1972. It was located more than 100 miles upstream of the JSF site. Mercury released from this industrial source has contaminated surface water and sediments of both the North Fork Holston and Holston Rivers. Since the 1970s, TVA has measured elevated levels of mercury in Cherokee Reservoir. In 1983, the

Saltville site was added to the Superfund National Priorities List. A 2001-2002 USEPA investigation of the North Fork Holston and Holston Rivers and an associated ecological risk assessment reported results indicating elevated mercury levels in sediment cores collected in front of the JSF detention dam, downstream from the JSF plant intake channel. TVA's Reservoir Vital Signs Monitoring Program continues to monitor mercury levels in water, sediment, and fish tissues (http://www.tva.com/environment/air/ontheair/3decades.htm). Olin Corporation and USEPA may also sample Holston River sediments in conjunction with assessments of the Saltville Waste Disposal Ponds Superfund Site.

3.2.2 Existing John Sevier Fossil Plant Wastewater Treatment Systems and Outfalls

The following sections discuss the existing wastewater treatment systems and permitted outfalls at JSF. These systems and outfalls include an ash pond (DSN 001), waste stabilization pond (WSP) (IMP 008 to DSN 001), MCTPs, dry stack stilling (DSS) pond (Outfall F-16A), and discharge of condenser cooling water (CCW) (DSN 002). Each of these may be involved as pathways for ammonia potentially to enter surface waters, or in mitigating impacts.

Ash Pond (DSN 001)

JSF burns approximately 1.9 to 2.2 million tons of coal annually. The coal averages 11.6 percent ash, so total ash production ranges from approximately 220,000-254,000 tons of ash per year. The ash is collected as either fly ash, which is fine enough and light enough to be carried with the flue gas stream exiting the boiler, or as bottom ash, which is coarser and heavier and falls to the bottom of the boiler. The fly ash/bottom ash split is approximately 93 percent fly ash and 7 percent bottom ash.

Coal ash at JSF has been disposed of in three main areas: Ash Pond J, Ash Disposal Area 2, and the current dry fly ash landfill area. Pond J was closed in 1995 under a closure/post closure plan issued by the TDEC Division of Solid Waste Management. The fly ash handling system at JSF is now a dry fly ash handling system.

Bottom ash collects in the bottom of the boiler and is washed from the boiler bottoms with jets of water and sluiced to a bottom ash dewatering area within the ash pond. Here, the bottom ash is washed and screened into several size fractions and sold for off-site use in concrete block manufacturing.

Although JSF collects most of the fly ash dry, it also retains the capability to sluice fly ash to the ash pond. Fly ash is sluiced during unit startup and during operational problems of the dry fly ash collection system. The amount wet sluiced has varied over the past few years. Current estimates of fly ash wet sluiced to Outfall 001 are 300-750 tons per year. Because wet-sluiced fly ash cannot be sold, reduces capacity in the ash pond, and reduces the marketability of the bottom ash, TVA ash management guidelines call for the amount of fly ash wet sluiced to the ash pond to be less than or equal to 2 percent of production (approximately 4,400 tons/year or less).

The ash pond discharges (DSN 001) to the Holston River via Polly Branch. Sources of flow into the ash pond are listed in Table 3-1. Approximately 10 percent of the average ash pond flow is from the WSP (IMP 008) which treats many different wastewater streams.

Table 3-1. Inflow Sources to the Ash Pond (DSN 001)	
Source	**Inflow to Ash Pond (MGD)**
Bottom Ash Sluice Water	4.55
Station Sumps	2.33
Waste Stabilization Pond Internal Monitoring Point (IMP) 008	0.83
Ash Bilge Sump	0.004
Direct precipitation onto ash pond	0.15
Evaporation from ash pond	-0.1
Total	**7.76**
*Startup/Shutdown/Upset Fly Ash Sluice Water**	*0.023*
*Metal Cleaning Treatment Pond through DSN 001b**	*0.02*

* Intermittent Flow
Source: 2003 NPDES Permit Number TN0005436

Waste Stabilization Pond (IMP 008 to Ash Pond Outfall 001) - Dry Stack Leachate
Based on average annual flows the largest wastewater flows into the waste stabilization pond (WSP) are from the HED (heavy equipment division) oil-water separator low-volume sump (0.14 MGD), coal pile storm water runoff (0.12 MGD), and water treatment plant wastes (0.12 MGD). The total average annual daily flow to the ash pond is approximately 0.83 MGD via IMP 008. The WSP also receives storm water runoff or wash down from various areas and domestic sewage from the plant's septic system. These wastewater streams into the WSP would not be impacted by the proposed NO_X reduction systems.

The WSP also currently receives a mixture of groundwater and leachate from the dry fly ash landfill (DFAL) leachate collection system, which may be impacted by ammonia compounds on the stacked dry fly ash. Portions (exact extent unknown) of the DFAL area are underlain by this collection system. The original part of this system was drain tiles, which were installed before JSF was built. Their existence prior to plant construction is why the total extent of this collection system is unknown. Other drainage pipes have been added to this system in the past. The DFAL Collection System is connected to two pump stations, which pump the collected mixture of groundwater and DFAL leachate (average flow = 0.013 MGD) to the WSP (IMP 008). The DFAL flow is approximately 2 percent of the average flow of the WSP.

The portion of the DFAL leachate that is not intercepted by the DFAL leachate collection system seeps into the Holston River adjacent to the DFAL. If fly ash containing leachable ammonia compounds should be placed into the area of the DFAL not intercepted by the DFAL collection system, this seepage could potentially be a pathway for ammonia from the proposed NO_X reduction systems to the river.

Metal Cleaning Treatment Ponds (MCTPs)
JSF has two MCTPs, the copper pond, and the iron pond. These ponds were originally built to receive the intermittent wash water from unit APH washes and waterside acidic

boiler wash. The copper and iron ponds have effective capacities of 0.824 MG and 2.929 MG, respectively.

At present, the waterside boiler washes are done with ethylenediaminetetraacetic acid (EDTA) and are injected into an online unit and evaporated. APHs are washed with raw river water and this process normally generates approximately 0.72 MG over a period of two to three days. The resulting APH wash water is considered a nonchemical wash and may be sent directly to the ash pond. The MCTPs are pumped to the ash pond approximately once per year to remove accumulated rainwater (Roger Sims, TVA, personal communication, 2005).

Historical data from other plants, which characterized their APH washes, showed that 70-80 percent of the mass of iron, sulfur, and other compounds removed from the APH surfaces during the entire wash was usually contained in the first 10-30 percent of the total APH wastewater volume. This same trend was observed for pH. If this occurs during APH washes at JSF and applies equally to ammonia, it would mean that the first 0.07 to 0.22 MG of an APH wash would contain 70-80 percent of the mass of removed materials.

The current NPDES permit effluent limitations on the ash pond are shown in Table 3-2. These requirements currently do not include monitoring or limitations for ammonia, but do include a WET limit.

Table 3-2. DSN 001 Discharge Requirements

Effluent Characteristics	Effluent Limitations				Monitoring Frequency	
	Monthly		Daily			
	Average Concen-tration	Average Amount	Maximum Concen-tration	Maximum Amount	Measurement Frequency	Sample Type
	(mg/L)	(Lb/Day)	(mg/L)	(Lb/Day)		
Flow	Report (MGD)		Report (MGD)		1/Week	Instantaneous
Oil & Grease	10.0	--	14.0	--	2/Month	Grab
pH	--	--	Range 6.0 to 9.0		1/Week	Grab
Total Suspended Solids	24.0	--	72.0	--	2/Month	Grab
Arsenic, Total	--	--	Report	--	1/Quarter	Grab
Copper, Total	--	--	Report	--	1/Quarter	Grab
Lead, Total	--	--	Report	--	1/Quarter	Grab
Mercury, Total	--	--	Report	--	1/Month	Grab
Selenium, Total	--	--	Report	--	1/Quarter	Grab
Cadmium, Total	--	--	Report	--	1/Year	Grab
Chromium, Total	--	--	Report	--	1/Year	Grab
Iron, Total	--	--	Report	--	1/Year	Grab
Manganese, Total	--	--	Report	--	1/Year	Grab
Silver, Total	--	--	Report	--	1/Year	Grab
IC_{25}	Survival, reproduction, and growth in 100 percent effluent				1/Year	Composite

Source: 2003 NPDES Permit Number TN0005436
IC = 25 percent inhibition concentration
Lb = Pound
mg/L = Milligrams per liter
MGD = Million gallons per day

Dry Fly Ash Landfill (DFAL) Stilling Pond Storm Water (Outfall F-16A)
Fly ash, which is separated from the flue gases in electrostatic precipitators (ESPs) and collected in hoppers, is collected dry and pneumatically transported to silos. The dry fly ash is then conditioned with water and loaded for transport to the fly ash disposal or utilization areas as described in Section 3.5. Under the current JSF ash management plan, the active ash handling area for exposed dry fly ash is limited to 10 acres or less. As stacking areas become inactive, they are closed with an interim cover. The interim cover, usually a 1-foot layer of soil suitable for the support of vegetation (or varying depths of other materials) provides fugitive emissions control on the unexposed or stabilized areas of the dry fly ash stack. The DFAL is graded to a 1 percent to 2 percent slope at the end of each day helping to limit ponding and encourage sheet flow runoff. Both intermediate term and long term stabilization includes planting grass on the soil cover layers.

Runoff from the DFAL area first drains to the sediment pond, then to a wetland (JSFW01), then to the stilling pond, where it evaporates or overflows intermittently through permitted storm water discharge point Outfall F-16A to the Holston River via Polly Branch. The discharge from the runoff collection system is currently strictly rainfall induced, as no process water flows are associated with this system (e.g., no sluicing occurs to the DFAL).

Condenser Cooling Water (DSN 002)
JSF discharges an average of approximately 670 MGD of once-through CCW, miscellaneous equipment cooling water, boiler blowdown wastewaters, intake screen backwash, and miscellaneous storm water to the Holston River via the CCW discharge channel. Under the NPDES permit, effluent temperature is limited to 36.1 degrees Celsius (°C) (97.0°F) or less. Plant effluent temperature records indicate that in 2004, the maximum-recorded temperature in the CCW discharge was 33.4°C, well below the 36.1°C limit. These data illustrate that the temperature of JSF CCW does not normally approach the temperature compliance limits. TVA monitors water temperatures in the vicinity and inputs these data into computer models to predict when the combination of flow and weather conditions could potentially lead to water discharge temperatures in excess of the permitted limit. If the computer models indicate the possibility of exceeding the discharge water temperature limit, JSF operations are altered to reduce the risk of noncompliance.

Whole Effluent Toxicity
The permit currently contains short-term chronic WET limits for Outfalls 001 and 002 (only if biocides are added). Compliance with permit limits is determined from a seven-day or three-brood cycle exposure of fathead minnows and daphnids to effluent samples. The JSF permit limits are based on a 25 percent inhibition concentration (IC_{25}) test endpoint. This means that if exposure of test organisms to the permitted effluent concentration results in a 25 percent reduction in fish survival and growth or daphnid survival and reproduction, the test is a failure and a permit violation has occurred.

Both acute and chronic toxicity of ammonia to aquatic life is pH-dependent, such that at higher pH levels, toxicity increases. Chronic toxicity is also temperature dependent, with toxicity increasing with increasing temperature. In addition, the presence of salmonids is a factor in determining the acute criterion, and the presence of early life stages of fish at cool temperatures is a factor in determining the chronic criterion. Aquatic life acute and chronic criteria are, therefore, based on pH, temperature, and the presence or absence of certain fish species or life stages. Formulae for calculating the acute criterion, or Criteria Maximum Concentration (CMC), and the chronic criterion, or Criteria Continuous Concentration

(CCC), for ammonia are provided in the recently revised criteria document (USEPA, 1999). The acute CMC is the 1-hour average concentration of total ammonia nitrogen (in milligrams nitrogen per liter [mg N/L]) that should not be exceeded more than once every three years on the average. The chronic CCC is the 30-day average concentration not to be exceeded more than once every three years. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the CCC.

Effluent ammonia concentrations that should not be exceeded at possible pH and temperature combinations to protect aquatic life from ammonia toxicity at the potential discharge points at JSF are provided in Table 3-3.

Table 3-3. Maximum Allowable Ammonia Concentrations to Protect Aquatic Life at Different pH Levels and Temperatures (Assumes Salmonids Absent and Fish Early Life Stages Present)

	CMC (mg N/L)*					CCC (mg N/L)				
Temp	pH=7.0	pH=7.5	pH=8.0	pH=8.5	pH=9.0	pH=7.0	pH=7.5	pH=8.0	pH=8.5	pH=9.0
15° C[†]						5.73	4.23	2.36	1.06	0.47
20° C						4.15	3.07	1.71	0.77	0.34
25° C	36.09	19.89	8.41	3.20	1.32	3.01	2.22	1.24	0.55	0.25
30° C						2.18	1.61	0.90	0.40	0.18
35° C						1.58	1.17	0.65	0.29	0.13

* The CMC is not temperature dependent.
[†] The chronic values do not change with temperature changes below 14.6[†]C.

Results from site-specific ammonia toxicity studies (Table 3-4) conducted with daphnids and fathead minnows using ammonia spiked JSF ash pond water and dry ash stack runoff pond water, adjusted to two target pH levels, indicate that the water quality criteria should be protective of aquatic life in the area.

Table 3-4. JSF Ammonia Spike Study - Toxicity Endpoint Summary (expressed as mg/L N)

	Baseline[1]		pH 7.0 (mg NH_3-N as N)		pH 9.0 (mg NH_3-N as N)	
Endpoint	Bottom Ash Pond	DFAL Pond	Bottom Ash Pond	DFAL Pond	Bottom Ash Pond	DFAL Pond
Fathead 96-h LC_{50}	>100%	>100%	>92.3	>91.3	3.2	3.4
Daphnid 96-h LC_{50}	>100%	>100%	>92.3	>91.3	8.4	8.3
CMC	N/A		36.1		1.32	
Fathead IC_{25}	>100%	>100%	51.0	57.8	2.0	2.5
Daphnid IC_{25}	>100%	>100%	44.1	16.4	3.4	1.2
CCC	N/A		3.01		0.247	

[1] Results expressed as percent sample.
[2] Downward pH drift occurred during 24-hour exposure periods, so it is possible endpoints are somewhat higher (less conservative) than they would have been if the nominal high pH had been better maintained. For this reason, the CMC and CCC were also determined based on measured mean test temperatures and pHs, and they were still determined to be below concentrations toxic to test organisms (i.e., protective).
IC_{25} = 25 percent inhibition concentration
LC_{50} = An estimate of the effluent concentration that is lethal to 50 percent of the test organisms in the time period prescribed by the test, expressed as the LC_{50}
mg NH_3-N as N = Milligrams ammonia nitrogen as nitrogen
N/A = Not applicable

Table 3-5 shows the ammonia concentrations that should not be exceeded under worst-case scenarios from historical data for site-specific conditions at the ash pond discharge (Outfall 001), the CCW (Outfall 002), and near the location of the proposed diffuser for protection of aquatic life under typical operating conditions. As described in the previous section, operational treatment measures would be utilized to meet permit limitations and to protect instream water quality conditions. Site-specific ammonia water quality criteria calculated using historic pH and temperature data that should not be exceeded are presented in Table 3-5.

Table 3-5. Site Specific Water Quality Criteria for Ammonia – Protective Concentrations for Extremes of Existing Ambient Conditions

Location	Minimum Temperature, T_{max} (ºC)	Maximum Temperature, T_{min} (ºC)	Minimum pH (standard units)	Maximum pH (standard units)	Range of Applicable Water Quality Criteria Continuous Concentrations (CCC) and other Appropriate Protective Concentration (mg/L NH_3-N)	
					CCC Protective of T_{min} and Minimum pH's	CCC Protective of T_{max} and Maximum pH's
Ash pond discharge (Outfall 001)[1,2]	8.2	29.8	7.8	8.7	4.78	0.29
CCW (Outfall 002)[1]	8.4	34	7.15	8.8	8.21	0.19
Holston River near dry fly ash landfill [2]	3.8	23.9[3]	7.1	8.7	5.6	0.41
Polly Branch near Outfall F-16A [1,2,4]	3.8	29.8	7.1	8.7	5.6	0.29[4]
Protective NH_3-N limit for Outfall F-16A [4]	2.5 times CCC =					0.72[4]

[1] 22 months 2004-2005 data from plant logbooks
[2] Storet data from HRM 102 to 106, 1980 to 1998, 2003-2005 plant log data for intake pH, 1989-2005 computed downstream river temperatures based on hydrothermal compliance monitoring data intake and CCW discharge temperatures
[3] This temperature corresponds to the highest recorded river pH from 30 months ending November 2, 2005.
[4] Discharge flow from the DFAL stilling pond is intermittent, dependent on rainfall, and unlikely to flow for more than four days. For these reasons, the 96-hour exposure calculation of 2.5 times CCC is more appropriate.

Using the computed river temperatures from 1989 to 2005 and the corresponding pH values in the plant vicinity, a chronic criterion, or CCC, for ammonia nitrogen of 0.41 mg/L would appear to be adequately protective of the Holston River for continuous discharges during periods of high temperature and pH. For Polly Branch, a CCC of 0.29 mg/L NH_3-N would be adequately protective. Since discharge from the DFAL stilling pond through Storm Water Outfall F-16A is intermittent, dependent on rainfall, and unlikely to flow for more than four days, the 96-hour exposure concentration as calculated by 2.5 times CCC, or 0.72 mg/L NH_3-N would be adequately protective. For a more detailed discussion of the source data used for calculating the values in Table 3-5, please see Appendix A.

3.3 Groundwater Resources

The plant site resides within the Valley and Ridge Physiographic Province, a region characterized by narrow, subparallel ridges and valleys trending northeast-southwest. Bedrock at the site is the Athens shale of Ordovician age. The Athens locally consists of calcareous shale with thin interspersed beds of limestone ranging up to 4 inches in thickness. Bedrock generally strikes northeast-southwest and dips to the southeast, although foundation drilling revealed evidence of minor local folding and some faulting.

Weathering of the bedrock surface is limited to the upper few feet of the formation (Kellberg and Benziger, 1952).

Unconsolidated overburden materials present above bedrock include (1) Recent alluvial deposits associated with the Holston River, (2) Pliocene-Pleistocene alluvial terrace deposits, (3) residual soils, and (4) ash and soil fill deposits. The Recent alluvium occupies an approximate 800-foot-wide band along the south bank of the river where predevelopment surface topography was at or below approximately elevation 1,080 feet. Older terrace deposits form a roughly 2,000-foot band bordering the Recent alluvium and extending southward to the base of the ridge south of the reservation. The predevelopment surface of this terrace was generally about 1,100 feet (Kellberg and Benziger, 1952). The alluvium is primarily composed of clay and silt with lesser but variable amounts of sand and gravel. The terrace deposits consist of clayey, sandy silt. Residual soils derived from weathering of the underlying shale bedrock are typically only a few feet thick and are composed of silty clay. The overall thickness of natural soil overburden ranges from near zero at the southern limits of the plant reservation to approximately 25 feet in interior areas of the site. Ash and soil fill materials range up to 70 feet in thickness in the ash disposal areas.

The first occurrence of groundwater beneath the site is generally within the basal portion of the unconsolidated overburden or upper weathered bedrock depending on location. Groundwater is derived from infiltration of precipitation and from lateral inflow from upland areas south of the plant site. As shown on Figure 3-2, groundwater movement is generally northwestward across the site toward the Holston River. All groundwater originating on, or flowing beneath, the site ultimately discharges to the Holston River or Dodson Creek without first traversing off-site property.

The DFAL Collection System mentioned in the earlier discussion of the WSP captures an average of 0.013 MGD of ash leachate affected groundwater that would otherwise discharge directly to the river. This system was originally designed to capture leachate seeps in immediate vicinity of old tile drains predating the TVA plant, and was not intended to intercept all leachate from the dry fly ash landfill.

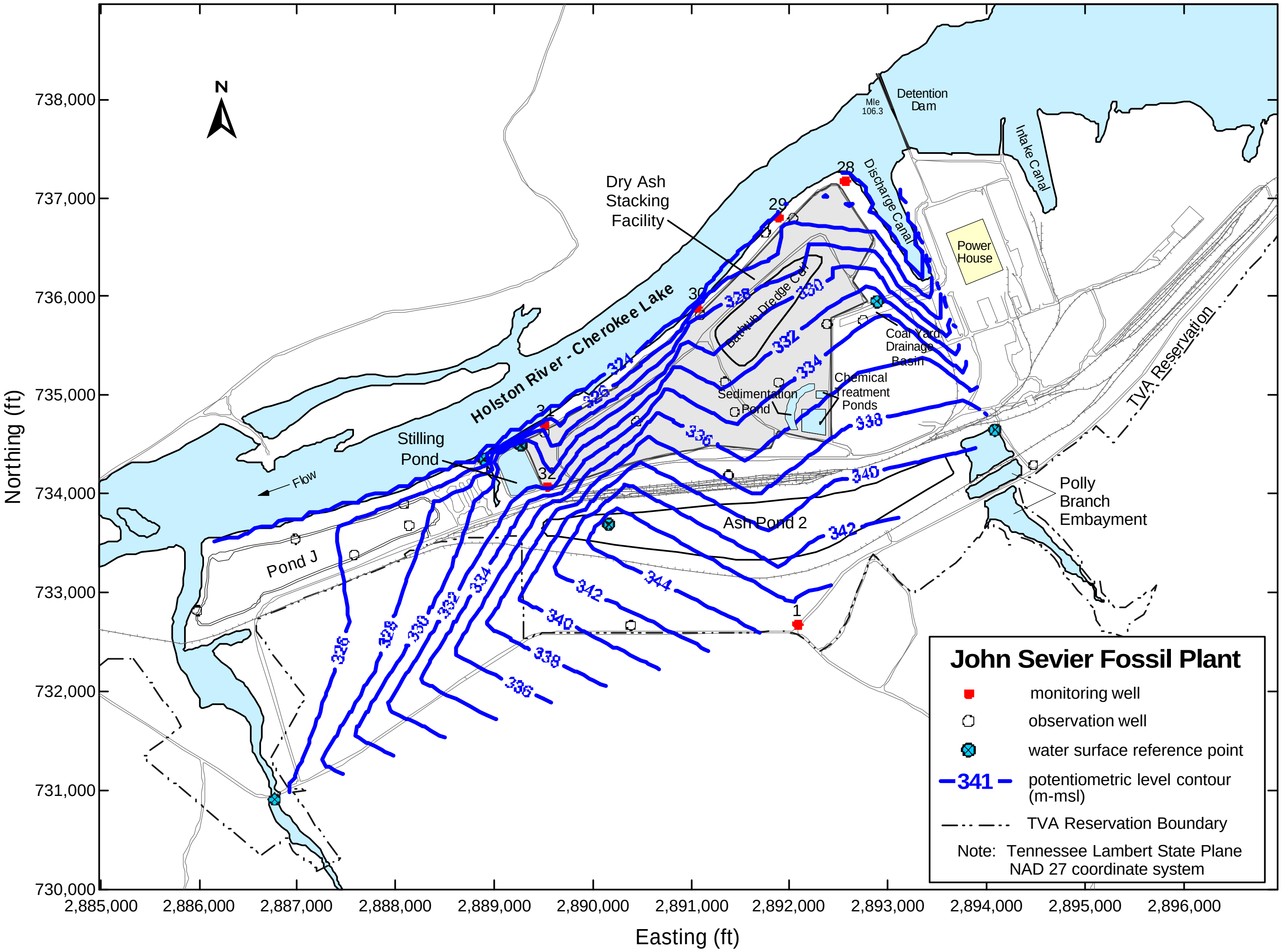


Figure 3-2. Groundwater Potentiometric Surface on January 28, 2003

3.4 Floodplains and Flood Risk

The JSF site is located on the Holston River in Hawkins County, Tennessee. The area potentially impacted by the construction of any of the alternatives extends from about HRMs 105.4 to 107.1. The 100-year floodplain for the Holston River varies from elevation 1,076.9 at HRM 105.4 to elevation 1,089.9 at HRM 107.1. The 500-year or "critical action floodplain" varies from elevation 1,081.3 at HRM 105.4 to elevation 1,092.0 at HRM 107.1. A "critical action" is defined in the Water Resource Council Floodplain Management Guidelines for implementing Executive Order (EO) 11988 as any activity for which even a slight chance of flooding would be too great.

3.5 Coal Combustion Byproduct Generation, Marketing, and Handling

JSF is expected to burn between 1.9 and 2.2 million tons of coal annually through at least 2023. The coal averages 11.6 percent ash; therefore, total ash production will range from approximately 220,000 to 254,000 tons of ash per year. The ash is collected as either fly ash, which is fine enough and light enough to be carried with the flue gas stream exiting the boiler, or as bottom ash, which is coarser and heavier and falls to the bottom of the boiler. The fly ash/bottom ash split is about 93 percent fly ash and 7 percent bottom ash.

In 1986, the fly ash handling system at JSF was converted to a dry fly ash handling system. Prior to this, all fly ash and bottom ash was sluiced to the ash pond complex. Since the conversion, fly ash, which is separated from the flue gases in ESPs and collected in hoppers, is pneumatically collected dry and blown to either of two 1,200-ton fly ash silos. Fly ash that meets industry specifications is marketed for ready-mix concrete or other products and can be delivered into pneumatic tanker trucks from one silo, which is equipped with a dry fly ash unloader. Fly ash that does not meet specifications and/or that is not marketed can be conditioned with water in pug mills located near the bottom of the silos and loaded into dump trucks for transport to the fly ash disposal area. Fly ash production is expected to range from about 206,000 to 236,000 tons per year, depending on coal burn, through 2023.

Although JSF collects most of the fly ash dry, it retains the capability to sluice fly ash to the bottom ash pond complex. Fly ash is sluiced during unit startup and during operational problems that compromise the reliability of the dry fly ash collection system. Since fly ash that is wet sluiced impedes ash-marketing efforts, wet sluicing fly ash is kept to a minimum. Current operating guidelines limit wet sluicing of fly ash to 2 percent by weight or less of the annual production.

Currently, JSF is marketing about half of its annual fly ash production for cement replacement in ready-mix cement. However, in the past this market has been sporadic due to variable and/or high carbon content (loss on ignition or LOI) in the fly ash. Due to the LOI variability, TVA has sought to develop markets for JSF fly ash that are not sensitive to LOI variability.

The existing dry fly ash stacking area currently has about 1,200,000 tons of remaining disposal capacity. If no fly ash were marketed, this would be enough disposal capacity for about four years (2009). If current marketing levels can be sustained, the life of the disposal facility will be about six years (to 2011). Extending the life of the fly ash disposal area defers the date when additional disposal areas will need to be developed. At the time, when the need for additional fly ash disposal areas is established, the appropriate environmental review would be undertaken to evaluate the use of alternative sites for ash disposal.

Bottom ash collects in the bottom of the boiler and is periodically washed from the boiler bottoms with jets of water and sluiced to a bottom ash dewatering area within the bottom ash pond complex. The bottom ash is currently collected in this area by Appalachian Products, an independent ash marketing company that processes and sells the bottom ash for use in concrete block manufacturing. Bottom ash production is expected to range from about 16,000 to 18,000 tons per year, depending on coal burn, through 2023.

3.6 Terrestrial Ecology

3.6.1 Terrestrial Plants

As previously stated, JSF is located within the Valley and Ridge Physiographic Province as defined by Fenneman (1938). Botanically, the proposed project area coincides with the Ridge and Valley of the Oak-Chestnut Forest Region described by Braun (1950). Native forest communities of this region have a large component of various oak, pine, and hickory species, with deciduous components characterized by red oak, white oak, red maple, sweet gum, sourwood, sassafras, tulip poplar, and dogwood.

The areas in and around JSF have been heavily impacted and altered as a result of the construction and operation of the existing facilities. Field inspections in September 2004 of the areas associated with proposed action reveal that little native vegetation remains. No uncommon communities are present on the JSF Reservation. The vegetated areas to be impacted consist of grass forbs, thickets intergrading into immature forests, and fragmented immature forests.

Grass forbs habitats occupy at least 75 percent of the proposed project area. This community is dominated by grasses. Lawns, managed fields, and old fields are most prevalent, although rights-of-way for roadsides and power lines are included. Most of the mowed areas are heavily dominated by tall fescue. Additional species present include foxtail grass, Johnson grass, Canada goldenrod, ragwort, sericea lespedeza, Queen Anne’s lace, Joe Pye weed, tall ragweed, and milkweed.

Thickets intergrading to immature forest occupy approximately 15 percent of the proposed project area. Characteristic species of this community are milkweed, sericea lespedeza, Japanese honeysuckle, blackberry, smooth sumac, Russian olive, eastern red cedar, mimosa, and crabapple.

Fragmented immature forests occupy approximately 5 percent of the proposed project area. These forest fragments are found only along drainage ditches and some containment ponds, which are seldom mowed. Dominant species found include loblolly pine, black willow, green ash, sweetgum, red maple, sycamore, boxelder, and tulip poplar. Common understory vegetation includes dogwood and smooth sumac. Herbaceous ground cover includes cattails, Japanese stilt grass, Johnson grass, and bulrush.

The vegetation of all reviewed areas is common and representative of disturbed areas in the vicinity. No uncommon plant communities are present on or adjacent to the reviewed areas.

3.6.2 Terrestrial Animals

Habitats observed within the project area have been largely impacted by the existence and operation of JSF. Approximately 20 percent of the project area is nonvegetated, consisting of buildings, roads, and areas of asphalt or gravel. An additional 55 percent of the project area is regularly mowed grass, and about 15 percent consists of grass/forb habitat. The remaining habitat consists of immature forest and scrub-shrub habitat; both habitat types are associated with several linear ditches and human-made ponds.

Together, the nonvegetated land and mowed grass areas make up the majority of the project area. Neither provides significant habitat for native terrestrial animals. American crow and killdeer were observed in these areas during field surveys. European starling, an introduced species, was also observed; house sparrow and rock pigeon are examples of other introduced bird species that are often abundant in these highly disturbed areas.

Several small areas of early successional vegetation (grass/forb) provide habitat for numerous terrestrial animals. White-tailed deer, wild turkey, American goldfinch, and mourning dove were observed during field surveys. Other animals species generally associated with this habitat type include eastern cottontail, house mouse, indigo bunting, eastern meadowlark, and eastern bluebird.

Several linear wet ditches and small human-made ponds exist in the project area. These sites are surrounded by scrub-shrub and immature forest habitats. Green frog, spring peeper, great blue heron, green heron, belted kingfisher, and Canada goose were observed utilizing the water in these ditches and ponds. Common bird species encountered in the scrub-shrub and immature forests include northern cardinal, blue jay, northern mockingbird, field sparrow, and Carolina wren. Other animal species associated with these sites include eastern cottontail, gray squirrel, eastern chipmunk, white-footed mouse, red bat, black rat snake, and eastern box turtle. However, these small areas of early successional woody habitat provide poor quality habitat overall for terrestrial animals because the areas are small, highly fragmented, and surrounded predominantly by nonvegetated areas or highly disturbed areas.

Several unique terrestrial features have been reported from the vicinity of Hawkins County, including 13 caves and one heronry. Two of the caves have records of protected species (see Threatened and Endangered Section), and one cave occurs within a 3-mile radius of the project area, but has no records of protected terrestrial animal species. One heronry also occurs within Hawkins County, but is greater than 3 miles from the project area and does not contain any protected terrestrial animal species.

3.7 Aquatic Ecology

The reach of the Holston River adjacent to JSF has been substantially altered from its former free-flowing character by the presence of the John Sevier Detention Dam (located adjacent to JSF), and Cherokee Dam (35.5 miles downstream). The area affected by Cherokee Reservoir extends to the tailwaters of the John Sevier Detention Dam. TVA began a program to monitor the ecological conditions of its reservoirs systematically in 1990. Reservoir (and stream) monitoring programs were combined with TVA's fish tissue and bacteriological studies to form an integrated Vital Signs Monitoring Program. Vital signs monitoring activities focus on (1) physical/chemical characteristics of waters;

(2) physical/chemical characteristics of sediments; (3) benthic macroinvertebrate community sampling; and (4) fish assemblage sampling (Dycus and Baker, 2001).

Benthic (lake bottom) macroinvertebrate and fish samples were taken in two areas of Cherokee Reservoir from 1991 through 1996, and again in 1998, 2000, and 2002 as part of TVA's Reservoir Vital Signs Monitoring Program. Areas sampled included the forebay (area of the reservoir nearest the dam), and a midreservoir transition station. Any fish species (and most benthic species) known from elsewhere in the reservoir and in the Holston River could occur in the vicinity of JSF. The Holston River was also sampled for fish at three stations in 2003 by TVA (Appendix A). Results of these sampling efforts are presented here.

Benthic macroinvertebrates are included in aquatic monitoring programs because of their importance to the aquatic food chain and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Sampling and data analysis were based on seven parameters that include species diversity, presence of selected taxa that are indicative of good water quality, occurrence of long-lived organisms, total abundance of all organisms except those indicative of poor water quality, proportion of total abundance comprised by pollution-tolerant oligochaetes, proportion of total abundance comprised by the two most abundant taxa, and proportion of samples with no organisms present. Compared to the stations of other TVA run-of-the-river reservoirs, the monitoring sites on Cherokee Reservoir have consistently rated as poor. Cherokee Reservoir rated poor in 2002 monitoring; ecological conditions were similar to those found in previous years. Cherokee is a relatively deep storage impoundment with a long retention time and plenty of nutrients, resulting in low dissolved oxygen levels and high chlorophyll levels.

The Reservoir Vital Signs Monitoring Program also has included annual fish sampling from 1991 through 1996, and again in 1998, 2000, and 2002. Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life cycle that allows them to reflect conditions over time. Fish are also important to the public for aesthetic, recreational, and commercial reasons. Ratings are based primarily on fish community structure and function. Also considered in the rating is the percentage of the sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies, such as diseases, lesions, parasites, deformities, etc. Compared to similar stations at other run-of-the-river reservoirs, the fish community rated fair at both monitoring locations, similar to all previous years. Typically, at both monitoring locations, good varieties of fish are collected, but many of the species are tolerant of degraded water quality, resulting in a fair rating. Forty-five fish species and one hybrid species were found in the Holston River in the vicinity of JSF in March 2003 (Appendix A).

Cherokee Reservoir provides many opportunities for sport anglers. A Sport Fishing Index (SFI) has been developed to measure sport fishing quality for various species in Tennessee and Cumberland Valley reservoirs (Hickman, 1999). The SFI is based on the results of fish population sampling by TVA and state resource agencies and, when available, results of angler success as measured by state resource agencies (i.e., bass tournament results and creel surveys). In 2003, Cherokee rated above average for channel catfish, hybrid striped/white bass, spotted bass, and striped bass, but below average for largemouth bass, smallmouth bass, sauger, and crappie. Fossil plant CCW discharge channels or structures have historically provided enhanced sport fishing opportunities for species, such as catfish, white bass, and striped bass, that are seasonally attracted to warmer waters found there.

3.8 Threatened and Endangered Species

3.8.1 Threatened, Endangered, and Rare Plant Species

Review of the TVA Natural Heritage database indicated that no federally listed plant species and eight state-listed plant species are known from Hawkins County, Tennessee (Table 3-6). Only one state-listed plant, American barberry, *Berberis canadensis,* is known within 5 miles of the proposed project. This species, the other state-listed species shown in Table 3-6, and federally listed species were sought within the project area.

Table 3-6. Listed Species of Plants Reported From Hawkins County, Tennessee

Scientific name	Common name	Federal status	State status
Berberis canadensis	American barberry		SPCO
Cimicifuga rubifolia	Appalachian bugbane		THR
Cypripedium acaule	Pink lady-slipper		E-CE
Juglans cinerea	Butternut		THR
Lonicera dioica	Mountain honeysuckle		SPCO
Panax quinquefolius	American ginseng		S-CE
Paxistima canbyi	Canby’s mountain-lover		END
Pieris floribunda	Mountain fetter-bush		THR

E-CE=endangered-commercially exploited; END=endangered; THR=threatened; SPCO=special concern; S-CE=special concern-commercially exploited

Field inspection of the project area conducted in September 2004 revealed that the state-listed plant species were not present on lands to be affected by the proposed activities nor was suitable habitat for these or other rare species present. No federally listed plant species are known from the area of proposed activities.

3.8.2 Terrestrial Threatened, Endangered, and Rare Animal Species

The TVA Natural Heritage database indicated that three federally listed species, the bald eagle, gray bat, and Indiana bat, and nine additional state-protected species have been reported from Hawkins County, Tennessee (Table 3-7). Only one record of a state-listed species, the southern bog lemming, is within 3 miles of the proposed project area.

The common raven is a large bird found locally at elevations greater than 3,000 feet within the southern Appalachian Mountains. Suitable habitat including rocky ledges or cliffs, preferred by this species, does not exist in this project area. The federally listed bald eagle has been reported from the vicinity. This species feeds primarily on fish and is often found near large bodies of water. Although the project area is immediately adjacent to the Holston River, mature trees and cliffs preferred by this species for perching and nesting are not available in the project area. Suitable habitat for barn owls occurs in the project area. This species nests in hollow trees and abandoned human-made structures. An abandoned, wooden building was found within the project area, but no evidence of barn owl was found in this structure. No other available roost sites (e.g., cave or hollow tree) were observed in the project area.

Table 3-7. Protected Species of Terrestrial Animals Reported From Hawkins County, Tennessee

Common name	Scientific name	State status	Federal status
Birds			
Common raven	*Corvus corax*	THR	-
Bald eagle	*Haliaeetus leucocephalus*	NMGT	THR
Common barn owl	*Tyto alba*	NMGT	-
Mammals			
Eastern big-eared bat	*Corynorhinus rafinesquii*	NMGT	-
Gray bat	*Myotis grisescens*	END	END
Indiana bat	*Myotis sodalist*	END	END
Woodland jumping mouse	*Napaeozapus insignis*	NMGT	-
Allegheny woodrat	*Neotoma magister*	NMGT	-
Hairy-tailed mole	*Parascalops breweri*	NMGT	-
Common shrew	*Sorex cinereus*	NMGT	-
Southeastern shrew	*Sorex longirostris*	NMGT	-
Southern bog lemming	*Synaptomys cooperi*	NMGT	-

Status abbreviations: END = endangered; NMGT = Deemed in Need of Management; THR = Threatened

Big-eared bats have been reported from a cave in Hawkins County. This species roosts in caves, abandoned buildings or mines, bridges, or large hollow trees. Evidence of bats was not observed in the abandoned building in the project area. Other suitable roosting habitat does not exist within the project area. Federally listed gray bats occupy caves year-round. Large maternity roosts form in caves near large reservoirs and rivers during summer months; the bats roost in other caves during winter. Gray bats have been reported from two caves in Hawkins County. Potential roost sites do not occur in the project area. However, gray bats likely forage over the adjacent Holston River. The federally listed Indiana bat hibernates in caves during winter months, but utilizes mature forests during the summer months. Optimal Indiana bat forest habitat is characterized by a closed tree canopy, an open midstory, nearby riparian zones for foraging, and trees with exfoliating bark or cavities for roosting. This species has been reported from one cave in Hawkins County. Although the adjacent Holston River offers possible foraging habitat, no caves or suitable forest habitat exists within the project area.

Woodland jumping mice occur in a variety of cool, moist, woodland habitat types, usually those having dense herbaceous vegetation near water. Although some dense herbaceous habitat exists near water within the project area, the lack of any mature forest types make the occurrence of this species unlikely within the project area. Allegheny woodrats are large rodents that nest in rocky crevices, caves, and bluff faces. The forested rocky outcrops preferred by this species do not exist within the project area. Hairy-tailed moles prefer sandy loam soils in habitats ranging from forests to grasslands, but usually containing sufficient vegetative cover and moisture. On the southern limit of its range, this mole is usually found at higher elevations within the southern Appalachian Mountains and most likely does not inhabit the project area. Southeastern shrews, common shrews, and southern bog lemmings all inhabit a wide variety of habitats ranging from grasslands to forests, but usually prefer moist areas near wetlands, bogs, or streams. Although these species were not observed during field visits, they may occur in the early successional vegetation surrounding the ditches and man-made ponds within the project area.

No other federally or state-listed species or their habitats are expected to occur within the proposed project area.

3.8.3 Aquatic Threatened and Endangered Animal Species

Data from the TVA Natural Heritage database indicated that several state-listed and federally listed aquatic animal species are reported from the Holston River and its tributaries upstream of JSF and the John Sevier Detention Dam (Table 3-8). The records for the federally listed purple bean mussel are from Beech Creek, a tributary to the Holston River that flows into the John Sevier Detention Reservoir at approximately HRM 108.7. Due to changes caused by impoundment of the river, there is no suitable habitat for this mussel species in the main stem of the Holston River. Due to the presence of the John Sevier Detention Dam and Cherokee Reservoir, suitable habitat is no longer present for the purple bean or any of the other state-listed or federally listed species in the main stem of the Holston River from Cherokee Dam (HRM 52.3), upstream to the upper end of the John Sevier Detention Reservoir (at HRM 118), and none of these species are likely to occur in the vicinity of JSF (HRMs 106-107). Several additional federally listed species were once present in the Holston River adjacent to and downstream of JSF, but have been eliminated from this portion of their former range. These species include the green blossom pearly mussel, fine-rayed pigtoe, spiny river snail, turgid blossom pearly mussel, birdwing pearly mussel, and Cumberland monkeyface.

Table 3-8. State- and Federally Listed Aquatic Animal Species Reported From the Holston River and its Tributaries Upstream of John Sevier Fossil Plant

Common name	Scientific name	State status	Federal status
Fish			
Spotfin chub	*Cyprinella monacha*	Threatened	Threatened
Tangerine darter	*Percina aurantiaca*	NMGT	-
Blotchside logperch	*Percina burtoni*	NMGT	-
Tennessee dace	*Phoxinus tennesseensis*	NMGT	-
Mussel			
Purple bean	*Villosa perpurpurea*	Endangered	Endangered

NMGT - Deemed In need of management by the Tennessee Wildlife Resources Agency

While the potential for impacts to sensitive aquatic resources downstream of Cherokee Dam (50+ river miles downstream of JSF) is extremely low, populations of several sensitive aquatic species are known to be present in the Holston River below Cherokee Dam (Table 3-9).

Table 3-9. State- and Federally Listed Aquatic Animal Species Reported From the Holston River and its Tributaries Downstream of Cherokee Dam (50+ River Miles Downstream of JSF)			
Common name	**Scientific name**	**State status**	**Federal status**
Fish			
Blue sucker	*Cycleptus elongatus*	NMGT	-
Snail darter	*Percina tanasi*	Threatened	Threatened
Tennessee dace	*Phoxinus tennesseensis*	NMGT	-
Mussels			
Pink mucket	*Lampsilis abrupta*	Endangered	Endangered
Sheepnose	*Plethobasus cyphyus*	Candidate	-

NMGT - Deemed In need of management by the Tennessee Wildlife Resources Agency

3.9 Managed Areas

Natural Areas
A review of the TVA Natural Heritage database indicated that the potential disturbance area of the proposed NO_X reduction system installation at JSF is within 3 miles of one ecologically significant site. No managed areas are within 3 miles of the proposed site. No streams are listed on the Nationwide Rivers Inventory (NRI) in Hawkins County, Tennessee.

Beech Creek Unit 7 Proposed Designated Critical Habitat (PDCH) is approximately 2.1 miles upstream from the proposed project site. Beech Creek Unit 7 PDCH in Hawkins County, Tennessee, is a critical habitat unit for *Villosa perpurpurea*, the purple bean mussel. Unit 7 includes the Beech Creek main stem from River Mile (RM) 2.0 upstream to the dismantled railroad bridge at RM 16.0. The purple bean was listed by the U.S. Fish and Wildlife Service (USFWS) in January 1997. It is currently designated as Endangered in the entire range. A USFWS recovery plan for the purple bean and four additional mussels was issued July 2004.

3.10 Wetlands

Activities in jurisdictional wetlands are regulated under Sections 404 and 401 of the federal Clean Water Act. To conduct activities in wetlands, a nationwide general permit or an individual permit from the USACE is required. The State of Tennessee regulates activities in wetlands under the provisions of the Section 401 Water Quality Certification of the Clean Water Act, which is administered through the ARAP program. In addition, as a federal agency, TVA has a mandate to implement the provisions of EO 11990 (Protection of Wetlands). EO 11990 requires federal agencies to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities. It also requires agencies to consider factors relevant to a proposal’s effect on the survival and quality of the wetlands, including maintenance of natural systems, conservation and long-term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources, as well as other uses of the wetlands in the public interest.

The federal "no-net-loss" policy for wetlands states an interim goal of no overall net loss of the nation's remaining wetlands and the long-term goal of increasing the quality and quantity of the Nation's wetlands resource base (White House Office on Environmental Policy, 1993). The Bush Administration's 2003 National Wetlands Mitigation Action Plan reaffirms the policy of no net loss of wetlands (http://www.epa.gov/owow/wetlands/pdf/map1226withsign.pdf).

Wetland determinations were performed according to USACE standards (Environmental Laboratory, 1987), which require documentation of hydrophytic vegetation (Reed, 1997), hydric soil, and wetland hydrology. Wetlands are classified according to the Cowardin system for the classification of wetlands and deepwater habitats (Cowardin et al., 1979).

Two wetlands, totaling approximately 5.9 acres, were identified in the vicinity of the proposed JSF NO_X emissions reduction project footprint (Table 3-10). Both wetlands are hydrologically connected to the Holston River. Wetland JSFW01, as defined by Cowardin et al., 1979, is an emergent (marsh and wet meadow) wetland intermixed with scrub-shrub habitat (PEM1/PSS1). JSFW01 covers about 3.8 acres along the southwest side of the proposed JSF NO_X emissions reduction project footprint. Wetland JSFW01 receives runoff from the active dry fly ash disposal area. Wetland area (JSFW01) meets all three of the USACE parameters for wetlands that may be regulated under the Clean Water Act. However, this wetland is an integral part of the existing wastewater treatment system for JSF. Wetland JSFW02 is a scrub-shrub wetland and covers 2.1 acres of scrub-shrub wetlands on the eastern side of the JSF site. Wetland JSFW02 receives runoff from the railroad tracks and storage areas at the east end of the plant. Wetland JSFW02 meets two of the three criteria for a jurisdictional wetland, but could be considered a resource needing protection by USACE. As discussed in Chapter 2, the proposed boundaries of the JSF NO_X emissions reduction project were changed so that Wetland JSFW02 would be entirely outside the proposed project footprint.

Table 3-10. Wetlands in the Proposed JSF NO_X Reduction Footprint

Wetland Identification	Wetland Classification*	Federal Jurisdiction (CWA) **	Total Wetland Acreage
JSFW01	PEM1/PSS1	TBD	3.8
JSFW02	PSS1	TBD	2.1
Total			**5.9**

* Based on Cowardin et al., 1979
** Federal jurisdictional determinations subject to consultation with USACE regulatory staff

The emergent and scrub-shrub wetlands perform valuable functions including flood control, contaminant removal, sediment retention, wildlife habitat, species diversity, and ecosystem support functions. These functions include:

- Filtering and retaining sediment and other contaminants from storm water runoff.
- Enhanced levels of primary production, nutrient cycling, and carbon storage and export.
- Essential habitat and woody structure required by species that are dependent on woody plants for all or part of their life cycle (woodland amphibians and some species of wintering, migratory, and nesting birds), including microhabitats such as shaded vernal ponds, stumps, and snags.
- Shading and cooling effects on vernal ponds and other wetlands.

3.11 Transportation

JSF is served by highway and railway modes of transportation. Portions of the existing transportation network in the vicinity of the plant are shown in Figure 3-3. Truck and automobile access to the plant is via Tennessee State Route (TN) 66 and TN 70. The state highways are high quality, rural roadways with good shoulder width traversing over rolling terrain in a north-south direction through Northeast Tennessee. Access from Interstate Highway 81 from the west is via TN 66 northeast to TN 70 east to the plant. Access from Interstate Highway 81 from the east is via TN 70 north to the plant. Direct access to the plant is via Old Highway 70 and a plant access road east into the plant site. Table 3-11 shows the 2004 Average Annual Daily Traffic counts (Tennessee Department of Transportation, 2005).

Table 3-11. Primary Routes Studied With 2004 Average Annual Daily Traffic Counts Shown

Highway	Average Daily Use
TN 66 (South of TN 70)	3,640
TN 66 (North of TN 70)	11,710
TN 70	1,170
Old Highway 70	840

Source: Tennessee Department of Transportation, 2005

Norfolk Southern Railroad operates a main north-south rail just south of the plant. JSF has a railroad spur from the mainline with a railroad storage yard utilized for coal handling operations (i.e., staging of loaded and empty rail cars). JSF receives all of their coal via rail. The west end of the access railroad leading to the loaded storage consists of 132-pound jointed rail in good condition. The loaded storage yard consists of seven tracks of 90-pound rail, and the unloaded yard consists of eight tracks of 90-pound rail. The storage yards are in generally good condition. Interchange with Norfolk Southern takes place in the storage yards with TVA locomotives handling the cars on TVA property.

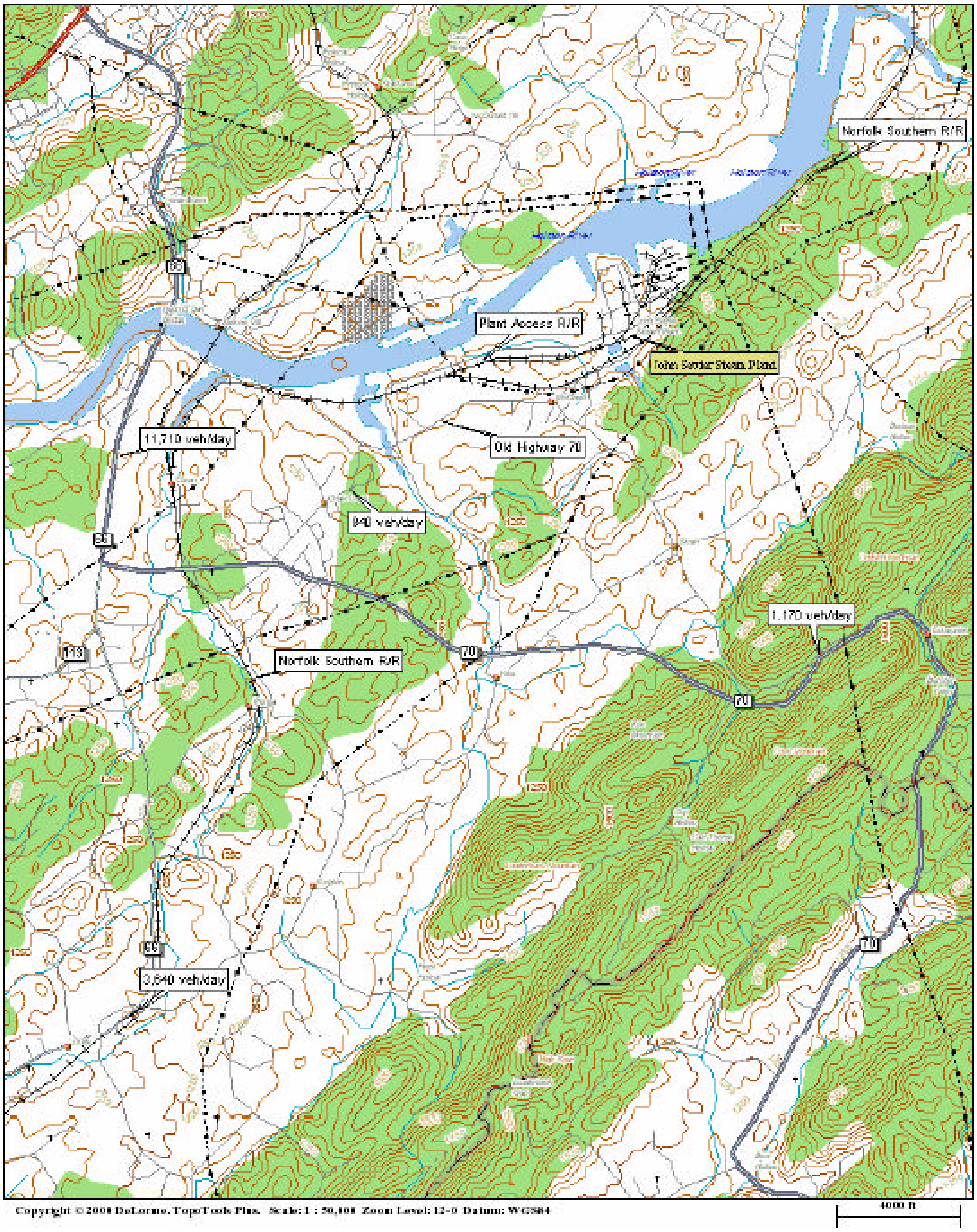


Figure 3-3. Portions of the Existing Transportation Network in the Vicinity of John Sevier Fossil Plant

3.12 Socioeconomics and Environmental Justice

Employment in the Hawkins County is far more dependent on farming and manufacturing than the state as a whole, and far less dependent on services. Compared to the state, Hawkins County has a smaller share of workers employed in managerial and professional jobs, service occupations, and sales, but a greater share of workers in farming, construction, and production jobs.

Based on current commuting patterns, the labor market area is defined to include Hawkins, Sullivan, Hamblen, Washington, Greene, Grainger, and Hancock Counties in Tennessee, and Scott County, Virginia.

3.12.1 Population

According to population estimates by the U.S. Census Bureau, Hawkins County had a population in 2003 of 55,037, which is an increase of 2.8 percent over the 2000 census count of 53,563, and a 23.5 percent increase over the 1990 population of 44,565. The labor market area population in 2003 was estimated at 505,880. Sullivan County has the greatest population in the labor market area, with 153,050 people.

The 2000 population in Hawkins was 97.2 percent white and 1.5 percent black. The minority population of the county, including white Hispanics was 3.3 percent.

3.12.2 Income and Employment

Per capita personal income in Hawkins County in 2002 was $21,564, which is 78 percent of the state average of $27,611 and 70 percent of the national average of $30,906. Per capita income was somewhat higher for the labor market area, at $24,634. Sullivan County had the highest per capita income at $26,306, while Hancock County had the lowest at $14,758. The largest source of earnings in Hawkins County in 2000 was manufacturing employment, which contributed 49.0 percent of earnings. This was followed by government employment and services, which contributed 15.7 percent and 12.6 percent, respectively.

The distribution of jobs by industry in Hawkins County is somewhat different from that of earnings. Manufacturing is the largest source of jobs, providing 29.1 percent of the total. That manufacturing employment accounts for 49.1 percent of earnings is the result of higher wages and fewer part-time jobs in manufacturing. Services employment is next at 16.3 percent, followed by government employment at 12.6 percent.

With a civilian labor force of 25,841 in 2003, Hawkins County had an unemployment rate of 7.1 percent, which is above the rate for the labor market area (6.0 percent), the state (5.8 percent), and the nation (6.0 percent). Only Grainger County (7.4 percent) had a higher unemployment rate within the labor market area.

3.13 Visual Resources

Visual resources are evaluated based on existing landscape character, distances of available views, sensitivity of viewing points, human perceptions of landscape beauty/sense of place (scenic attractiveness), and the degree of visual unity and wholeness of the natural landscape in the course of human alteration (scenic integrity).

The proposed project area is located in a rural portion of Hawkins County, Tennessee, near the small settlement of McCloud. The surrounding topography ranges from gently sloping near the banks of the Holston River, to moderately and steeply sloping ranges at Piney Mountain to the south and Town Knobs to the north. Dense vegetation is visible along the slopes leading up from the valley floor to the hilltops above. Agricultural operations, as well as scattered private residences and rural farmsteads are visible toward the banks of the Holston River to the south. To the north, and slightly obscured from view, residential development increases in density along the banks and farther northward to the nearby town of Rogersville.

Within the immediate vicinity of the plant site, the landscape character is pronouncedly industrial. The existing JSF stacks, as well as the 500-kilovolt transmission lines leaving the plant site to the east are dominant elements in the landscape for recreational river users, shoreline and near-shore residents, and motorists traveling on nearby roadways within the foreground (within 0.5 mile from the observer) and middleground (0.5 mile to 4 miles from the observer) viewing distances. Plant employees, visitors, and visitors to the recreation area, located just off the plant access road and to the west of a large ash disposal area, currently have views of taller elements within the plant site. Views along portions of the access roadway to the south are precluded due to changes in elevation and existing vegetation. Views are similar to the north, before reaching the ash disposal areas as the topography and vegetation moderate and expansive views of the plant are available.

The scenic attractiveness of the proposed project area is common to minimal, and the scenic integrity is low.

3.14 Recreation

The TVA JSF Reservation includes the following public use recreational facilities: a campground for recreational vehicles, a soccer field, a walking track, a parking lot, and a boat ramp for fishermen. The TVA JSF Reservation is frequented by numerous sport fishermen. Recreational fishing occurs in close proximity to the plant’s water intake channel, the CCW discharge channel, and Polly Branch outlet to the Holston River, the receiving stream for the ash pond discharge and overflow from the plant alternate boiler makeup water supply pond (now abandoned for this use) at the head of Polly Branch. TVA converted the construction worker barracks and kitchen into a fishermen’s campground and parking lot after construction was completed in the 1950s. The fishermen's campground and parking lot are southwest of the confluence of Polly Branch and the Holston River. TVA also constructed a boat ramp, soccer field, and walking track in the 1980s. These facilities are used seasonally, with the campground in use from April 1 through October 31. Recreational fishing in the vicinity of the plant occurs year-round. JSF provides a somewhat unique fishing opportunity for the Holston River and Cherokee Reservoir, because the diversion dam and discharge channel have a tendency to concentrate certain sport fish during certain times of the year.

3.15 Cultural Resources

East Tennessee has been an area of human occupation for the last 12,000 years. This includes five broad cultural periods: Paleo-Indian (11,000-8000 B.C.), Archaic (8000-1600 B.C.), Woodland (1600 B.C.-1000 A.D.), Mississippian (1000-1700 A.D.), and Historic (1700 A.D. - to present). Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on floodplains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. In East Tennessee, during the 17th and 18th centuries, Europeans and Native Americans began interacting through the fur trading industry. European-American settlement increased in the early 19th century as the Cherokee were forced to give up their land. Hawkins County was originally established as a North Carolina county on January 6, 1787. At this time, the county consisted of what are now Hancock, Grainger, Jefferson, Knox, Roane, Meigs, and Hamilton Counties. Development around the Hawkins Court House soon became known as the town of Rogersville. In 1791, the town of Rogersville printed Tennessee's first newspaper, *The Knoxville Gazette*. In 1858, East Tennessee and Virginia Railroad used slave labor to lay the first tracks through an area called Bulls Gap, which is located near Rogersville. During the Civil War, the strategic location of the tracks made Bulls Gap the frequent scene of fighting between Union and Confederate forces. After the war, the railroad dominated the economic life of Bulls Gap. From the 1840s through the 1870s, the marble industry was developed in Hawkins County, and the area became famous for its pink and red variegated marble. Marble from Hawkins County was used in the Washington Monument in Washington, D.C., as well as the balustrades and stairways of the Capitol. Today the principal sources of farm income are beef cattle and burley tobacco (Price, 1998).

The area of potential effect (APE) means the geographic area or areas within which an undertaking directly or indirectly may cause alterations in the character or use of historic properties, if any such properties exist. The APE for the proposed project was determined for archaeological resources as all the areas in which land disturbing activities would take place, which total 271 acres. For historic structures, the APE was determined as those areas from which the alterations would be visible within 0.5-mile radius.

3.16 Seismology

JSF is located in the Appalachian Valley and Ridge physiographic province. The bedrock geology at the site is the Athens Shale of Ordovician age. The shale units are interlayered with thin limestone beds. The shale and limestone beds contain numerous tight folds and some small-scale faults. These ancient faults do not cut the overlying alluvial and terrace deposits and are not active in the current geologic environment. Prior to construction activities, the entire site was covered by a mantle of alluvial and terrace deposits up to a maximum thickness of 31 feet (Kellberg and Benziger, 1952). The alluvial deposits are composed of slightly sandy silt with a few interspersed pebbles and cobbles. The older terrace deposits consist of clayey silts throughout, which are scattered pebbles and cobbles ranging in size up to a maximum of 6 inches.

The strength and thickness of soils strongly influence the amount and type of shaking a structure is subjected to during earthquakes. Generally, sites founded on soft rocks and soils experience much stronger shaking than sites founded on competent, hard rock. The hardest rock conditions are Category A, and the softest soils fall in Category F on this scale. Structures founded on alluvial or terrace deposits at the site likely fall in site Category C or D, but soil testing is necessary to define the site category. Soil testing would also be necessary to quantify the potential for earthquake-induced liquefaction. Structures founded in competent rock at this site most likely have foundation conditions corresponding to Category A or B, but this would also need to be verified by testing.

The primary source of earthquake hazard to the JSF site is the East Tennessee Seismic Zone, a 300-kilometer-long (186-mile-long), northeast-southwest-trending concentration of mostly minor earthquakes that has been well delineated in recent years by regional seismograph networks (Powell, et al., 1994).

The earthquake hazard at a site can be modeled probabilistically by considering all seismic source zones around a site, and the probability that these source zones will produce earthquakes of various sizes. The U.S. Geological Survey (USGS) performed probabilistic seismic hazard analyses throughout the United States to prepare the 2002 national seismic hazard maps (USGS, 2002). The USGS's analysis assumes that foundation conditions correspond to NEHRP B-C (intermediate between Categories B and C) site conditions.

Table 3-12 presents the USGS's seismic hazard values for the JSF (36.37° North, 82.96° West) location. The USGS expresses seismic hazard as the minimum horizontal ground motion that would be expected to occur during two time spans (return periods): 475 and 2,375 years. The ground shaking is computed at three different frequencies of motion: Peak Ground Acceleration, 5.0, and 1.0 hertz. In the same way that the "100- or 500-year flood" means the level of flooding expected to occur at least once during those periods of time, ground-shaking return periods refer to the minimum level of ground shaking expected during the specified time. In this case, Table 3-12 shows that at a frequency of 1.0 hertz, the ground should shake with a force of at least 4.2 percent g once in 475 years (g is the acceleration of a falling object due to gravity). The 475-year return period is equivalent to a 1 in 10 chance that the ground shaking will be exceeded in only 50 years.

Table 3-12. Probabilistic Ground Motion Values

Ground Motion Frequency (hertz)	Ground Accelerations in %g	
	10% Probability of Exceedance in 50 years (475-year return period)	2% Probability of Exceedance in 50 years (2,375-year return period)
Peak Ground Acceleration	7.4	25.1
5.0	14.8	43.5
1.0	4.2	10.7

Source: USGS 2002
% = Percent
g = acceleration of a falling object due to gravity

3.17 Tornado Risk

There are excellent records of the occurrence of tornadoes in populated areas of the United States. One source used for nuclear plant siting applications is *Tornado Climatology of the Contiguous United States* (NRC, 1986). To determine the probability of a tornado affecting JSF, a study area was defined as a box of one degree of latitude by one degree of longitude containing the plant (82° West to 83° West and 36° North to 37° North). This resulted in a study area of approximately 3,836 square miles, which is equivalent to a square with sides about 62 miles in length.

The average tornado path affects an area of 2.82 square miles (Thom, 1963). As an example, this would be equivalent to a tornado with a path width of 0.25 mile and a travel distance of 11.28 miles (0.25 mile x 11.28 miles = 2.82 square miles). For the study area, 14 tornadoes occurred during the 30-year period 1954 to 1983. This results in a tornado frequency of 0.47 tornadoes per year (14 tornadoes/30 years = 0.47). The annual probability of affecting a particular site in the study area, such as JSF may be calculated as follows:

$$\text{Annual Probability} = \frac{(0.47 \text{ tornadoes/year}) \times (2.82 \text{ square miles affected/tornado})}{(3{,}836 \text{ square miles study area})}$$

= **0.00035** *per year*.

In other words, there is a 0.035 percent chance each year of a tornado affecting a particular site in the study area. This is significantly less than one-tenth of 1 percent chance per year. Another way to express risk is to calculate how often, on average, a tornado may affect a particular site. This may be calculated by:

Recurrence Interval = 1/(0.00035 *per year*) approximately **2,857** *years*.

So, on average, a tornado would be expected to affect a site in the study area, such as JSF, once every 2,857 years. Additionally, the probability of Class F stability occurring is about 0.1 to 0.15, although occurrence immediately after a tornado is unlikely and therefore even lower. The resulting probability of both a tornado and Class F stability in the study area is about 5.25×10^{-5}.

CHAPTER 4

4. ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential environmental consequences of the proposed alternatives for reducing NO_X emissions at JSF with details organized as construction or operating impacts for each resource area. The SCR and SNCR processes under consideration use ammonia or urea as a reactant compound to remove NO_X from the flue gas. Some of the unreacted ammonia “slips” past the reaction and either exits to the atmosphere with the flue gas or attaches to ash (except low-dust SCR). Ammoniated ash subsequently yields ammonia to the wastewater streams within JSF, which can then potentially enter surface or groundwaters. Impacts to these three resource areas (i.e., air, surface water, and groundwater) are the primary potential environmental concerns that could result from the proposed alternatives.

4.1 Air Resources

4.1.1 Alternative A – No Action

Under the No Action Alternative, current air quality in the vicinity of JSF is expected to continue.

4.1.2 Construction Impacts of Action Alternatives

Under the action alternatives, transient air pollutant emissions would occur during the construction phase of this project. Since the JSF site has already been developed as an industrial site, construction-related emissions would be relatively less than for a new site. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

Vehicle Emissions and Excavation Dust

Land clearing, site preparation, and vehicular traffic over unpaved roads and construction sites result in the emission of fugitive dust particulate matter (PM) during site preparation and active construction periods. The largest size fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of PM would be subject to longer-range transport. If necessary, open construction areas and unpaved roads would be sprinkled with water to reduce fugitive dust emissions by as much as 50 percent.

Combustion of gasoline and diesel fuel by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, NO_X, carbon monoxide, volatile organic compounds (VOCs), and sulfur dioxide throughout the site preparation and construction period. The total amount of these emissions would be small and would result in minimal off-site impacts.

Air quality impacts from construction activities would be temporary and dependent on both man-made factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality that should not exceed or violate any applicable ambient air quality standard.

Overall, the air quality impact of construction-related activities for the project would not be significant.

4.1.3 Plant Vicinity Operational Impacts From Action Alternatives

Operation of the action alternatives for any of the options under consideration would not adversely impact local air quality. There would be the possibility, for all options except boiler optimization, of slight increases in ammonia concentrations downwind of the plant site. This possibility is discussed below. Overall, operation for the action alternatives would improve air quality.

4.1.3.1 Ozone Scavenging Losses

Ozone concentrations below background levels occur immediately downwind of NO_X sources, such as power plants, due to ozone scavenging, i.e., NO emissions consuming ozone. Significant ozone production does not occur until 20 to 80 kilometers (12.4 to 49.7 miles) downwind of the NO_X source. The reduction of NO_X emissions may reduce the size of the area in which ozone scavenging occurs. While ozone concentrations may increase slightly in areas previously affected by ozone scavenging, they are not expected to increase above background ozone levels.

4.1.3.2 Plume Opacity and Plume Blight

Plume opacity is determined by the amount of NO_2 and PM emitted. Due to the optical properties of NO_2, it tends to give a plume a slight reddish-brown color when viewed against a clear sky. Since the action alternatives would greatly reduce NO_X emissions, they would also be expected to reduce plume opacity. There is a possibility that SCR operation would be accompanied by an increase in sulfur trioxide (SO_3) emissions, which could result in some offset of the plume visibility improvements due to NO_X reduction. The potential exists, however, for minor increases in plume visibility under some meteorological and operational conditions.

4.1.4 Regional Operational Impacts From Action Alternatives

4.1.4.1 Introduction

TVA has installed, is in the process of installing, or is considering the installation of additional NO_X controls, using SCR or SNCR technologies, at up to nine other coal-fired power plants (Allen, Bull Run, Colbert, Cumberland, Johnsonville, Kingston, Paradise, Shawnee, and Widows Creek). Table 4-1 lists all units being considered including the proposed action at JSF. To meet Title IV requirements, low-NO_X burners have already been installed on 34 TVA boilers; staged over-fire air has been installed on six units; and combustion optimization has been installed on an additional 18 units. The controls would reduce TVA's seasonal NO_X emissions roughly 75 percent below 1990 levels.

The new controls would help reduce local and regional ozone levels, and would help prevent violations of the new more stringent 8-hour ozone standard that was promulgated by USEPA in 1997. The strategy is also consistent with the types of controls that would be needed to comply with USEPA's proposed rule for ozone transport, known as the ozone transport State Implementation Plan call.

Unit	State	Generation Capacity (Megawatt)	Year Installed or Estimated to be Completed
Paradise 2	Kentucky	704	2000
Paradise 1	Kentucky	704	2001
Paradise 3	Kentucky	1,050	2003
Allen 2	Tennessee	330	2002
Allen 3	Tennessee	330	2002
Allen 1	Tennessee	330	2003
Widows Creek 7	Alabama	575	2003
Widows Creek 8	Alabama	550	2004
Cumberland 2	Tennessee	1,300	2004
Cumberland 1	Tennessee	1,300	2003
Bull Run	Tennessee	950	2003
Kingston 1-4, 7-8	Tennessee	1,300	2004
Kingston 5-6	Tennessee	400	2005
Kingston 9	Tennessee	200	2006
Colbert 5	Alabama	500	2004
Colbert 1-4	Alabama	800	2005 to 2014
Johnsonville 1	Tennessee		2005
Shawnee	Kentucky		2005
John Sevier 1-4	Tennessee	800	2006 to 2016

Table 4-1. TVA Fossil Plant Units Planned for Installation of SCR Systems or Other NO_X Reduction Technologies

Note: TVA currently has no plans for further NO_X reductions at Widows Creek Units 1-6 or Gallatin Fossil Plant.

As discussed earlier, the primary purpose of the action alternatives is to reduce emissions of NO_X, a pollutant that can, in combination with VOCs and sunlight, lead to the production of ozone. The purpose of this section is to describe the nature of ozone and the impacts that reducing NO_X emissions from JSF would have on ambient ozone levels. In addition, the potential impact of the action alternatives on secondary particulate formation and regional haze is described.

4.1.4.2 Ozone

Ozone forms in the atmosphere as a result of a mixture of NO_X and VOCs being exposed to sunlight. Both NO_X and VOCs have natural and anthropogenic (man-made) emissions sources. For example, isoprene (a VOC important in ozone formation) is primarily emitted from trees and crops. Other VOCs, however, are emitted into the atmosphere as the consequence of human activity, such as the use of solvents or the operation of motor vehicles. While there are also natural sources of NO_X, they are relatively small compared to the NO_X emitted from motor vehicles and other forms of fuel combustion. Since large utility boilers burn large quantities of fossil fuel, they are a major source of the NO_X emitted into the atmosphere.

Ozone levels in the TVA region have historically been less than the NAAQS (with the exception of a few urban centers). With the recent revision of the ozone standard from a 1-hour average concentration of 120 parts per billion to an 8-hour average concentration of 80 parts per billion, more areas in the TVA region are expected to experience ozone concentrations exceeding the standard. Furthermore, it is anticipated that a number of urban areas—even some remote, rural areas in the Appalachian Mountains—which barely met the former 1-hour standard will experience ozone concentrations above the 8-hour standard.

Although it is not possible to quantify the change in ambient ozone concentration (or the frequency of that change) at a specific place due to NO_X emission reductions at JSF, it is known from previous modeling and air quality research that the overall effect would be to reduce the amount of ozone produced in the atmosphere. It is also known that the area that would benefit the most would be the area within about 150 kilometers (93.2 miles) downwind from JSF.

Precise quantification of ozone changes due to the proposed action is not practical or possible due to daily variations in meteorology and operating conditions. It is possible, however, to assess the overall impact of the proposed action in combination with anticipated NO_X reductions at other TVA fossil plants. This assessment is possible by comparing the results of photochemical modeling performed with and without consideration of TVA's overall NO_X reduction strategy. Specifically, modeling was performed as part of the effort of the Ozone Transport Assessment Group's (OTAG) work that considered the NO_X and VOC emissions in the eastern half of the United States projected to the year 2007. Photochemical modeling was performed with the OTAG emissions databases modified to reflect the effect of TVA's NO_X strategy. Although modeling was limited to a single 10-day episode in 1995, the results are illustrative of the effect of TVA's NO_X reduction strategy on atmospheric ozone. Within Alabama, Kentucky, and Tennessee, the modeling indicated that TVA's NO_X reduction strategy would decrease the overall peak 1-hour ozone in the ambient atmosphere by 2, 4, and 4 percent, respectively, and the peak 8-hour ozone burden would be decreased by 2, 3, and 4 percent, respectively. This modeling did not include the additional NO_X emission reductions that would occur at JSF, since the modeling was performed prior to consideration of installing NO_X reduction equipment at JSF. It is reasonable to assume that reduction of NO_X emission from JSF would further aid in reducing ozone. In addition, it is important to note that the modeling did not account for additional NO_X emission reductions that are likely to occur from other utilities as a consequence of recent USEPA action establishing statewide NO_X budgets in the eastern states.

4.1.4.3 Secondary Particulate and PM_{10}/$PM_{2.5}$

Except for the boiler optimization option, all other options under the action alternatives require the use of ammonia or urea. In the SNCR NO_X reduction process, the urea decomposes to ammonia and carbon dioxide. The ammonia in turn reacts with NO_X. Although almost all of the ammonia or urea is chemically converted to nitrogen and water in the reactions that are responsible for the reduction in NO_X emissions, there is a possibility that some ammonia would be emitted from the stack. Since ammonia is associated with the formation of particulate in the atmosphere, any ammonia that is emitted has the potential to result in the formation of additional atmospheric particulate. Therefore, allowing ammonia to slip through the system without reacting can lead to the formation of particulate leading to a slight increase in the atmospheric particulate burden. The potential for an increase in particulate due to ammonia emissions could possibly be more than offset by the decrease in particulate due to NO_X reductions (NO_X is a source of secondary particulate). With the eastern bituminous coal presently being burned at JSF, the SO_3, which would be produced during the combustion process, would be expected to react with and remove unreacted ammonia for slip rates of about 5 parts per million by volume (ppmv) for all four units. Since the four units at JSF share two stacks, if one unit sharing a common stack operated at 10-ppmv ammonia slip while the second unit on that stack had zero ammonia slip (for SCR operation; SNCR cannot operate with zero ammonia slip), the SO_3 from the second unit could be expected to react with and remove the excess ammonia from the first unit.

There is limited experience and knowledge about the operation of SNCR on large utility boilers and the variables that impact the NO_X reduction efficiency and the formation of other compounds from reactions of other flue gas constituents with the unreacted ammonia in the flue gas path. There is conflicting information concerning the formation of ammonium sulfate and ammonium bisulfate and the factors affecting the reaction products, the affinity of fly ash for ammonia and the factors affecting the revolatilization of ammonia that can release it back into the flue gas stream. To better assess how excess unreacted ammonia reacts with other flue gas constituents and the fate of those reaction products, a flue gas sampling and monitoring program will be implemented during the study phase of the project. The monitoring and sampling program is described in Appendix B and is similar to other monitoring and sampling programs conducted by TVA in studies on SNCR NO_X control technologies at other locations.

4.1.5 Ammonia Handling and Storage Safety

4.1.5.1 Alternative A: No Action

Under the No Action Alternative, no new substances hitherto not used on the JSF site would be introduced, so no new risks would be introduced to the plant site and the surrounding communities. However, no benefits to public health that may result from improvements to local and regional air quality would be achieved.

4.1.5.2 Alternative B: Boiler Optimization

Under Alternative B, Boiler Optimization, some improvements to local and regional air quality may be achieved. These improvements may result in some limited benefits to public health. Under Alternative B, no new potentially hazardous substances would be introduced at the JSF site, so no adverse impacts to safety and health would be anticipated.

4.1.5.3 Action Alternatives C, D, E, and F: Anhydrous Ammonia Storage and Handling Safety

Action Alternative C, SNCR, could be installed and operated using urea solutions or aqueous ammonia solutions instead of anhydrous ammonia, but since it is possible to operate an SNCR system with ammonia, and TVA may elect to operate in this manner at some point in the future, for the purposes of this EA, Alternative C may be assumed to potentially involve use of anhydrous ammonia. Alternatives D and E would use anhydrous ammonia. Alternative F would use anhydrous ammonia if SNCR using anhydrous ammonia or SCR were selected.

Background on Anhydrous Ammonia

Anhydrous ammonia is 99.5 percent commercial grade ammonia (with 0.5 percent water) as compared to aqueous ammonia, which is a solution of ammonia and water. A saturated aqueous ammonia solution is 47 percent ammonia by weight at 32°F and at atmospheric pressure (by comparison, household ammonia is a 5 percent solution). Anhydrous ammonia is very volatile and boils at -33.5°C under atmospheric pressure. Anhydrous ammonia must be pressurized or refrigerated to be maintained as a liquid. Air mixtures of ammonia are difficult to ignite. The auto ignition temperature is 650°C. The lower explosive level is 16 percent by volume, and the upper explosive level is 27 percent by volume. The reportable quantity under the Comprehensive Environmental Responsibility, Compensation, and Liability Act for release of ammonia is 100 pounds.

Excerpts from a typical material safety data sheet (MSDS) for ammonia concerning the acute and chronic health hazards are as follows:

> *Inhalation: Vapor may cause irritation to the respiratory tract. High atmospheric concentrations in excess of the occupational exposure limit may cause injury to the mucous membranes. Fluid buildup on the lung (pulmonary edema) may occur up to 48 hours after exposure to extremely high levels and could prove fatal. The onset of the respiratory symptoms may be delayed for several hours after exposure.*
>
> *Skin Contact: High concentrations of vapor may cause irritation. By rapid evaporation, the liquid may cause frostbite.*
>
> *Eye Contact: The vapor is an irritant, but the liquid is a severe irritant. Liquid splashes or spray may cause freeze burns. May cause severe damage if eye is not immediately irrigated. The full effect may occur after several days.*
>
> *Ingestion: Will cause corrosion of and damage to the gastrointestinal tract.*
>
> *Long-term Exposure: This material has been in use for many years with no evidence of adverse effects.*

Air concentration thresholds have been established for ammonia as guides for purposes of monitoring short-term and long-term occupational exposure, and for the purpose of emergency planning. These threshold concentration values for ammonia vapor, their application, and the reference guideline, standard, or regulation are listed in Table 4-2.

The toxic endpoint concentration for ammonia, based on Emergency Response Planning Guideline 2 is 197 parts per million (ppm) (140 mg/m^3 [milligrams per cubic meter] or 0.14 mg/L). It was developed by the American Industrial Hygiene Association and defined as the maximum airborne concentration below which nearly all individuals can be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual’s ability to take protective action.

Table 4-2. Ammonia Concentration Limits in Air		
Concentration	**Application**	**Reference**
25 ppm (17.75 mg/m^3)	Recommended exposure limit for 10-hour workday during a 40-hour work week	NIOSH Guide and ACGIH
35 ppm (24.85 mg/m^3)	Short-term exposure limit not to be exceeded in a 15-minute period	NIOSH Guide and ACGIH
50 ppm (35.5 mg/m^3)	Permissible exposure limit	OSHA
197 ppm (140 mg/m^3)	The concentration that defines the endpoint for a hazard assessment of off-site consequences	40 CFR 68
500 ppm (355 mg/m^3)	Concentration that is immediately dangerous to life or health for a worker without a respirator with an exposure time greater than 30 minutes	NIOSH Guide and ACGIH

ppm = parts per million
mg/m3 = Milligrams per cubic meter
NIOSH = National Institute for Occupational Safety and Health
ACGIH = American Conference of Governmental Industrial Hygienists
OSHA = Occupational Safety and Health Administration
CFR = Code of Federal Regulations

Anhydrous Ammonia Safety

The storage and handling of anhydrous ammonia in large quantities is a potentially significant hazard. This requires attention to the engineered features, control and mitigation safeguards, and operating procedures and training for plant personnel. Applicable guidelines, standards, and regulations related to the use of anhydrous ammonia are listed below.

- American National Standard Institute Standard K61.1 (CGA Standard G-2.1)— Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910.38 — Employee Emergency Plans and Fire Protection Plans
- 29 CFR 1910.111 — Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910.119 — Process Safety Management of Highly Hazardous Chemicals
- 29 CFR 1910.1000 — Air Contaminants
- 40 CFR 68 — Chemical Accident Prevention Provisions
- Pocket Guide to Chemical Hazards — National Institute for Occupational Safety and Health (NIOSH)
- Threshold Limit Values for Chemical Substances — American Conference of Governmental Industrial Hygienists (ACGIH)
- Emergency Response Guidebook — U.S. Department of Transportation

The applicability of standards and regulations are generally triggered by the quantity of ammonia stored. These quantities are called threshold quantities and are listed in Table 4-3.

Table 4-3. Regulatory Threshold Quantities for Ammonia

Chemical	Threshold Quantity (pounds)	Federal Regulation
Anhydrous Ammonia	10,000	40 CFR 68
Aqueous Ammonia >20%	10,000	40 CFR 68
Anhydrous Ammonia	10,000	29 CFR 1910.119
Aqueous Ammonia >44%	15,000	29 CFR 1910.119

> = greater than
% = percent

The proposed minimum storage quantity for the JSF SCR systems (60,000 gallons or 289,883 pounds) would exceed threshold quantities. In addition to on-site storage, anhydrous ammonia must be transported to the plant site to replenish system storage. The use of railcars with a capacity of 33,000 gallons (159,390 pounds) would be the mode of transportation.

Risk Factors

The risk and potential severity of an ammonia storage or handling accident would be influenced by a number of factors including:

- Design of the ammonia storage and handling facility including engineered features and safeguards, and the quantity of ammonia stored.
- Railcar transportation for ammonia deliveries and the frequency of deliveries (see Section 4.11).
- Procedures for normal operations.
- Training of operations personnel for normal operations and emergency response.
- Population distribution in the plant vicinity.
- Emergency planning and response procedures.
- Probability of events, such as earthquakes and tornadoes, that could initiate a worst-case release.

Engineered Features and Safeguards

Properly engineered features and safeguards as well as adequate operating and maintenance procedures and training should make accidents unlikely and limit their consequences. Adherence to standards such as CGA G-2.1 or OSHA 29 CFR 1910.111 can result in safe equipment design. Compliance with 40 CFR 68 and 29 CFR 1910.119 ensures proper hazard assessment, operating procedures, employee training, and emergency planning have been provided.

A primary feature for limiting the potential hazard from an ammonia leak would be a water deluge (fogging) system with both automatic and manual actuation to address both the storage tank area and unloading area. A deluge system applies a fog blanket of small water droplets to wash ammonia vapor from the air, combining with the ammonia to form liquid aqueous ammonia, which would drain to the ammonia storage area emergency spill retention pond and then to the ash pond. As discussed in the Groundwater Resources Section (4.3) below, preliminary site evaluations indicate that the emergency spill retention pond would at a minimum be lined with clay or compacted in-situ soil. The ammonia-water mixture resulting from an emergency release would be sampled, analyzed, and managed in a way that prevented significant impacts. This would prevent uncontrolled discharge of aqueous ammonia to surface waters, which would kill aquatic life.

To be effective, a deluge system must, at a minimum, deliver a uniform spray of fine droplets over the surface of an ammonia spill at a rate that exceeds the mass transfer (boil-off) of anhydrous ammonia by a factor of at least 3.5. This accounts for the fact that a saturated aqueous ammonia solution at 100°F (summer design condition) is about 29 percent ammonia by weight. Thus, 3.5 pounds of water must be combined with each pound of ammonia vapor boiling off of a spill simply to achieve a saturated solution. The deluge system would limit the impact of an ammonia leak but may not entirely mitigate the impact on surface water of the worst-case failure of a storage tank or other catastrophic release. Because of the low probability of a worst-case failure, this impact is not considered significant.

4.1.6 Propane Storage and Handling Safety (Action Alternatives D and F)

Background Information on Propane

Propane is a liquefied petroleum gas and aromatic hydrocarbon that may be utilized as a gaseous fuel. Propane is a colorless gas. For safety and detection purposes, a chemical odorant (ethyl mercaptan) is added to propane. The presence of the odorant alerts one of a potential propane gas leak. Other hydrocarbons used for fuel include methane (natural gas) and butane (disposable cigarette lighters). Unlike methane vapor that is lighter than air, propane vapor is heavier than air. Unlike liquid butane that will not vaporize at temperatures less than 0°C, liquid propane will vaporize at any temperature above -42°C. A gallon of liquid propane weighs 4.24 pounds and contains 91,650 British thermal units. The auto ignition temperature is 467°C. Propane has a narrow range of flammability when compared to other petroleum products. In order to ignite, the propane/air mix must contain from 2.2 to 9.6 percent propane vapor. Propane and all other hydrocarbon-based fuels must be kept away from open flames and ignition sources. Propane must also be handled with care, transported properly, and stored safely.

Excerpts from a typical MSDS for propane concerning the acute and chronic health hazards are as follows:

> *Inhalation: Oxygen deficient atmospheres may produce rapid breathing, headache, dizziness, visual disturbances, muscular weakness, tremors, narcosis, unconsciousness, and death, depending on concentration and duration of exposure.*
>
> *Eye Contact: This gas is non-irritating, but direct contact with liquefied/pressurized gas or frost particles may produce severe and possibly permanent eye damage from freeze burn.*

Skin Absorption: This material is not expected to be absorbed through the skin.

Skin Irritation: Non-irritating, but solid and liquid forms of this material and pressurized gas can cause freeze burn.

Ingestion: Solid and liquid forms of this material and the pressurized gas can cause freeze burn.

The NIOSH/OSHA recommended exposure limit for propane is 1000 ppm (1800 mg/m^3). This is a time-weighted average concentration for up to a 10-hour workday during a 40-hour workweek. The immediately dangerous to life or health concentration is 2,100 ppm.

<u>Propane Safety</u>

The storage and handling of propane in large quantities is a potentially significant hazard. This requires attention to the engineered features, control and mitigation safeguards, and operating procedures and training for plant personnel. Applicable guidelines, standards, and regulations related to the use of propane are listed below:

- 29 CFR 1910.38 — Employee Emergency Plans and Fire Protection Plans
- 29 CFR 1910.110 — Storage and Handling of Liquefied Petroleum Gases
- 29 CFR 1910.119 — Process Safety Management of Highly Hazardous Chemicals
- 29 CFR 1910.1000 — Air Contaminants
- 40 CFR 68 — Chemical Accident Prevention Provisions
- Pocket Guide to Chemical Hazards — National Institute for Occupational Safety and Health (NIOSH)
- Threshold Limit Values for Chemical Substances — American Conference of Governmental Industrial Hygienists (ACGIH)
- Emergency Response Guidebook — U.S. Department of Transportation

The applicability of standards and regulations are generally triggered by the quantity of propane stored. These quantities are called threshold quantities, and the threshold quantity for propane is 10,000 pounds (40 CFR 68).

The proposed minimum storage quantity for JSF (180,000 gallons or 763,200 pounds) would exceed threshold quantities. In addition to on-site storage, propane must be transported to the plant site to replenish system storage. The use of railcars with a capacity of 33,000 gallons (139,920 pounds) would be the mode of transportation.

<u>Risk Factors</u>

The risk and potential severity of a propane storage or handling accident would be influenced by a number of factors including:

- Design of the propane storage and handling facility including engineered features and safeguards, and the quantity of propane stored.
- Railcar transportation for propane deliveries and the frequency of deliveries.

- Procedures for normal operations.
- Training of operations personnel for normal operations and emergency response.
- Population distribution in the plant vicinity.
- Emergency planning and response procedures.
- Probabilities of events, such as earthquakes and tornadoes, that could initiate a worst-case release.

Engineered Features and Safeguards

Properly engineered features and safeguards as well as adequate operating and maintenance procedures and training should make accidents unlikely and limit their consequences. Adherence to standards such as OSHA 29 CFR 1910.110 can result in safe equipment design. Compliance with 40 CFR 68 and 29 CFR 1910.119 ensures proper hazard assessment, operating procedures, employee training, and emergency planning have been provided.

Propane facilities must be protected against tampering with systems and appurtenances and from accidental collision of vehicles with containers and/or transfer lines. Requirements to prevent such tampering or accidents are specified in the code. The propane facility should have proper lighting, vehicle impact protection, corrosion protection, a perimeter fence, personnel training, and lock-in-place devices to prevent unauthorized use or operation.

The potential for ignition of vapors of propane released in a facility is reduced by eliminating as many ignition sources as possible, designing electrical equipment to reduce or eliminate sparking, and ensuring that during transfer operations known ignition sources are turned off. The ignition source control involves both passive methods as well as active methods. Examples include: Weeds and tall grasses should not be closer than 10 feet from each storage tank; approved, portable, dry chemical fire extinguishers should be provided at the facility; and the prohibition on smoking within the facility premises should be strictly enforced.

The separation distance provisions in National Fire Protection Association 58 are minimum requirements and are intended to buy time in an emergency and to implement appropriate response. The requirements are dependent upon the size of the storage tank. The minimum separation distance from an aboveground 30,000-gallon propane storage tank to buildings and property line is 75 feet.

Adherence to the noted guidelines, standards, and regulations, as well as implementation of the engineered features and safeguards, would additionally reduce the potential for impacts to occur from an accidental release.

4.2 Surface Water Resources

The potential impacts to surface water from the proposed action alternatives for reducing NO_X emissions at JSF can be categorized as construction impacts, operating impacts, or those occurring from nonroutine (emergency) situations. Because of the complexity of the possible wastewater pathways for ammonia to result in impacts, the sections are structured such that there is discussion, where appropriate, of possible pathways and sources of impacts, cause and effect relationships and mitigation identified as needed to ensure insignificance of impacts to surface waters from that particular pathway. Since the water quality criteria for ammonium compounds are written in terms of ammonia nitrogen, the term ammonia nitrogen, represented by the chemical symbol, NH_3-N, will be used to refer to all of the different ammonia-based compounds that might potentially be formed by the reaction of excess unreacted ammonia with other compounds present in flue gases and be subsequently deposited on the fly ash, the APHs, or in the wastewater.

4.2.1 Construction and Operational Impacts for Alternative A – No Action and Alternative B – Boiler Optimization

There would be no impacts to surface water resources for the No Action, Alternative A. For Alternative B, Boiler Optimization, all modifications would take place within the existing powerhouse, and there would be no foreseeable impacts to surface water for either construction or operation.

4.2.2 Construction and Operational Impacts for Alternative D - Low-Dust SCR

4.2.2.1 Construction Impacts

Construction activities for this action alternative involve disturbance of 20 acres or less. Most of the construction activity would occur in the vicinity of the existing powerhouse, with some construction on the east side of the plant for ammonia tanks, ammonia spill retention pond, and propane tanks. All construction activities would be within the existing plant site. Surface runoff that flows to the ash pond is currently permitted. Construction-related runoff may require a storm water construction permit if more than an acre is disturbed. Using appropriate BMPs, all construction activities would be conducted to ensure that waste materials are contained and that no polluting materials are introduced into receiving waters and potential impacts are insignificant.

Portable toilets would be provided for the construction workforce. These toilets would be regularly pumped out and the sewage transported by tanker truck to a publicly owned treatment works accepting pump out.

4.2.2.2 Operational Impacts

Normal operation of a low-dust SCR (Alternative D) would not be expected to result in the deposition of ammonia compounds in the APHs or on fly ash. The only potential for ammonia entering the wastewater stream would be from the accidental release of ammonia from the storage tanks, line leaks, or rupture, and as accumulated from the ammonia blowdown line. The potential for accidental release is discussed in Section 4.1.6 and is considered quite low and insignificant. The amounts of ammonia potentially entering the wastewater streams at JSF from the blowdown line is small and negligible in terms of potential for producing significant environmental effects to surface waters.

4.2.3 Construction and Operational Impacts From Alternatives C (SNCR), E (High-Dust SCR), and F (Combinations)

4.2.3.1 Construction Impacts

Construction impacts under these alternatives would be the same as under Alternative D, except that Alternatives C, E, and F may involve construction of a diffuser (discussed later in this section) on one or more of the wastewater discharge points and rerouting storm water and wastewater flows to one or both of the MCTPs, the ash pond, or the CCW discharge channel within the areas previously disturbed by plant construction. The construction of the diffuser would require an ARAP from the State of Tennessee. Alternative C could also involve construction of urea solution storage tanks, urea dissolution tanks, or solid urea storage warehouses.

4.2.3.2 Operational Impacts

Operation of SNCR, and high-dust SCR would be expected to result in deposition of unreacted (slipped) ammonium compounds on the fly ash being discharged to the wet and dry ash handling systems through the precipitators and in the APHs. Regardless of which of the three alternatives (C, E, or F) were implemented, this deposition in turn would likely result in ammonium compounds entering various components of the wastewater treatment stream from four sources, i.e., (1) when fly ash is wet sluiced to the ash pond, (2) when rainfall mobilizes ammonium compounds on contaminated fly ash on the DFAL by either storm water runoff (surface flow) or infiltration (subsurface flow), (3) when the APHs are washed, and (4) for the SCR options, as condensate from the ammonia blowdown line (Alternative E).

If not properly controlled, the anticipated amounts and concentrations of ammonia nitrogen depositing on fly ash for any of the three alternatives could potentially produce significant impacts to off-site water resources. In addition, with the exception of ammonia condensate in blowdown (# 4 above), the above-identified sources of NH_3-N individually each has the potential to produce significant impacts to surface waters if not controlled and mitigated. These four potential sources, amounts of NH_3-N anticipated to result from each source, their potential total effect, and mitigation measures are summarized below. Ensuring that impacts to off-site surface waters and water resources are insignificant, and that JSF meets existing permit requirements, would involve control of the ammonia-nitrogen compounds through a suite of actions (e.g., use of existing wastewater treatment systems, design features of the proposal, commitment to operational controls and mitigations are all important aspects). As identified for the various sources and alternatives (Section 2.5 Summary of Commitments), some of these actions would be clearly required under all scenarios, while a firm need for others is contingent upon the actual soluble ammonia nitrogen on ash content and NH_3-N leachate concentrations that result and other data to be gained during operational monitoring of the NO_X reduction system(s) chosen (see below).

Selection of environmentally protective and cost-effective methods for controlling ammonia nitrogen is complicated by the fact that available information indicates a wide range for amounts of possible deposition of ammonium compound on fly ash from the NO_X reduction systems under consideration. Published studies indicate considerable variations, and therefore some degree of uncertainty, in likely ammonia compound accumulation on fly ash depending on the ammonia slip rates, the type of coal burned, operating conditions, site-specific equipment configuration, and the particle sizes of the fly ash (Electric Power Research Institute [EPRI], 1998; 2004).

Concentrations of ammonium compounds on fly ash likely to result are, therefore: (1) somewhat uncertain and cannot be absolutely determined until at least test phases of the NO_X reduction systems are operational; (2) but based upon the available studies and information the range have been bounded (see below) for the present analyses of impacts and identification of effective mitigations; and (3) in a step-wise, adaptive approach for controlling ammonia nitrogen, among the mitigations identified in this EA, the specific array of mitigations implemented would be selected to limit impacts of ammonia compounds. This selection would based upon timely evaluation of operational monitoring data as laid out in the monitoring, sampling, and mitigative action plan as discussed in Section 2.5 (Summary of Environmental Commitments) and Appendix B.

Based upon these reports and operational information from TVA facilities operating NO_X reduction equipment, for the purposes of evaluating potential environmental impacts, ammonia concentrations on fly ash ranging from 12.5 to 500 mg/kg were used, as appropriate, in various technical analyses for this EA. This range of ammonia concentrations on fly ash was also used as the basis and bounds for evaluating impacts and identifying mitigation measures appropriate for predicted ammonia compound accumulations on fly ash, such that surface water resources would be protected. Additionally, through the proposed approach of adaptive decision-making based upon monitoring and evaluation, over time, TVA will continue to gain more knowledge about the plant-specific operational characteristics of NO_X reduction technology at JSF, continue to evaluate the performance characteristics of alternatives, and adapt and improve decisions on technology installations and options for mitigating ammonia concentrations consistent with their potential for impacts confirmed with monitoring data.

The following summary of overall mitigation strategy is subsequently followed by a discussion of each of the four areas identified above. This detailed information is provided because of: (1) the multiple pathways for ammonia nitrogen to enter the wastewater streams at JSF and eventually to reach surface waters (i.e., Polly Branch and the Holston River); (2) the potential for each source (except blowdown), if unmitigated, to cause significant impacts to surface waters; and (3) the need to identify and support source-specific mitigations.

4.2.3.3 Cumulative Impacts of Alternatives C, E, and F on Ash Pond and Surface Water Resources

The potential annual loadings of ammonium compounds from the various source pathways into the JSF wastewater treatment system from Alternatives C, E, and F are summarized in Table 4-4. The highest potential loadings of ammonia to the JSF wastewater treatment system from full implementation of these alternatives would result from chronic groundwater leaching of ammonia-contaminated fly ash, and from intermittent APH wash water. Ammonia-contaminated storm water runoff from the dry fly ash stacking area represents a lesser source, as does wet sluicing of fly ash. Ammonia blowdown represents the least source for causing potential impacts to surface waters.

Alternatives A – No Action or B – Boiler Optimization would not produce any of these loadings. Alternative D–Low-Dust SCR would only have the potential to introduce the minor loadings from ammonia blowdown and the possibility for an ammonia spill (as for any alternative under which ammonia is used). Impacts to surface water from boiler optimization or low-dust SCRs would be insignificant even if installed on all four units at JSF.

If unmitigated and uncontrolled, the potential combined impacts to surface waters from either the test on one unit or full four-unit implementation, which results in discharge of ammonia-nitrogen-containing wastewaters from JSF under Alternatives C, E, or F could be significant. Additionally, without mitigation and controls, most of the pathways described have the potential individually to cause violations of existing NPDES permit requirements or failure to meet USEPA Water Quality Criteria protective of aquatic life when the discharges enter the receiving stream. This potential for causing impacts is particularly increased: (1) with increasing soluble NH_3-N concentrations on the fly ash; (2) if accumulations of ammonium compounds in the APHs are in the higher end of the possible range; or (3) with the greater loadings associated with installing SNCR or high-dust SCR technology on more than one unit at JSF.

Because of the wide uncertainty in estimates of ammonia loadings to APH and fly ash, if Alternative C, Install SNCR, were selected, testing that NO_X reduction technology on only one unit and evaluating ammonia compound accumulations in the APH and on fly ash before committing to final design may be an effective wastewater management strategy. However, even for testing and evaluation on one unit, mitigation measures such as a carbon dioxide addition system for pH control on DSN 001, and restoring the capability to capture APH wash water in the MCTP or similar facility and slowly release it to the ash pond would need to be in place to ensure ammonia compound contaminated wastewater does not adversely impact Polly Branch and the Holston River.

If SNCR were selected, the sampling plan contained in Appendix B would be implemented to collect appropriate background information as soon as feasible. If the ammonia content in any of the wastewater, storm water, or ground water samples reaches the trigger points during the test phase, ammonia or urea additions would be turned down or off. The ammonia slip rates, loadings on fly ash, and resulting concentrations in the JSF wastewater treatment system would be measured long enough to analyze any potential impacts from adding additional NO_X reduction technologies to additional units before those systems are designed, specified, or purchased. In addition, results of the monitoring plan would be utilized to select and design the most cost-effective mitigation measures/operational strategies to ensure that there are no significant environmental impacts from implementation of NO_X reduction technologies at JSF. While the NO_X reduction systems are operating, adequate monitoring data would be collected, evaluated, and reported until sufficient data are available to assist in the design of possible future NO_X reduction systems.

4.2.3.4 Impacts of Individual Pathways for Ammonia Entering Wastewater Treatment Systems

Wet Sluicing of Fly Ash During Startup, Shutdown, or Upset Condition

Although most of the fly ash at JSF is now handled dry, the plant retains the ability to wet sluice the fly ash to the bottom ash pond. Wet sluicing still occurs at the plant during unit startup, shutdown, or when the dry handling system is experiencing an upset. Wet sluicing occurs 12-32 times per year and could contribute a substantial “spike” amount of additional ammonia-nitrogen loading to the ash pond for higher concentrations of soluble NH_3-N on the fly ash.

Table 4-4. Potential Ammonia Loads to Ash Pond From Installation of SNCR or High-Dust SCR NO_X Reduction Equipment at JSF

Source of Potential Ammonia	Route	One Unit			Four-Unit Low			Four-Unit High			Notes
		mg/L	pounds /day	pounds /year	mg/L	pounds /day	pounds /year	mg/L	pounds/ day	pounds /year	
APH Wash	-MCTP-ash pond	0.055	3.5	1,300	0.22	14	5,100	1.1	70	25,600	1
APH Wash 1st flush (75% of ammonia)	-MCTP-treatment or disposal	0.04	2.8	950	0.17	11	3,800	0.81	53	19,200	1,6
APH Wash 2nd flush (25% of ammonia)	-MCTP-ash pond	0.01	0.87	320	0.05	3.5	1,300	0.28	18	6,400	1,6
Wet Sluicing Fly Ash (23.2 tons, 22 events per year)	-Ash pond	0.09	1.9	42	0.09	1.9	42	0.88	19	420	2
DFA Leachate Coll. Sys.	-WSP-ash pond	0.05	2.9	1,070	0.18	12	4,300	1.84	120	42,300	3
Improved DFA Leachate Coll. Sys.	-WSP-ash pond	0.18	11	4,200	0.70	46	16,800	6.9	450	166,000	4
Ammonia Blowdown Line	-Drums or MCTP-ash pond	0.01	0.8	270	0.05	3.0	1,080	0.06	3.9	1,440	5
Total NH_3-N entering ash pond existing DFA Leachate System and without segregation of APH wash water		**0.21**	9.1	2682	**0.54**	30.9	10522	**3.88**	212.9	69,760	6
Total NH_3-N entering ash pond improved DFA Leachate System and without segregation of APH wash water		**0.34**	17.2	5812	**1.06**	64.9	23022	**8.94**	542.9	193,460	

Notes:

1. Low estimate one-year operation by EPRI (Paul Chu, EPRI, personal communication, December 6, 2004) guidance; high estimate one year at ABB Environmental Systems study method. Each unit has one APH per year, 0.72 MG each.
2. Low: 50 mg/kg on NH_3 on fly ash; high 500 mg/kg NH_3 (concentrations are based on 8-hour flow of 2.6 MG).
3. Low: 50 mg/kg on NH_3 on fly ash; high 500 mg/kg NH_3. Dry Fly Ash Leachate Collection System flow at 0.013 MGD.
4. Low: 50 mg/kg on NH_3 on fly ash; high 500 mg/kg NH_3. Dry Fly Ash Leachate Collection System flow at 0.051 MGD.
5. Estimated as equivalent to 12 drums per year of 15 percent to 20 percent ammonia by weight would be 1,080 to 1,440 pounds.
6. See discussion for development of APH wash procedures under Section 4.2.3 subheading *Ammonia Accumulation in Air Preheaters (APHs) and Resulting Concentration in APH Wash Water*, and in Appendix B.

The total estimated annual tonnage of fly ash that may be wet sluiced to the ash pond would be 278 to 742 tons. Only fly ash resulting from wet sluicing during a unit shutdown following operation of the NO_X reduction equipment would potentially be contaminated with NH_3-N. Since the NO_X reduction equipment is not operated until the unit stabilizes, fly ash sluicing following unsuccessful unit starts would not be expected to increase NH_3-N loadings on the ash pond. The fly ash would be mixed with the average ash pond flow of 2.6 million gallon water flow per 8-hour shift.

The concentrations of ammonia in DSN 001 that could result from fly ash sluicing (assuming no biodegradation of ammonia compounds occurs in the ash pond) are shown in Table 4-5. As shown, ammonia loadings on the fly ash up to approximately 150 mg/kg could be discharged to the bottom ash pond without exceeding an NH_3-N concentration of 0.29 mg/L, which for Polly Branch (Table 3-5) represents a concentration protective of aquatic life as specified by the USEPA Water Quality Criteria for ammonia under conditions of continuous discharge during periods of high temperature and pH occurring at JSF. As a precautionary measure, a pH control system would be installed on the ash pond to maintain the pH of Outfall DSN001 within anticipated NPDES limits. At pHs below 7.8, even the maximum estimated ammonia-nitrogen concentration of 500 mg/kg would not result in an aquatic toxicity issue.

The values in Table 4-5 are based on single-unit emergency shutdown. Limiting injection of urea or ammonia following an unplanned shutdown would greatly reduce the risk of overloading the ash pond with NH_3-N in the event of an unplanned shutdown of another unit. For planned shutdowns, an additional procedure would be to turn the ammonia or urea injection off at least 8 hours before unit shutdown. This would mean that the fly ash in the hoppers that might be wet sluiced would be at least 80 percent free of ammonia. In addition to the pH control system, TVA would select, as needed, among a combination of other measures (e.g., limiting ammonia or urea injections to other units following an unplanned unit shutdown that resulted in wet sluicing of ammonia-contaminated fly ash, or limiting ammonia on fly ash) to manage and further reduce the potential impacts of wet sluicing fly ash containing ammonia at JSF. If improvements to the dry fly ash handling system at JSF decrease the amounts of fly ash potentially subject to being wet sluiced, the operational plan would be amended as appropriate to maintain compliance with anticipated NPDES NH_3-N limits.

Table 4-5. Potential Ash Pond NH_3 Concentrations from Startup, Shutdown, or Upset Wet Sluicing Discharged From Ash Pond Outfall 001, Without Mitigation

Estimated Soluble Fly Ash Ammonia Content (mg/kg NH_3)	50	62.5	100	150	200	250	300	400	500
Fly ash wet sluiced, pounds of NH_3-N (23.2 tons/event)	1.91	2.39	3.82	5.73	7.64	9.55	11.5	15.3	19.1
Fly ash wet sluiced, ash pond (Outfall 001) effluent NH_3-N (23.2 tons/event)	0.09	0.11	0.18	0.26	0.35	0.44	0.53	0.70	0.88

Management of Potential Ammonia Nitrogen Loadings to Surface Waters From the Dry Fly Ash Landfill (DFAL) Area

Two potential pathways exist for ammonium compounds deposited on the fly ash stored in the DFAL to enter surface waters. The first pathway would be by surface flow: ammonium compounds in the surface layer of exposed fly ash could be mobilized by storm water and transported above ground with the storm water runoff. The second pathway would be by subsurface flow: Rainwater that infiltrates the DFAL instead of running off would leach soluble ammonium compounds, then slowly transport them down the DFAL toward the groundwater. Potential groundwater impacts from ammonia-compound contaminated leachate will be discussed in Section 4.4. As one of the potential impacts from rainwater infiltration and leaching of ammonia-contaminated fly ash in the DFAL is a surface water impact on the Holston River, it will be discussed following the discussion of potential surface transport of ammonium compounds by storm water runoff.

Management of Potential Ammonia Nitrogen Loadings to Surface Water from Storm Water Mobilization and Transport of Ammonium Compounds on Fly Ash in DFAL

During a rainfall event sufficient to yield runoff from the DFAL area, a portion of the ammonia compounds accumulated on the dry fly ash would be expected to dissolve and be transported with the runoff.

Storm water runoff from the dry fly ash landfill flows into a sediment pond, traverses a half-mile-long drainage ditch where Wetland JSFW01 has formed, and then enters the DFAL stilling pond. Currently, this pond does not overflow except during heavy or extended rain periods. Operating NO_X emissions reduction equipment would not change this situation; most storm water runoff would simply remain in the pond evaporating, and due to the long residence times in the DSS pond, biodegradation of ammonia would be highly probable. On infrequent occasions, the pond does overflow through Outfall F-16A. This outfall discharges to Polly Branch and ultimately to the Holston River. Because of the intermittent nature of discharges from Outfall F-16A, the most applicable ammonia-nitrogen criterion deemed protective of aquatic life (Table 3-5) is 0.72 mg/L, or 2.5 times the CCC (see Section 3.2.2).

To evaluate the potential for operation of SNCR or high-dust SCR to impact surface waters by causing ammonia contaminated storm water runoff from the dry fly ash stack, daily runoff was computed using the USEPA HELP model for a relatively wet five-year period (actual rainfall events equivalent to the actual rainfall that fell from 1993 to 1997). Transfer of ammonia from exposed ash to surface runoff was modeled using the physically based soil diffusion and runoff transport model of Wallach et al. (1988). It was assumed that the exposed surface area of the stack had just reached maximum capacity before being covered. As discussed earlier, the estimated concentrations of ammonia on the fly ash used for the model ranged from 12.5 to 500 mg of ammonia nitrogen per kg of fly ash. Modeling assumed a maximum active ash handling area of 10 acres. Restricting the amount of dry fly ash exposed to 10 acres or less is an important factor in limiting the amount of ammonia contaminated ash available to be leached by rainfall, i.e., the greater the surface area of exposed dry fly ash, the more ammonia that would be available to be dissolved by rain during a rain event.

For a one-unit test of SNCR technology with no more than 50 mg/kg NH_3-N on ash (12.5 mg/kg when averaged with ash from the other three units), predicted maximum concentrations of NH_3-N in runoff discharges (i.e., 0.6 mg/L) that do intermittently occur from Outfall F-16A would be under the applicable water quality criterion for ammonia that is deemed protective of aquatic life (i.e., 0.72 mg/L). Predicted impacts of the one-unit test to surface waters and aquatic life would, therefore, be insignificant. If the average soluble NH_3-N on ash concentration for all four units of SNCR or SCR technology were to be maintained at or below the 12.5 mg/kg level, impacts from installation of SNCRs or high-dust SCR on all four units would also be insignificant. However, as this concentration of ammonia on ash would correlate to a low ammonia slip rate or indicate the ammonia slip was being discharged along another pathway to either the water or air, this latter situation would be highly unlikely for four-unit installation, and as discussed below, mitigation(s) would be necessary.

For the 1-unit test, TVA would confine the ammoniated ash in a designated area of the DFAL and place a daily cover consisting of a minimum of 6 (six) inches of non-ammoniated ash or other suitable material to reduce potential storm water runoff. TVA would monitor parameters (Appendix B) with protocols appropriate to determine NH_3-N on ash content, to confirm the anticipated concentrations, and to identify if, or which additional mitigative actions discussed below would need to be taken either during the one-unit test phase or with a decision for full four-unit installation (see Section 2.5 Summary of Environmental Commitments).

With implementation of the daily cover on the ammoniated ash of the DFAL for the testing period, it is not expected that concentrations of ammonia in the intermittent discharges from the DFAL Stilling Pond will be a problem. However, if storm water monitoring of the effluent to the DFAL Stilling Pond indicates an ammonia nitrogen concentration in excess of 0.54 mg/L, then the discharge from F-16A shall be monitored on a daily basis until the effluent levels return to 0.54 mg/L. If the ammonia nitrogen concentration at the discharge reaches the 0.54 mg/L level, then one or a combination of the following appropriate actions to ensure that the DFAL Stilling Pond discharge does not exceed 0.72 mg/L would be implemented. For the event Polly Branch would also be sampled for pH and temperature and ammonia nitrogen to calculate the applicable toxicity level for ammonia associated with streamflow. Mitigation options include:

- Reduce or cease operation of SNCR or high dust SCR equipment.
- Design and implement measures to enhance removal of ammonia compounds in the sediment pond, Wetland JSFW01, and the DFAL Stilling Pond; or
- Design and implement modifications to route a percentage of the storm water runoff to the WSP for treatment along with groundwater leachate; or
- Design and reroute discharge from Outfall F-16A through one or two diffuser pipes (see Appendix F for preliminary design) to the Holston River, such that the discharge would not exceed ambient water quality criteria for ammonia, or the appropriate toxicity levels indicated in the earlier discussion of WET limits in Section 3.2 of this EA; or

For the full 4-unit installation of SNCRs or SCRs, it is anticipated that TVA would need to install a diffuser unless monitoring data demonstrate that it is not needed, or other of the mitigation measures were adequate to ensure that discharges from Outfall F-16A meet EPA water quality criteria protective of aquatic life.

Any of the above options would maintain ammonia concentrations at levels that would produce only insignificant impacts to surface water resources or aquatic biota. Additionally, TVA is continuing to explore efficacy and cost effectiveness of other potential mitigation measures such as pumping the DFAL stilling pond to the ash pond; pumping the DFAL stilling pond to the CCW discharge; installing a pH control system on the DFAL stilling pond; installing baffles on the DFAL stilling pond to ensure good mixing with the free water volume of the pond; augmenting natural biodegradation of ammonia in the DFAL stilling pond; installation of conventional wastewater treatment technology, such as (but not limited to) a trickle filter, ammonia stripping tower, recirculating sand filters, or an activated sludge package plant. If upon further analyses, one or a combination of these technologies becomes feasible and determined to be equally protective of water resources (i.e., maintains discharges so that they meet the ammonia concentration criteria protective of aquatic life criteria that were identified in this EA), TVA will conduct the appropriate level of environmental review prior to implementation.

Management of Potential Ammonia Nitrogen Loadings to Surface Water from Rainwater Infiltration, Leaching, and Subsurface Seepage to the Holston River of Ammonium Compounds on Fly Ash in DFAL

As described in Section 3.3 Groundwater Resources, and illustrated in Figure 3-2, groundwater flow patterns at the JSF plant site are generally northwestward toward the Holston River. Due to these groundwater flow patterns, rainfall which infiltrates the DFAL would eventually be transported northward by shallow groundwater to the Holston River. As described in Section 4.3.2 Groundwater Resources, computer models were used to evaluate subsurface flow and leaching of ammonium compounds in the DFAL, which might be expected to result from the operation of Alternatives C, E, and F.

Modeling results indicate that, even at low NH_3-N concentrations on ash, during a one-year test, a peak flow-weighted average aqueous NH_3-N concentration of 7.6 mg/L in groundwater leachate would enter the Holston River. This corresponds to a peak NH_3-N loading to the river of 0.78 kg/day based on a total seepage flux of 0.959 MGD (3630 ft^3/day). Under these conditions, leachate seepage would eventually occur along approximately 1,250 feet of river frontage opposite the stack. A plume, varying in maximum width of 10 to 20 feet, would extend off the shoreline along up to 1,255 feet of the 3,500 feet of TVA-owned plant property before the NH_3-N concentration of the plume would drop below 0.41 mg/L NH_3-N. This is the concentration level estimated by the USEPA 1999 Water Quality Criteria for ammonia as protective of aquatic organisms for extreme high temperature conditions encountered at Holston River in proximity to JSF. This means that the plume would dissipate approximately one-third of the way between the north end of the DFAL and the confluence of Polly Branch and the Holston River. This estimated ammonia-nitrogen load to the Holston River is well within the assimilative capacity of the river, and the computer modeling results indicate that the localized toxicity to aquatic organisms would be insignificant since the plume of concentrations higher than the applicable water quality criteria protective of aquatic life, 0.41 mg/L NH_3-N (Section 3.2.2, Table 3-5), would only cover a small area in the immediate vicinity of the plant and would only affect the surface layer of water, not the mid and lower depths. Based upon the modeling for a one-unit, one-year operational SNCR test at JSF, such a demonstration would not be expected to produce significant adverse environmental impacts. As discussed below, in section 2.5, and in the monitoring plan in Appendix B, with the commitments to be implemented, the estimated peak NH_3-N loading to the river of 0.78 kg/day based on a total seepage flux of 3630 ft^3/day would not be expected to occur and the impact of ammoniated leachate seepage to surface water quality of the Holston River from the proposed one year, one unit SNCR test would be insignificant. However, because of the noted uncertainty regarding the actual levels to be encountered once operational, a robust monitoring and evaluation plan for stepwise decision-making on if, or what mitigation measures need implementing, has been established (Section 2.5 and Appendix B).

Scaling up predicted impacts of a one-year SNCR test of one unit to long-term implementation of SNCR on all four units indicates that without mitigation NH_3-N levels in leachate seepage entering the river might be high enough to cause adverse impacts. By the same token, uncertainty regarding chemical and biological transformation of NH_3-N during transport, which were not unaccounted for in the previously described analysis but which would tend to attenuate NH_3-N, leaves open the possibility that actual NH_3-N concentrations could be at acceptable levels by the time leachate enters river even without mitigation. A rigorous groundwater monitoring program would be initiated prior to the one-year test to allow early detection of adverse NH_3-N trends and implementation of a mitigation program to prevent aquatic impacts to the river (see Appendix B). An NH_3-N action limit of 2.09 mg/L (corresponding to the CMC aquatic limit for worst-case river temperature and pH) would be applied at designated shallow observation and control wells located immediately downgradient of ammonia-contaminated fly ash disposal area and approximately 300-400 feet from the river. If the action limit were exceeded at any of the observation or monitoring wells, a groundwater remediation system would be installed within one year to prevent groundwater entering the river from exceeding the NH_3-N CMC.

One additional pathway that does not add to, but would divert ammonia along a different pathway that allows for consideration of additional options for mitigation is as follows. As mentioned earlier, portions (exact extent unknown) of the DFAL area are underlain by a collection system which pumps the collected mixture of groundwater and leachate (average flow = 0.013 MGD) to the WSP (IMP 008), which then discharges to the bottom ash pond. For the one-unit test installation, the estimated concentration of ammonia nitrogen in groundwater leachate, which would result from operating SNCR or high-dust SCR NO_X reduction technology with 50 mg/kg on the fly ash, would range from 1.7 to 27 mg/L NH_3–N. Using the higher number and assuming no removal mechanisms in the WSP, about 2.9 pounds/day of ammonia nitrogen would be added to the bottom ash pond, with a resulting effluent concentration from this source of 0.045 mg/L. This concentration alone would have insignificant impacts on the receiving stream.

Expansion of the DFA Leachate Collection System to prevent additional leachate from reaching the Holston River could increase the flow to 0.051 MGD, but the ammonia-nitrogen concentration should remain at 27 mg/L or below. The expanded DFA Landfill Collection System would add between 11 and 450 pounds per day of NH_3-N to the bottom ash pond, with a resulting influent concentration from this source alone of 0.18 to 6.9 mg/L NH_3-N. The higher concentration, representative of four-unit implementation and 500 mg/kg NH_3-N on the fly ash would probably require the described mitigative treatments in the WSP or the ash pond, or some other mitigation measure to ensure compliance with anticipated NPDES limits. The design for enhancing the DFAL Leachate Collection System, if TVA were to elect this mitigation, would incorporate appropriate treatment for anticipated leachate volumes and NH_3-N concentrations collected.

For the proposed one-unit test, the anticipated NH_3-N loading to the ash pond from the existing DFAL leachate collection system would not be expected to exceed the anticipated target value of 0.29 mg/L of ammonia nitrogen for DSN 001, even if no loss or degradation of NH_3-N occurred in the WSP or the ash pond and even if APH wash water metering into the ash pond were allowed to continue following an emergency unit shutdown that resulted in the wet sluicing of fly ash. Therefore, for the proposed one-unit test, NH_3-N contaminated water from the existing DFAL Leachate collection system would have an insignificant effect on DSN 001, Polly Branch, and the Holston River.

Mitigation Measures for Management of Potential Ammonia Nitrogen Loadings to Surface Water From Rainwater Infiltration, Leaching, and Subsurface Seepage to the Holston River of Ammonium Compounds on Fly Ash in DFAL (Alternatives C, E, or F)

If evaluation of the monitoring data indicates the need, prior to implementation of a 4-unit installation of SNCR or high-dust SCR technology, TVA would select among the following mitigation measures either alone or in combination as necessary to protect groundwater and surface water resources.

<u>Interim Cap and Underdrain System for Capture of Ammonia Contaminated Leachate</u>

Under the present ash management plan for JSF, the ammonia-contaminated fly ash would be added to the top of the existing fly ash landfill at JSF. A system utilizing a low permeability interim cap or landfill liner and an underdrain system could be designed and built to capture and divert ammonia-contaminated leachate from the top of the dry fly ash stack to the wastewater treatment systems at JSF. Such a system could prevent ammonia-contaminated leachate from reaching the groundwater. Since the interim cap or liner would only cover the top 63 acres of the dry fly ash stack, the volume of ammonia-contaminated leachate would be less than if the leachate were allowed to migrate farther down the dry fly ash stack before being collected for treatment. Table 4-6 shows the anticipated volume of contaminated groundwater leachate that might be collected from an interim cap and underdrain system and the range of potential ammonia-nitrogen concentrations that might be expected given a range of 12.5 to 500 mg/kg ammonia on the fly ash. Under an action plan to be incorporated in the preliminary design for a one-unit SNCR test, a variation on this mitigation measure whereby the interim cap is installed on top of approximately 10 acres of ammonia-compound-contaminated fly ash might be selected. Since installation of a cap and drain system over a lesser area would result in less loading to the JSF wastewater treatment systems, the impact of this variation on the plant wastewater treatment systems would also be insignificant.

<u>Improve Existing Leachate Collection System and Wastewater Treatment Systems to Capture and Treat all Ammonia-Contaminated Groundwater Leachate</u>

As discussed in Chapter 3, the existing leachate collection system was not designed to capture leachate flowing into the river, but rather to intercept effluent from two existing tile drains. Borehole flow meter testing has shown most groundwater flow occurs close to the top of the rock (approximate elevation 1,058). Depending on results of evaluation of subsurface conditions and project economics, either a series of French drains or horizontal wells could be designed and installed between the bottom (foot) of the dry fly ash landfill and the river. This system would capture groundwater flow, which would then be pumped to the plant's wastewater treatment system. Engineering design would have to account for dike stability concerns, since the dry fly ash landfill is located on top of a former ash pond. The design would also have to account for the anticipated efficiency of the enhanced leachate collection system and incorporate additional mitigation measures in the event that the projected collection efficiency was not adequate to divert enough of the contaminated leachate away from the Holston River. The second line in Table 4-6 gives the range of flows and estimated ammonia-nitrogen concentrations in ash leachate, which could potentially be added to the JSF wastewater treatment system if this mitigation option were chosen.

Reduce Leachable NH_3 Compounds in Fly Ash to Acceptable Levels

This could be accomplished by fly ash beneficiation to remove ammonia from the fly ash, which will be described in Section 4.5. For Alternative E, High-Dust SCR, or Alternative F (if it were a combination of Alternatives B and E), decreasing leachable NH_3 compounds in fly ash could be accomplished by operating high-dust SCRs as described below.

Operate High-Dust SCR at Low Ammonia Slip

This mitigation measure would only apply to Alternative E, High-Dust SCR, or Alternative F if it were a combination of Alternatives B and E. TVA and other industry operating experience indicates that high-dust SCRs can be operated at low ammonia slip especially when the catalysts are new. Lack of excess ammonia to deposit on the fly ash could eliminate the problem of ammonia-contaminated groundwater leachate for the first few years of operation, allowing completion of other possible mitigation measures to be deferred until the time the ammonia slip rates might be expected to increase due to catalyst age.

Table 4-6. Estimated Volumes and Ammonia Nitrogen Concentration Ranges for Groundwater Mitigation Options for Alternatives C, E, or F

Groundwater Mitigation Option	Potential Volume of Contaminated Groundwater Leachate Requiring Treatment		Range of Estimated NH_3-N Concentrations in Groundwater Leachate	
	Drought Cubic Feet per Day	Average Cubic Feet Day	Ash NH_3 = 12.5 mg/kg mg/L NH_3-N	Ash NH_3 = 500 mg/kg mg/L NH_3-N
Install interim cap (or liner) with underdrain leachate collection system	3230	3840	31	1250
Improve existing leachate collection system	5450	6810	27	1068
Reduce leachable NH_3 compounds in fly ash to acceptable levels	0	0	=2.09 mg/L NH_3-N (1)	

(1) This concentration is the CMC concentration for the Holston River in the vicinity of the DFAL for extreme weather conditions. .

Ammonia Accumulation in Air Preheaters (APHs) and Resulting Concentrations in APH Wash Water

The varying ammonia slip rates could result in accumulation of sufficient mass of ammonium compounds in the APHs subsequently to yield high concentrations of NH_3-N in APH wash water. The APHs for each unit are presently washed once every two to three years; accumulations of ammonium compounds in the APHs could possibly require washing more frequently. Presently APH wash water is routed directly to the ash pond. Estimates indicate the annual amount of ammonia nitrogen that could accumulate in the two APHs per unit would be between about 1,200 and 6,400 pounds. Even at the lowest probable accumulation of ammonium compounds in the APH for a one-unit test (i.e., 1,200 pounds NH_3-N) without mitigation, the predicted resulting concentrations of ammonia nitrogen in the ash pond would likely result in intermittent failure of the ash pond discharges to meet USEPA Water Quality Criteria for Ammonia (USEPA 1999) in Polly Branch, the receiving stream for ash pond discharges. ,

This situation requires that a strategy for mitigating potential surface water impacts from APH washes be in place prior to even a one-unit test or operation of SNCR or high-dust SCR. With implementation of any one of the six mitigation strategies for managing APH washes described below, the concentrations of ammonia in discharges would be reduced to the point where effects to surface water quality or aquatic ecology would be insignificant. The five effective mitigation options (in addition to pH control), per an operational plan to be developed with selection of an option, are:

(1) Capturing APH wash water into the MCTP, then slowly releasing ammonia-contaminated APH wash water from the MCTP to the ash pond per an operational plan to maintain ash pond discharges within the USEPA Water Quality Criteria for Ammonia.

(2) APH wash water mitigation by capturing and treating the assumed, more highly contaminated first flush plus slowly releasing the less-concentrated APH wash water to the ash pond.

(3) Capturing the APH wash water in the MCTP then staged pumping of the MCTP to the CCW.

(4) Capturing the APH wash water in the MCTP then pH adjustment and air stripping ammonia followed by staged release to the ash pond or the CCW.

(5) Designing, installing, and operating equipment at the MCTP to facilitate reduction of ammonia concentrations by nitrification followed by staged release to the ash pond or CCW. This would mitigate ammonia contamination in APH wash water such that expected NPDES permit requirements would be met, aquatic life criteria for ammonia would not be exceeded, and environmental impacts would be insignificant.

In addition to this suite of actions, TVA would continue to refine mitigation options as more process knowledge is gained through the monitoring effort and, and TVA may elect to implement other or additional options that are documented to be equally or more protective.

APH wash water mitigation Options 1 and 3 may not require pH control on the ash pond effluent if the APH ammonia loadings are at the low end of the range. However, even relatively low ammonia nitrogen concentrations in the ash pond might promote algal growth during warm weather. This potential algal growth could remove dissolved carbon dioxide from the water resulting in greatly increased pH. For this reason, installation of pH control on the ash pond effluent would ensure compliance with current or anticipated NPDES limits.

If Action Alternative C, E, or F were selected, TVA would either select one of these six alternative mitigations for APH wash water, or in the event that another equally effective method should be identified for implementation, conduct the appropriate environmental review on the new mitigation option(s) at that time.

Management of Ammonia Condensate From Ammonia Vapor Supply Lines (Applicable to Alternatives D, E, and F)

The SCR alternatives involving use or potential use of ammonia could generate a small waste stream of condensed ammonia and water vapor. Formation of ammonia-contaminated condensate in ammonia vapor supply lines to the SCRs has occurred at other TVA facilities. Quantities generated were usually relatively small; several months' accumulation could in theory be collected in a 55-gallon drum. TVA would either route the ammonia condensate line to the ash pond either directly or by way of the MCTP; have the collected condensate hauled away by a waste disposal contractor; or have the collected condensate used as fertilizer. Excessive ammonia blowdown line flow may be indicative of other operating problems, such as improper ammonia feed rate, so procedures may need to be modified to ensure appropriate corrective actions are taken if ammonia blowdown line flow increases are noted. Properly mitigated, generation of ammonia blowdown would produce negligible, insignificant impacts to the wastewater treatment systems or on surface waters.

Potential Surface Water Impacts From Nonroutine (Emergency) Situation – Alternatives C, D, E, and F

SNCR, low-dust SCR, high-dust SCR, and Alternative F, which includes combinations of the different technologies, may all involve use of anhydrous ammonia. A potential pathway for ammonia to be released to surface water would be a failure of an ammonia tank or piping or a spill from an ammonia truck or tank car unloading operation. In order to contain and control an accidental spill of ammonia, the area around the ammonia unloading and storage area would be configured to drain to a spill retention basin. The spill retention basin would be sized to retain the contents of an entire tank, the anticipated water flow from the fogging system, and the rainfall from the 10-year, 24-hour rain event. The spill retention basin at a minimum would be lined with compacted in-situ earth or low permeability clay liner. Following pH testing, spilled material would either be hauled away by a waste disposal contractor, neutralized and recycled to a fertilizer dealer, pumped to an MCTP for treatment or slow release, or slowly released directly to the ash pond at a rate sufficient to maintain compliance with NPDES permit limits. The plant's SWPPP would be revised as necessary to include sampling and pumping after routine rain events.

Alternative C, Install SNCR, includes the option of using a urea solution instead of ammonia for injection into the process. Urea solutions are less hazardous than anhydrous ammonia, but a large urea solution spill could be a significant impact on surface waters, with potential to result in a fish kill from dissolved oxygen depletion. For this reason, secondary containment lined at a minimum with compacted in-situ earth or low permeability clay liner would be designed to hold the contents of the largest urea solution tank and the 10-year, 24-hour rain event. The plant's SWPPP would be revised as necessary to include sampling and pumping after rain events. In the event of a urea solution tank failure, the contents of the secondary containment basin would be recovered for use as fertilizer, hauled away by a waste disposal contractor, or slowly pumped to one of the wastewater treatment ponds (e.g. WSP, MCTPs, or ash pond) at a rate sufficient to maintain compliance with NPDES permit limits.

4.3 Groundwater Resources

4.3.1 Construction Impacts

4.3.1.1 Alternative A - No Action or Alternative B - Optimize Boilers on Units 1 Through 4

There would be no groundwater resource impacts associated with construction of either of these alternatives.

4.3.1.2 Alternative C – Install SNCR on Units 1 Through 4

Construction activities potentially affecting groundwater resources would be limited to excavations associated with SNCR process structures, equipment, and subsurface pipelines. Excavations would not exceed about 5 feet in depth and would not be expected to encounter groundwater. Groundwater control, if needed, would be limited to short-term dewatering from excavations. The overall impact of construction of an SNCR system on groundwater resources would be negligible.

4.3.1.3 Alternatives D through G – Install Low-Dust SCR, High-Dust SCR, or Combinations of Alternatives Sequentially on Units 1 Through 4

Construction impacts of these alternatives on groundwater would be similar to Alternative C.

4.3.2 Operational Impacts from Alternative A – No Action, Alternative B – Boiler Optimization, and Alternative D – Low Dust SCR

4.3.2.1 Alternative A - No Action or Alternative B - Optimize Boilers on Units 1 Through 4

There would be no groundwater resource impacts beyond the current local impact to shallow groundwater quality beneath the ash disposal and coal storage areas.

4.3.2.2 Alternative D - Low-Dust SCR on Units 1 Through 4

Ash produced by the low-dust SCR process would contain no residual ammonia and would be similar in composition to the ash currently generated by JSF. Therefore, the groundwater impacts of disposing of low-dust SCR ash in the proposed dry stacking facility would, like Alternative A, have no significant groundwater impacts.

4.3.3 Operational Impacts from Alternative C – Install SNCR on Units 1 through 4, Alternative E – Install High Dust SCR on Units 1 through 4, and Alternative F – Combinations of Alternatives Sequentially on Units 1 through 4

4.3.3.1 Alternative C - Install SNCR on Units 1 Through 4

Since SNCR would operate at a constant ammonia slip rate, fly ash produced would be expected to contain approximately the same ammonia content. High Dust SCR would be expected to produce fly ash with less ammonia on the ash when the catalysts are new with increases as the catalyst ages. Dry ammoniated fly ash produced by the SNCR or High Dust SCR systems would be stacked directly on top of existing ash in the dry stacking area.

The total area proposed for future dry stacking is approximately 63 acres. This area generally includes the region encompassed by the 1130 ft elevation contour of the existing dry stack. No more than approximately 10 acres of dry ash would be exposed at any time during the stacking process. Six to twelve inches of interim cover in compliance with the facility operations plan would be applied to inactive disposal areas. At current rates of fly ash production and marketing, the disposal area would reach maximum capacity after about 10 years. The ash stacking facility would then be closed. Final cover would include (in ascending order) 1 ft of compacted soil cover, a geosynthetic clay liner, a geotextile drainage layer, followed by a 1-ft layer of vegetated topsoil (Tribble & Richardson, Inc. and Law Engineering, Inc, May 1997).

There would be no potential for contamination of off-site water supply wells due to ammoniated ash leachate seepage from the dry stack. Groundwater flow patterns in the stack vicinity suggest that ammonia-affected leachate entering the groundwater system below the base of the dry ash stack would be transported northward by shallow groundwater to the Holston River (Figure 3-2). All leachate seepage would discharge into the river through the riverbed along river frontage opposite the dry stack. No impacts to existing or future groundwater users in the site vicinity would occur since all property downgradient of the DFAL lies within the plant reservation. Furthermore, there would be no opportunity for future development of large production wells in the vicinity of the plant reservation that could alter existing groundwater gradients and induce off-site movement of contaminated groundwater. Bedrock in the site vicinity is comprised of the Sevier Shale, which is not an aquifer, and is capable of supporting only small domestic water-supply wells.

In order to quantify ammoniated leachate seepage to the Holston River, and therefore impacts to surface waters, numerical simulations of the subsurface transport of ammonia from dry stack to the river were performed for a one-year SNCR demonstration of one unit. The analyses assumed fly ash produced during the demonstration would be deposited over a 10-acre area within the existing dry stack. In general, downward transport of NH_3-N produced by infiltrating rainfall through partially-saturated ash deposits to the water table was simulated with the HYDRUS-1D model (Simunek et al., 2005). The predicted time-series output of leachate rate and NH_3-H concentration from HYDRUS-1D were subsequently incorporated as a boundary condition into a three dimensional groundwater model previously developed for a portion of the JSF reservation which includes the ash dry stack (Boggs and Reeves, 1998). The 3D model simulated transport and dispersion of NH_3-N with ambient groundwater flowing beneath the stack toward to the Holston River. Further discussion of the modeling methodology and input data are provided in Appendix C.

With one unit having a 50 mg/kg NH_3 with non-ammoniated ash from three units with no fly ash marketing, a one-year test would result in a peak flow-weighted average NH_3-N concentration of 7.6 mg/L entering the Holston River. This corresponds to a peak NH_3-N loading to the river of 0.78 kg/day based on a total seepage flux of 3630 ft^3/day. As discussed in Section 4.2, with the commitments to be implemented, even this level of loading would not be expected to occur and the impact of ammoniated leachate seepage to surface water quality of the Holston River from the proposed one year, one unit SNCR test would be insignificant. However, because of the noted uncertainty regarding the actual levels to be encountered once operational, a robust monitoring and evaluation plan for stepwise decision-making on if, or what, mitigation measures need implemented, has been established (Section 2.5 and Appendix B).

Scaling up predicted impacts of a one-year SNCR test of one unit to long-term implementation of SNCR on all four units indicates that without mitigation, NH_3-N levels in leachate seepage entering the river might be high enough to cause adverse impacts. By the same token, uncertainty regarding chemical and biological transformation of NH_3-N during transport, which were not unaccounted for in the previously described analysis but which would tend to attenuate NH_3-N, leaves open the possibly that actual NH_3-N concentrations could be low and within acceptable limits by the time leachate enters river even without mitigation. A rigorous groundwater monitoring program would be initiated prior to the one-year test to allow early detection of adverse NH_3-N trends and implementation of a mitigation program to prevent aquatic impacts to the river (see Appendix B). An NH_3-N action limit of 2.09 mg/L (corresponding to the CMC aquatic limit for worst-case river temperature and pH) would be applied at designated shallow observation and control wells located immediately downgradient of ammoniated ash disposal area and inshore approximately 300-400 feet from the river. If NH_3-N concentrations equal to or in excess of the action limit were detected at any of the observation and control wells, a groundwater remediation system would be installed within one year to prevent groundwater entering the river from exceeding the NH_3-N CMC. Possible mitigation alternatives to protect river water quality are described in Section 4.2.

4.3.3.2 Alternative E - High-Dust SCR on Units 1 Through 4

Ash produced by the high-dust SCR process would be expected to contain ammonia compounds similar to ash produced by the SNCR processes. Consequently, potential groundwater impacts associated with this alternative would be similar to Alternative C. Since a high-dust SCR may operate at extremely low ammonia slip rates when the catalysts are new, Alternative E may be less likely to result in ammonia compounds in groundwater exceeding action levels.

4.3.3.3 Alternative F - Combinations of Alternatives B Through E

Groundwater impacts associated with any combinations involving Alternative C or E would be similar to those impacts described for Alternative C. The combination of Alternatives B and D would, like Alternative A, have no significant groundwater impacts.

4.4 Floodplains and Flood Risk

4.4.1 Alternative A – No Action and Alternative B – Boiler Optimization

Under Alternative A, No Action, and Alternative B, Boiler Optimization, there would be no impacts to the 100-year floodplain in this area.

4.4.2 Alternatives C, D, E, and F

Construction of the remaining alternative systems for NO_X emission reduction (Alternatives C through F) would not involve construction within the 100-year floodplain, and all components of the system, including any ammonia storage tanks, would be located outside the 500-year floodplain. Therefore, this portion of the project would comply with EO 11988. Under Alternatives C through F, some road and railroad construction and/or modifications could be required. This work would not involve construction within the 100-year floodplain. For Alternatives C, E, and F, an underground pipeline and outfall would be constructed within the 100-year floodplain. Minor alterations to existing outfalls for storm water detention ponds may also be necessary for Alternatives C, D, E, and F. For compliance with EO 11988, an underground pipeline and outfall and alterations to other outfall piping would be considered to be repetitive actions in the floodplain that would not result in adverse floodplain impacts because the area would be returned to pre-construction conditions after completion of the project. However, to ensure compliance with EO 11988, if mitigation measures involving construction of a diffuser or other alterations to outfalls were selected, TVA would not store any materials subject to flood damage within the 100-year floodplain.

4.5 Coal Combustion Byproduct Generation, Marketing, and Handling

4.5.1 Alternative A – No Action

For the No Action Alternative, fly ash and bottom ash marketing and handling would be expected to continue as under present conditions with no anticipated impacts.

4.5.2 Alternative B – Boiler Optimization

Alternative B, Boiler Optimization for NO_X Removal, could cause the unburned carbon to increase in the fly ash. Unburned carbon is also detrimental to fly ash marketing. Levels above 4 percent unburned carbon (measured as LOI) in fly ash would not be marketable. If current fly ash marketing projections of 60,000-100,000 tons per year can be maintained, the life of the dry fly ash stacking area would be extended from its original five-year planned life to at least seven years, or through 2011. If marketing cannot be maintained at these levels, the capacity of the dry fly ash stacking area would be exhausted by about 2009. The existing area would have to be closed. If a new dry fly ash stacking area were required, it would need to be permitted and developed at least three years prior to that time. That action would undergo environmental review at the appropriate time.

4.5.3 Alternatives C and E – SNCR and High-Dust SCR, and F - Combinations of Alternatives B through E

Alternatives C, E, and F, could impact fly ash marketing to a greater or lesser extent, depending on the ammonia concentration in the ash. As described earlier, considerable variation in the range of ammonia compound accumulations on the fly ash could occur during operations of SNCR or high-dust SCR, depending on the ammonia slip rates, the type of coal burned, operating conditions, site-specific equipment configuration, and the particle sizes of the fly ash (EPRI, 1998; 2004).

During operation of SNCR (Alternatives C or F), some amount of constant ammonia slip would be expected. This would be expected to result in ammonia deposition on the fly ash. During operation of high-dust SCR (Alternative E), ammonia slip would be expected to increase as the catalyst ages. Most of the anticipated ammonia slip is expected to be adsorbed on the fly ash in the form of ammonium bisulfate, which tends to be a “sticky” compound. Some of this contaminated ash would adhere to the APHs where it would be removed periodically by washing with water. Most of the rest of the ammoniated ash would be removed in the ESPs and collected dry in hoppers for pneumatic transport to the dry fly ash silo. For a discussion of the potential impacts and mitigation measures for handling ammoniated ash, see 4.2 Surface Water and 4.3 Groundwater.

If the dry fly ash collection system is bypassed, ammoniated fly ash would be sluiced to the bottom ash pond where the ammonia would dissolve into the sluice water. The concentration of the ammonia in the sluice water would depend upon the amount of fly ash sluiced, the concentration of ammonia on the fly ash, and the volume of water in the pond.

If concentrations of ammonia exceed 100 mg/kg ammonia in the dry fly ash, JSF fly ash marketing would be adversely impacted. Variability of ammonia concentrations in the fly ash can be as detrimental to marketing as high levels—for example, if the concentration fluctuates from 50 mg/kg one week to higher or lower levels the following week and is generally inconsistent, customers may be reluctant to commit to using this source.

If current fly ash marketing projections of 60,000-100,000 tons per year can be maintained, the life of the dry fly ash stacking area would be extended from its original five-year planned life to at least six years, or through 2011. If marketing cannot be maintained at these levels, the capacity of the dry fly ash stacking area would be exhausted by about 2009. The existing area would have to be closed. If a new dry fly ash stacking area is required, it would need to be permitted and developed at least three years prior to that time. That action would undergo environmental review at the appropriate time.

4.5.4 Alternative D – Low-Dust SCR

Action Alternative D would not result in ammonia deposition on the fly ash. If current fly ash marketing projections of 60,000-100,000 tons per year can be maintained, the life of the dry fly ash stacking area would be extended from its original five-year planned life to at least six years, or through 2011.

4.5.5 Possible Impacts on Bottom Ash Handling

Installation of any of the action alternatives for NO_X emissions reduction at JSF would not be expected to impact bottom ash use since the bottom ash is collected in the boiler prior to ammonia injection. However, if ammoniated fly ash is sluiced to the bottom ash pond, odor problems could impact workers at the bottom ash processing plant. As discussed in Sections 4.1 and 4.2, the anticipated ammonia concentrations in the ash pond that would result from startup and shutdown fly ash sluicing would not evolve sufficient quantities of ammonia to exceed applicable OSHA ammonia exposure thresholds. Therefore, anticipated effects of installation of the action alternatives on bottom ash handling would be insignificant.

4.5.6 Use and Impacts From Fly Ash Beneficiation as Potential Mitigation of High LOI and Ammonia-Contaminated Fly Ash

Due to the favorable economics of recycling fly ash into concrete, numerous processes have been invented to reduce unburned carbon (LOI) concentrations in fly ash to marketable levels. With the increased deployment of NO_X emissions reduction systems, many of these processes have been adapted to also remove ammonia from the fly ash. One suite of methods for offsetting the effects on marketability of ash of those alternatives producing ammoniated ash or altering LOI is termed fly ash beneficiation. The feasibility and economics of this approach is being evaluated by TVA. Since most of the thermal fly ash beneficiation processes and the dry mechanical separation processes that TVA would consider, would not involve any appreciable change in equipment, air emissions, or wastewater streams from those already present or anticipated with installations of NO_X reduction systems at JSF, these types of fly ash beneficiation measures are being covered by this EA, and their impacts would be insignificant. However, if fly ash beneficiation were chosen as a mitigation measure for reducing LOI or removing ammonia from fly ash, the appropriate level of review would be conducted at that time to confirm that the site-specific details of the proposed installation conform and are bounded by those assumed for the present review. Installation and operation of a proven fly ash beneficiation technology, which reduces leachable ammonia compounds to appropriate levels, would render the potential groundwater impacts of ammonia compound deposition on fly ash insignificant.

Description of Fly Ash Beneficiation

The fly ash beneficiation processes for enhancing fly ash marketability by removing or passivating excess unburned carbon and ammonia fall into three main categories: thermal, physical separation, and chemical processes. Thermal fly ash beneficiation processes involve increasing the temperature. Examples of this would be reburning the fly ash by injection into a specialized small boiler designed to reduce LOI or recycling a side stream of the fly ash into one of the main boilers. Temperatures involved in reburning fly ash for LOI reduction cause the ammonia compounds to either revolatilize or decompose. Resultant ammonia concentrations on fly ash of =5 mg/kg have been reported. If the LOI concentrations are not high enough to support self-sustained combustion, propane or natural gas could be used as a supply supplemental fuel supply. This EA will assume the propane supply system proposed for the low-dust SCR (Alternative D) processes will be adequate also to supply propane, if needed, for fly ash beneficiation by reburning, or other potential thermal fly ash beneficiation measures. If needed propane supplies exceed those described in Chapter 2 of this EA or if natural gas is selected for a secondary fuel source, additional environmental review will be undertaken at that time. Thermal stripping of ammonia from fly ash by heating the fly ash in various types of reactors has also been extensively described in the literature. Suggested reactors and processes for thermally stripping ammonia without the benefit of combustion range from heated fluidized beds to recycling air heated by waste heat over the hoppers to facilitate ammonia off-gassing. Physical separation processes involve both dry mechanical separation equipment like vibrating screens or centrifuges or wet separation processes, which function due to relative buoyancy differences of different size particles. Unburned fly ash carbon usually has less than 1/100th the available surface area of activated carbon, but some chemical fly ash beneficiation processes involve addition of a substance that decreases the available adsorptive capacity of the unburned carbon in the fly ash to "passivate" it. Other chemical beneficiation processes involve additives either to make the ammonia compounds less soluble or to remove the ammonia compounds from the ash.

4.6 Terrestrial Ecology

4.6.1 Environmental Consequences to Terrestrial Plants

4.6.1.1 Alternative A - No Action Alternative

Under the No Action Alternative, no NO_X reduction equipment would be installed at JSF, and the project area would likely remain in its current state. No impacts to uncommon terrestrial communities or otherwise unusual vegetation would be expected as a result of this alternative.

4.6.1.2 Alternative B - Boiler Optimization

Under the boiler optimization alternative, NO_X monitors, temperature monitors, computer control systems, and other equipment would be installed, interconnected, and programmed to reduce NO_X formation in the boilers at JSF. These installations would take place inside or immediately outside the powerhouse, so no disturbance of existing plant communities would occur during the boiler optimization process. No impacts to uncommon terrestrial communities or otherwise unusual vegetation would be expected except the possible beneficial impact of reduced NO_X emissions.

4.6.1.3 Alternatives C, D, E, and F

Some disturbance of existing plant communities would occur during installation of the new NO_X emissions reduction equipment. Since no uncommon terrestrial communities or otherwise unusual vegetation occurs on the lands to be disturbed under these proposed action alternatives, impacts to the terrestrial ecology of the region are expected to be insignificant as a result of these proposed action alternatives.

4.6.2 Environmental Consequences to Terrestrial Animals

4.6.2.1 Alternative A - No Action Alternative

Under the No Action Alternative, no NO_X emissions reduction equipment would be installed at the JSF, and the project area would likely remain in its current state. Therefore, terrestrial animals and their habitats would not be affected.

4.6.2.2 Alternative B - Optimize Boilers for Units 1 Through 4 at the John Sevier Fossil Plant

Under Alternative B, all equipment installation would be restricted to the existing powerhouse and would not result in the disturbance of habitat within the proposed project area. No impacts except the possible beneficial impacts of reduced NO_X emissions would occur. Therefore, terrestrial animals and their habitats would not be affected.

4.6.2.3 Alternative C - Installation of SNCR on Units 1 Through 4

Under Alternative C, SNCR emission-reduction system would be installed on one unit for testing as early as the fall of 2006 and would be installed on the remaining units at JSF following successful testing.

The majority of the proposed project area consists of previously and heavily disturbed habitats, resulting in a large proportion of nonvegetated and mowed grass areas that are essentially unsuitable to terrestrial animals. The remaining habitat has been previously disturbed, remains in early successional stages, and is heavily fragmented. The installation of the SNCR systems at one to four units would displace a portion of the early successional grass/forb, scrub-shrub, or immature forest habitats, and any associated terrestrial animals. Little disturbance of terrestrial animal populations is expected given the already heavily disturbed and fragmented nature of the existing habitats, as well as the similarity of surrounding habitat that would remain. These alternatives would not result in adverse impacts to caves or heron colonies in the vicinity. Therefore, Alternative C would displace or disrupt very little wildlife, and impacts to terrestrial animals and their habitats would still not be significant.

4.6.2.4 Alternative D - Installation of Low-Dust SCR on Units 1 Through 4; Alternative E - Installation of High-Dust SCR on Units 1 Through 4; and Alternative F - Combinations of Alternatives

Under Alternatives D and E, two low-dust SCRs would be installed or four high-dust SCRs would be installed at JSF following successful testing of the SNCR system under Alternative C or could be installed without installation of the SNCR system if tests are unsuccessful. Alternative F involves combinations of technological options, which could include installation of one of the SCR technologies at some point.

Alternatives D and E would disturb more ground than Alternative C. However, since this ground has already been heavily disturbed, this would displace a similar amount of habitat in the same location as Alternative C. Therefore, these alternatives would similarly have no significant impacts on terrestrial animal species, their habitats, or other unique terrestrial habitats. Depending on the combination of alternatives selected, Alternative F could displace habitat necessary for the installation of any of the NO_X reduction options on one to four units. No impacts for Alternatives B through E are significant for terrestrial animals and their habitats within the proposed project area, and any combination of these alternatives would similarly have no significant impact.

4.7 Aquatic Ecology

Installation and operation of the proposed NO_X emissions reduction systems could potentially impact aquatic communities in the Holston River. However, appropriate mitigation measures such as those described in Section 2.5 and Section 4.2 would make these potential impacts insignificant.

4.7.1 Alternative A – No Action

Under the No Action Alternative, no NO_X emissions reduction equipment would be installed or operated, so no impacts to aquatic life would result.

4.7.2 Alternative B – Boiler Optimization

Under Alternative B, Boiler Optimization, all equipment installation would be restricted to the existing powerhouse, so no impacts to aquatic life would result, except possible beneficial impacts of reduced NO_X emissions.

4.7.3 Alternatives C, D, E, and F Construction Impacts

Under Alternatives C, D, E, and F, potential construction impacts to Holston River would include temporary erosion and siltation resulting from construction of the following: NO_X reduction systems in the vicinity of the powerhouse, ammonia or urea storage tanks, construction of propane storage tanks (for Alternatives D and F only), possible construction of warehouses, laydown areas, railroad tracks, construction of spill retention basins, and for Alternatives C, E, and F, construction of the proposed diffuser system for the DFAL pond. These areas have previously been disturbed by plant construction and modification activities. These impacts would be minimized by implementation of BMPs to control erosion during construction and stabilize disturbed areas as soon as practicable after disturbance (Muncy, 1999). TVA BMPs for erosion control include recommended plant species for revegetating and stabilizing disturbed areas and guidelines for using native plant species. Native plant species require less long-term maintenance and should be used when feasible. As described in section 4.2, surface runoff would be routed to existing treatment facilities that meet regulatory requirements. These measures would substantially reduce the potential impacts in Holston River to the point of causing only minor, temporary, and insignificant effects on fish and other aquatic life.

4.7.4 Alternatives C, E, and F Operational Impacts

The storage, handling, and use of anhydrous ammonia (or aqueous ammonia or urea solutions) for the proposed SNCR system (Alternative C) or the proposed high-dust SCR system (Alternative E) or combinations of action alternatives (Alternative F) would result in the potential for the release of ammonia or other nitrogenous compounds to surface water and impacts to aquatic life. One pathway for impacts is a direct accidental release of ammonia to surface water. The engineered features of the anhydrous ammonia system include a retention basin for spills and emergency water fogging to minimize this risk. Another pathway for surface water impacts is ammonia contamination of combustion byproducts such as fly ash. As discussed in Section 4.2, there are several potential pathways for ammonia to be released to Polly Branch and the Holston River. However, management of water treatment system flows and other appropriate mitigation measures as necessary (see Sections 2.5 and 4.2) would maintain discharge ammonia concentrations at levels that would safeguard water quality and protect aquatic life. Appropriate mitigation of ammonia concentrations in effluent water would result in insignificant impacts to aquatic life that uses adjacent areas of Cherokee Reservoir for spawning or feeding.

4.7.5 Alternative D – Low-Dust SCR Operational Impacts

The storage, handling, and use of anhydrous ammonia for the proposed low-dust SCR system (Alternative D) would result in the potential for ammonia contamination of surface water and impacts to aquatic life. Table 2-3 documents two pathways for ammonia releases to surface water. The first pathway would be the direct accidental release of ammonia to surface water. The engineered features of the anhydrous ammonia system include a retention basin for spills and emergency water fogging to minimize this risk. Another pathway for surface water impacts would be ammonia and water condensate in the ammonia blowdown line from the boiler. The condensate from the ammonia system blowdown line would be routed to one of the MCTPs and then slowly released to the ash pond to reduce the risk of impacting aquatic life. The potential for ammonia impacts to surface water or aquatic life forms from either of these pathways is very low compared to Alternatives C, E, and F. Management of water treatment system flows and other appropriate mitigation measures as necessary (see Sections 2.5 and 4.2) would maintain discharge ammonia concentrations at levels that would safeguard water quality and protect aquatic life. Appropriate mitigation of ammonia concentrations in effluent water would result in insignificant impacts to aquatic life that uses adjacent areas of Cherokee Reservoir for spawning or feeding.

4.8 Threatened and Endangered Species

4.8.1 Environmental Consequences to Threatened or Endangered and Rare Terrestrial Plants

4.8.1.1 No Action Alternative (Alternative A)

No occurrences of the state-listed or federally listed plant species are known on or immediately adjacent to JSF; no impacts to such plant species are expected as a result of the No Action Alternative.

4.8.1.2 Action Alternatives B, C, D, E, and F

No occurrence of the state-listed or federally listed plant species is known on or immediately adjacent to the lands to be disturbed under any of the proposed action alternatives; no impacts to such plant species are expected.

4.8.2 Environmental Consequences to Threatened or Endangered and Rare Terrestrial Animal Species

4.8.2.1 Alternative A - No Action Alternative

Under the No Action Alternative, no NO_X emissions reduction equipment would be installed at the JSF, and the project area would likely remain in its current state. Therefore, this alternative would not result in adverse impacts to federally listed or state-listed protected terrestrial animal species or their habitats.

4.8.2.2 Alternative B - Optimize Boilers for Units 1 Through 4 at the John Sevier Fossil Plant

Under Alternative B, all equipment installation would be within the existing powerhouse and not require disturbance of habitat within the proposed project area. No impacts except the possible beneficial impacts of reduced NO_X emissions would occur. Therefore, protected terrestrial animal species and their habitats would not be affected.

4.8.2.3 Alternative C: Installation of SNCR on Units 1 Through 4 at the John Sevier Fossil Plant

Under Alternative C, the SNCR emission reduction system would be installed on one unit for testing as early as the fall of 2006 and would be installed on the remaining units at JSF following successful testing of the SNCR system.

Suitable habitat for common ravens, Allegheny woodrats, woodland jumping mice, and hairy-tailed moles does not exist within the project area. Therefore, these species would not be affected by the proposed project.

Although not part of the proposed project area, the adjacent Holston River may provide foraging habitat for the three federally listed species, i.e., bald eagles, gray bats, and Indiana bats. No other habitat requirements for any of these species exist within the proposed project area, and any displacement of habitat within the project area should not affect the Holston River as potential foraging habitat for these species and, therefore, result in no effects to federally listed species.

Little habitat exists for Rafinesque’s big-eared bat and the barn owl within the proposed project area. No evidence of either species was found in the project area. Therefore, this action alternative is not expected to impact either species.

Habitat for southeastern shrew, common shrew, and southern bog lemming exists in the early successional vegetation surrounding the ditches and man-made ponds within the proposed project area. These species likely occur in suitable habitat within the project area. There would be temporary disturbance to these species during construction of the NO_X emissions reduction equipment, but adverse impacts are not expected due to their mobility, wide range of habitat preferences, and abundance of suitable habitat in the surrounding area.

4.8.2.4 Alternative D - Installation of Low-Dust SCR on Units 1 Through 4; Alternative E - Installation of High-Dust SCR on Units 1 Through 4; and Alternative F - Combinations of Alternatives

Under Alternatives D and E, two low-dust SCRs would be installed or four high-dust SCRs would be installed at JSF. Alternative F involves combinations of technological options, since installation of one of the SCR technologies could be done after one-unit SNCR testing or after full implementation of SNCR.

Alternatives D and E would disturb more ground, but due to the highly disturbed nature of the site, these alternatives would displace a similar amount of habitat as Alternative C. Therefore, these Alternatives would similarly have no significant impacts on any federally listed or state-listed terrestrial animal species and their habitats. Depending on the combination of alternatives selected, Alternative F could displace habitat necessary for the installation of any of the NO_X emissions reduction options on one to four units. No impacts for Alternatives B through F are significant for protected terrestrial animal species and their habitats within the proposed project area, and any combination of these alternatives would similarly have no significant impact.

4.8.3 Environmental Consequences to Threatened and Endangered Aquatic Animal Species

4.8.3.1 No Action Alternative

Under the No Action Alternative, NO_X emissions reduction equipment would not be installed or operated, so no impacts to state-listed or federally listed aquatic animal populations would result.

4.8.3.2 Action Alternative B - Boiler Optimization

Under Action Alternative A, Boiler Optimization, only monitoring and computer control equipment would be installed within the immediate vicinity of the existing powerhouse, so no impacts to state-listed or federally listed aquatic animal populations would result.

4.8.3.3 Action Alternatives C, E, and F

Construction Impacts

Because no state-listed or federally listed aquatic animals are known to occur in the section of the Holston River impounded by Cherokee Dam, or the John Sevier Detention Dam, no impacts to protected aquatic animals would result from construction activities under any of these action alternatives.

Operational Impacts

The storage, handling, and use of anhydrous ammonia for the proposed NO_X emissions reduction systems would result in the potential for ammonia contamination of surface water and impacts to aquatic life. One pathway for impacts is a direct accidental release of ammonia to surface water. The engineered features of the ammonia system would include a retention basin for spills and emergency water fogging to minimize this risk. Another pathway for surface water impacts is ammonia contamination of combustion byproducts including bottom ash and fly ash. Water discharged from the on-site ash pond may contain ammonia. Management of water treatment system flows and other appropriate mitigation measures as necessary (see Sections 2.5 and 4.2) would maintain discharge ammonia concentrations at levels that would safeguard water quality and protect aquatic life. Appropriate mitigation of ammonia concentrations in effluent water would ensure that no significant impacts to water quality occur in Cherokee Reservoir or the John Sevier Detention Reservoir.

Since no state-listed or federally listed species are known or likely to occur in areas that could be directly impacted by water discharges, no impacts to state-listed or federally listed species would be anticipated to occur as a result of operational activities under any of these action alternatives.

4.8.3.4 Action Alternative D

Construction Impacts
Construction impacts would be similar to those described for Alternatives C, E, and F.

Operational Impacts
The storage, handling, and use of anhydrous ammonia for the proposed NO_X emissions reduction systems would result in the potential for ammonia contamination of surface water and impacts to aquatic life. Similar to Alternatives C, E, and F, these potential impacts to aquatic communities from storage, handling, and use of anhydrous ammonia would be mitigated with a retention basin for spills and an emergency water fogging system.

Alternative D would differ from the other action alternatives because installation and operation of a low-dust SCR system on Units 1 through 4 would not be anticipated to result in the accumulation of ammonia compounds in the fly ash. Therefore, the potential for impacts to aquatic resources in the Holston River would be even less than for Action Alternatives C, E, and F. Further, there would be no potential for impacts to state-listed or federally listed species as a result of operational activities under this alternative.

4.9 Managed Areas

4.9.1 Alternative A – No Action

Under Alternative A, no NO_X reduction equipment would be installed at the JSF. Therefore, no impacts would occur to the one ecologically significant site that is within 3 miles of the proposed project. Because no managed areas or NRI streams are in the vicinity of the proposed project, no impacts to such areas and streams would occur.

4.9.2 Alternatives B Through F

Under any of the proposed action alternatives, no significant impacts to natural areas are anticipated because the distance from the Beech Creek Unit 7 PDCH is sufficient (2.1 miles) and because this ecologically significant site is upstream and upwind from JSF. No managed areas or NRI streams are in the vicinity of the proposed project; therefore, no impacts would occur to such areas and streams as a result of project activities as defined under these alternatives.

4.10 Wetlands

Potential wetland impacts resulting from the proposed action include the conversion of wetlands, erosion, and sedimentation in wetlands, soil compaction, hydrologic alteration, and reduction of certain functions such as providing wildlife habitat. For the proposed actions, the majority of these potential impacts would be avoided or minimized through wetland avoidance and implementation of BMPs (Muncy, 1999). As described below, with implementation of these measures, impacts to wetlands would be insignificant.

4.10.1 Alternative A – No Action; and Alternative B – Optimize Boilers for Units 1 Through 4 at JSF

Under the No Action Alternative and the Boiler Optimization Alternative, Wetland JSFW01 would continue to receive runoff from the Dry Ash Stacking area and Wetland JSFW02 would receive runoff from the eastern end of the plant. Both wetlands would filter sediment and potential pollutants from storm water runoff.

4.10.2 Alternative C – Install SNCR on One to Four Units at JSF; Alternative E – High-Dust SCR on One to Four Units at JSF; Alternative F – Combination of Alternatives B Through E

Alternatives C, E, and F would not have any direct adverse effects on any wetlands at the site. During high-precipitation storm events, storm water runoff from the ash pile into Wetland JSFW01, which is an integral part of the existing wastewater treatment system at JSF, would be expected to contain NH_3 concentrations of approximately 27 mg/L NH_3-N or less, based on the assumption that ammonia accumulations on the fly ash would be 350 mg/kg or less. If the assumption about ammonia accumulations on fly ash are incorrect, and ammonia concentrations on the fly ash actually approach 500 mg/kg, ammonia concentrations in storm water runoff entering Wetland JSFW01 could potentially approach 39 mg/L NH_3-N in response to rainfall events. Based on available literature many wetlands have been shown to assimilate and/or remove NH_3 concentrations as high as 55 mg/L NH_3 (Hilton, 1993; Hunter et al., 1993; Green and Upton, 1993). Since NH_3 removal is strongly correlated with bacterial action, removal efficiency is higher during the spring, summer, and fall and lowest in winter. In another study Hill et al. (1997) demonstrated that NH_3 concentrations as high as 82.4 mg/L did not have any significant effect on biomass production of several wetland plants. NH_3 in storm water runoff would not have any adverse impacts on Wetland JSFW01.

Soil disturbance during construction of the anhydrous ammonia and propane storage facilities could potentially lead to indirect adverse impacts on Wetland JSFW02 by increasing sediment mobilization in storm water runoff during the construction period. Utilization of BMPs and other engineering controls (Muncy, 1999) would minimize the opportunity for sediment to leave the construction site without affecting wetlands.

4.10.3 Alternative D – Install Low-Dust SCR on Units 1 Through 4 at JSF

Under Alternative D, no ammonia accumulation on the fly ash would occur, so the water quality of the storm water runoff from the dry fly ash stack would not change from present operating conditions. Construction impacts to Wetland JSFW02 during construction of the anhydrous ammonia and propane storage facilities would be similar to those described for Alternative C.

4.11 Transportation

4.11.1 No Action Alternative

If no plans are undertaken to add NO_X emissions reduction equipment at JSF, none of the roads listed in Table 3-11 In Section 3.11 would be affected.

4.11.2 Action Alternatives B, C, D, E, and F

By building NO_X emissions reduction equipment at JSF, there would be minor impacts to the federal, state, and county roads during both the construction and operational periods. The construction period and workforce would vary according to the options as shown in the following table.

Table 4-7. Anticipated Peak Employment and Duration for Action Alternatives

Alternative	Peak Workforce	Peak Duration	Construction Period
Alternative A	140	N/A	N/A
Alternative B	155	3 weeks	4 months
Alternative C - 1 Unit - Full	 100 150	 3 months 3 months	 10 months 2 years
Alternative D	500	6 weeks	2 years
Alternative E	600	6 weeks	2 years
Alternative F	600	6 weeks	2 years

N/A = not applicable

There would also be additional traffic added to the road network throughout the day in the form of construction material deliveries to the site (estimated at 100 deliveries per day). These deliveries may be by highway or rail. Assuming an average ridership of 1.6 persons per vehicle, and a trip in and out each day, up to 750 vehicle trips would be added to the road network due to daily commuters during this period. Some additional delay may be experienced at the local intersections at shift changes, primarily at TN 70 and TN 66. Such a problem can be easily tolerated for the short-term duration of the construction period. The employment levels would spike to peak levels in short durations, rising and falling quickly over a period of a few months. A much smaller number of additional workers may be on site performing construction-related work during the few months before and after a unit outage.

The methodology in the *Highway Capacity Manual*, (Transportation Research Board, 1994) was used to identify possible traffic flow problem areas. The manual provides a qualitative method to measure the operational conditions within a traffic stream and their perception by motorists. This method takes into account lane widths, shoulder effects, average highway speed, alignment, etc. Six levels of service (LOS) are defined and given letter designations, from A to F, with LOS A representing the best conditions and LOS F the worst. The upper limit of LOS E is considered to be the capacity of the facility. At several representative points, the LOS provided to the existing traffic was compared to the LOS to the sum of the existing traffic and the projected additional traffic. The results are shown in Table 4-8.

Table 4-8. Existing and Anticipated Levels of Service on Roadway Segments in the Vicinity of Proposed Project		
Roadway segment	**Existing Level of Service (LOS)**	**Anticipated LOS**
TN 66 (South of TN 70)	D	D
TN 66 (North of TN 70)	E	E
TN 70	C	C
Old Highway 70	D	D

For all alternatives, the roads in this area are fully capable of absorbing this additional traffic with no drop in the existing LOS currently provided to the road users. In the long term, operation of NO_X reduction would not generate any noticeable additional traffic for the roads in the local area. The potential traffic impact for both the construction and operational phase of the NO_X reduction facility is insignificant.

Ammonia and Propane Unloading Facilities/Operations–Continual deliveries of ammonia, propane, and urea may be required for utilizing the various NO_X reduction options. The unloading facility would be sited southeast of the plant and northwest of the unloaded railroad yard. After construction is completed, operation would require a minimal additional permanent staff. Delivery of these products is anticipated to be via rail. As noted in Table 4-9, the delivery volumes and frequencies would vary by option.

Table 4-9. Rail Car Deliveries per Week			
Alternative	**Ammonia**	**Propane**	**Urea**
Alternative A	None	None	None
Alternative B	None	None	None
Alternative C	0 to 4	0	0 to 6
Alternative D	2	7	None
Alternative E	2	None	None
Alternative F	0 to 4	0 to 7	0 to 6

A short rail spur and turnout would be constructed from the existing plant track to either unloading facility location. JSF plans to conduct the unloading operations of these products utilizing on-site locomotives and personnel. None of the options would affect the capacity of the railroad mainline.

Since the no net reductions in LOS for local roads and highways would result from the action alternatives for construction of NO_X emissions reduction equipment at JSF and deliveries of ammonia, propane, or urea for operating NO_X emissions reduction equipment under the various action alternatives would not affect the railroad mainline, impacts to transportation from all of the proposed alternatives would be insignificant.

4.12 Socioeconomics and Environmental Justice

4.12.1 Construction Impacts for Alternative A – No Action and Alternative B – Boiler Optimization

There would be no differential impacts under the No Action Alternative. Alternative B would have virtually no impacts given additional staffing of only 15 people for three weeks.

4.12.2 Construction Impacts for Alternative C – Install SNCR on One to Four Units

4.12.2.1 Employment

For installation of SNCR technology, Alternative C has two phases. Design and construction would last approximately 10 months for the first phase. There would be a three-month overlap of Phases 1 and 2. Peak staffing for Phase 1 is estimated at 100 people. Phase 2 would require approximately 12-15 months with a short duration peak of 150 people. These peak-staffing levels would occur intermittently during about three months of each phase. Related construction activities would be minimal.

4.12.2.2 Income

Total cost of labor is expected to be a few million dollars, which would be less than 1 percent of the annual earnings in Hawkins County. However, since some workers would commute from surrounding counties, especially Sullivan County, the impact on Hawkins County income would be even less than this. The impact on the entire labor market area would be less than one-tenth of 1 percent. An additional small and temporary impact on earnings would result from construction-related purchases and spending by workers.

4.12.2.3 Population

Given the population of the labor market area (over 500,000 people), the majority of the workforce likely would be drawn from the local area, resulting in minimal changes in population, and any increase in population would be of short duration. Additionally, workers who move to the area for only temporary work are less likely to bring their families with them. Any incoming workers would locate to areas within the labor market area where housing is most readily available.

4.12.2.4 Community Services and Infrastructure

The impact on community services, such as police, fire, medical, and education would be small because of the small impact on population and the short duration of the maximum impact.

4.12.3 Construction Impacts for Alternative D – Install Low-Dust SCR on Units 1 Through 4

4.12.3.1 Employment

Alternative D would require increased staffing for approximately 20 months, reaching a short duration peak of about 500 workers. Except for the peak periods, which would occur off and on over about three months, staffing would be in the 100-175 range. Related construction activities would be minimal.

4.12.3.2 Income

Total cost of labor is expected to be a few million dollars, which would be less than 1 percent of the annual earnings in Hawkins County. However, since some workers would commute from surrounding counties, especially Sullivan County, the impact on Hawkins County income would be even less than this. The impact on the entire labor market area would be less than one-tenth of 1 percent. An additional small and temporary impact on earnings would result from construction-related purchases and spending by workers.

4.12.3.3 Population

Given the population of the labor market area (over 500,000 people), the majority of the workforce likely would be drawn from the local area, resulting in minimal changes in population, and any increase in population would be of short duration. Additionally, workers who move to the area for only temporary work are less likely to bring their families with them. Any incoming workers would locate to areas within the labor market area where housing is most readily available.

4.12.3.4 Community Services and Infrastructure

The impact on community services, such as police, fire, medical, and education would be small because of the small impact on population and the short duration of the maximum impact.

4.12.4 Construction Impacts for Alternative E – Install High-Dust SCR on Units 1 Through 4

4.12.4.1 Employment

Alternative E would require increased staffing for approximately 20 months, reaching a short duration peak of about 600 workers. Except for the peak periods, which would occur off and on over about three months, staffing would be in the 100-200 range. Related construction activities would be minimal.

4.12.4.2 Income

Total cost of labor is expected to be a few million dollars, which would be less than 1 percent of the annual earnings in Hawkins County. However, since some workers would commute from surrounding counties, especially Sullivan County, the impact on Hawkins County income would be even less than this. The impact on the entire labor market area would be less than one-tenth of 1 percent. An additional small and temporary impact on earnings would result from construction-related purchases and spending by workers.

4.12.4.3 Population

Given the population of the labor market area (over 500,000 people), the majority of the work force likely would be drawn from the local area, resulting in minimal changes in population, and any increase in population would be of short duration. Additionally, workers who move to the area for only temporary work are less likely to bring their families with them. Any incoming workers would locate to areas within the labor market area where housing is most readily available.

4.12.4.4 Community Services and Infrastructure

The impact on community services, such as police, fire, medical, and education would be small because of the small impact on population and the short duration of the maximum impact.

4.12.5 Construction Impacts for Alternative F - Combinations of Alternatives B Through E

4.12.5.1 Employment

Alternative F would require increased staffing for approximately 30 months. The first 10 months would see a peak of approximately 400 workers, followed by a peak of 600 workers during the final 20 months. Except for the peak periods, which would occur off and on over about three months, staffing would be in the 100-150 range during the first 10 months and 100-200 during the last 20 months. Related construction activities would be minimal.

4.12.5.2 Income

Total cost of labor is expected to be more than the other alternatives by a few million dollars, but still no more than 1 percent of the annual earnings in Hawkins County. However, since some workers would commute from surrounding counties, especially Sullivan County, the impact on Hawkins County income would be less than this. The impact on the entire labor market area would be less than a few tenths of 1 percent. An additional small and temporary impact on earnings would result from construction-related purchase, and spending by workers.

4.12.5.3 Population

Given the population of the labor market area (over 500,000 people), the majority of the workforce likely would be drawn from the local area, resulting in minimal changes in population, and any increase in population would be of short duration. Additionally, workers who move to the area for only temporary work are less likely to bring their families with them. Any incoming workers would locate to areas within the labor market area where housing is most readily available.

4.12.5.4 Community Services and Infrastructure

The impact on community services, such as police, fire, medical, and education would be small because of the small impact on population and the short duration of the maximum impact.

4.12.6 Operational Impacts on Socioeconomics for All Alternatives

Once construction is complete, any operational changes would be minor under any of the action alternatives and would have no noticeable socioeconomic impacts. Under the No Action Alternative, there would be no impacts on operations.

4.12.7 Environmental Justice

The proposed actions would physically be a minor addition to an expansive heavy industrial facility that has a significant property buffer area. Therefore, during construction, important impacts are unlikely on any residents of the surrounding area, and disproportionate impacts on minority or low-income populations are unlikely. On the other hand, all residents in the surrounding area, including minority and low-income residents, would benefit from the reduction in NO_X.

In general, operational impacts would be minor and not noticeable to residents of the surrounding area. However, there is a small chance of ammonia releases, as discussed earlier. In the unlikely event of such releases, demographic data indicate that disproportionate impacts on minority populations would be unlikely. As can be seen in Table 4-10, the minority population percentage within the block group (1.9 percent) and within the census tract (2.0 percent) where the JSF is located is less than Hawkins County as a whole (3.3 percent), and far less than the state (20.8 percent). However, there is the possibility of slightly disproportionate impacts on low-income individuals, given that the low-income population percentage in the block group (17.6 percent) and the census tract (16.9 percent) is slightly greater than Hawkins County (15.8 percent) and the state (13.5 percent).

Table 4-10. Population Statistics for Proposed Project Area

Geography	Total Population 2000	Minority Population 2000	Low-income Population 1999
Block Group 1	1355	1.9 %	17.6 %
Census Tract 508	4522	2.0 %	16.9 %
Hawkins County	53,563	3.3 %	15.8 %
Tennessee	5,689,283	20.8 %	13.5 %

Source: U.S. Bureau of the Census, 2000 Census of Population

4.13 Visual Resources

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. Collectively, the introduction of NO_X reduction equipment and related construction activity, as proposed, would not result in significant impacts to the existing visual resources.

4.13.1 Alternative A – No Action

Under the no action alternative, steps would not be taken to remove NO_X from coal combustion flue gases at JSF. The scenic attractiveness and scenic integrity would remain as they exist.

4.13.2 Alternative B – Optimize Boilers for Units 1 Through 4 at JSF

Under Alternative B, monitors, computer control systems, and other equipment would be installed within the powerhouse area, or in the immediate vicinity. Proposed project elements in this alternative would not be readily discernable from viewing positions previously described in Section 3.13. This alternative, as proposed, would not impact the existing scenic value of the project area.

4.13.3 Alternative C – Install SNCR on One to Four Units at JSF

Under Alternative C, installation of several project elements would occur within the plant or boiler and would not be readily visible. The introduction of these aboveground features would not result in a discernable contrast from the existing landscape character. The installation of storage facilities for ammonia and/or propane would potentially require modifications to the existing rail service in the immediate vicinity. These modifications to existing rail service would not permanently affect the landscape character of the plant site. Diffuser pipes and pipe headers could be required for mitigation of wastewater impacts. Impacts associated with installation of the diffuser pipes would remain in context with construction activities, which would generate temporary visual, insignificant discord. In addition to these alternative-specific elements, views of the general construction-related elements would be seen in broader context with existing plant structures and operations and would not significantly impact existing visual resources.

4.13.4 Alternative D – Install Low-Dust SCR on Units 1 Through 4 at JSF

Under Alternative D, TVA would install low-dust SCRs on Units 1 through 4, which would require duct and equipment structures not included in the previous alternatives. The low-dust SCR alternative would include the installation of ammonia tanks and propane tanks. Rail service near proposed ammonia tanks or propane tanks would potentially be modified to facilitate installation and operation of these project elements. Components of Alternative D would be similar in scale and character to existing plant structures and operations and would not significantly impact existing visual resources.

4.13.5 Alternative E – Install High-Dust SCR on Units 1 Through 4 at JSF

Under Alternative E, installation of roughly twice as much ductwork would occur than under Alternative D. Similarities to the previous alternatives include potential diffuser pipes, ammonia tanks, construction parking, laydown and staging areas, and the possibility of a modification to the rail delivery system near ammonia tanks on Figure 2-3. This proposed alternative would remain in context with the existing landscape character and would not result in a significant impact to existing visual resources.

4.13.6 Alternative F – Combinations of Alternatives B Through E

Under Alternative F, combinations of the previously discussed alternatives would be combined to address the removal of NO_X from the coal combustion flue gases at TVA's JSF. The combination of these project elements would remain similar in context to the established industrial landscape character. Recreational river users, shoreline, and near-shore residents would have views of the reduction equipment, construction parking, laydown, and staging areas amidst structures and operations that are similar in scale and visual character, causing them to be seen as subordinate elements in the landscape. Motorists traveling McDonald Hills Road would have similar views, but those views available would be intermittent through existing vegetation and of considerably shorter duration.

Residents and motorists in the vicinity would likely notice a slight increase in traffic within the project area. This incremental increase would not result in an overly adverse impact to existing visual resources. Views also available to motorists and nearby residents would include project elements noted in previous descriptions and descriptions of their individual impacts. Alternative F, as with each of the previous alternatives, would be compatible with the established landscape character.

4.14 Recreation

4.14.1 Alternatives A – No Action and B - Boiler Optimization

Under the No Action Alternative, no new recreation facilities or opportunities would be provided, so no new risks would be introduced to the plant site and the surrounding communities. However, unlike for Alternative B, no benefits to public health that may result from improvements to local and regional air quality would be achieved.

4.14.2 Alternatives C, D, E, and F

Under all other alternatives, there would be some degree of impacts to recreation, particularly fishing from the bank, at the inlet and discharge channel. These impacts would be associated with restrictions to parking during the construction phase. Even if TVA imposed no formal restrictions on parking during construction, there would still be fewer parking spaces. There would still be walking access to the discharge channel from the campground, although, this would be a considerable walk. These impacts should be considered temporary in nature. Normal boating access to these sites would be expected to continue as usual except for possibly a brief period of restriction for installation of the proposed diffuser on the DFAL pond discharge, if TVA selects that mitigation option. None of the preliminary conceptual designs for any of the action alternatives indicate a need to close the campground during construction.

From available preliminary conceptual design information, no reasons for restricting or eliminating existing public parking after construction are readily apparent. Similarly, the proposed facility locations for the various action alternatives would not reduce the amount of land used for public pedestrian access areas and most frequented by bank fishermen. Therefore, under normal operating conditions, there would be no impact to recreation. However, under the most critical events and to some degree less critical events, as discussed in Sections 4.1.5 and 4.1.6, there would be impacts to recreation. The degree of these impacts would be as hypothetical as the event but these impacts would also be considered temporary. In summary, if no new restrictions on public parking or pedestrian access occur, there would be no impacts on recreation.

4.15 Cultural Resources

Six different alternatives have been considered for the proposed project including the No Action Alternative, boiler optimization, installation of SNCR systems, installation of low-dust

SCR systems, installation of high-dust SCR, and a final action alternative, which includes combinations of the other action alternatives. As discussed in Section 3.15, the APE for the archaeological resources that could be potentially affected by this project was defined as the 271 acres in which land-disturbing activities could occur. For historic structures, the APE was determined as those areas from which the alterations would be visible within a 0.5-mile radius. A records search at the Tennessee Historical Commission and the Tennessee Division of Archaeology indicated no previously recorded or National Register of Historic Places (NRHP) listed properties are located within the project's APE. A review of the archaeological APE, by TVA's Cultural Resources Staff, found that previous ground-disturbing activities associated with the construction and operation of JSF would have removed any remnants of the archaeological record assuming such remains had been in place. Specifically, there are no historic sites or structures located within the APE, and the 1952-1957 construction activities associated with the startup and operation of JSF have been extensive, such that any archaeological resources that may have been present would have been obliterated by these construction and operational activities. In regard to potential effects to historic structures, based on the low profile of the storage tanks and the presence of JSF and based on the fact that the supporting infrastructure has compromised the historic viewshed of the surrounding region, it is TVA's finding that the proposed project would not adversely or visually affect any historic properties that are listed on or are eligible for listing on the NRHP (Karpynec, 2004).

Pursuant to Section 106 of the National Historic Preservation Act and its implementing regulations at 36 CFR Part 800, TVA in consultation with the Tennessee State Historic Preservation Officer (SHPO) determined that the proposed undertaking would not affect any archaeological sites, historic sites, or historic structures that are listed on or are eligible for listing on the NRHP. The formal concurrence of the SHPO is documented in the letter in Appendix D.

4.16 Seismology

As discussed in Section 3.16, there is a minimal likelihood for earthquake in the JSF area. Although there is only minor potential for occurrence, the earthquake hazard to ordinary buildings at the proposed project site would be addressed through adherence to the seismic provisions of the Uniform Building Code (ICBO, 1997) or more recent building codes as appropriate. The earthquake hazard at the JSF relative to other locations in the United States is low (Zone 1 on a scale of 0 to 4 with 4 being the highest hazard) based on the 1997 Uniform Building Code (ICBO, 1997). Special structures that house hazardous processes or sensitive equipment may require additional considerations. Transportation of hazardous substances (e.g., ammonia) through underground or aboveground piping may also require special designs and careful siting to address seismic hazards. Adherence with the seismic provisions of the Uniform Building Code (ICBO, 1997) is standard practice for TVA, so this would apply for all of the alternatives. Compliance with appropriate construction codes would make potential environmental impacts due to the effect of seismic activity on the ammonia storage system insignificant.

4.17 Tornado Risk

As previously discussed, with the calculated occurrence interval for how often, on average, a tornado may affect a particular site (i.e., 2,857 years for JSF), the risk of damage to proposed project equipment from tornados is negligible. However, the risk of damage from tornados or high winds to structures or equipment at the proposed project site would be addressed through adherence to the wind load design provisions of the Uniform Building Code (ICBO 1997) or more recent building codes as appropriate. Special structures that house hazardous processes or sensitive equipment may require additional considerations. Transportation of hazardous substances (e.g., ammonia) through aboveground piping may also require special designs and careful siting to address meteorological hazards. Adherence with the wind load design provisions of the Uniform Building Code (ICBO, 1997) is standard practice for TVA, so this would apply for all of the alternatives.

CHAPTER 5

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CHAPTER 6

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CHAPTER 7

7. SUPPORTING INFORMATION

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7.2 Acronyms, Abbreviations, and Glossary of Terms

>	Greater than
<	Less than
≤	Less than or equal to
≥	Greater than or equal to
°	Degree
°C	Degree Celsius
°F	Degree Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
Ammonia slip	Emission of unreacted ammonia and ammonia compounds
APE	Area of potential effect
APH	Air preheater
ARAP	Aquatic Resource Alteration Permit
BMP	Best management practice
CCC	Criteria continuous concentration
CCW	Condenser cooling water
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CMC	Criteria maximum concentration
DFA	Dry fly ash
DFAL	Dry fly ash landfill
DSN	Discharge Serial Number
e.g.	Latin term, exempli gratia, meaning "for example"
EA	Environmental Assessment
ECHEM	TVA Central Laboratories - Environmental Chemistry
EDTA	Ethylenediaminetetraacetic acid
EO	Executive Order
EPRI	Electric Power Research Institute
ESP	Electrostatic precipitator
et al.	Latin term, et alii (masculine), et aliae (feminine), or et alia (neutral) meaning "and others"
etc.	Latin term et cetera meaning "and other things" "and so forth"
HRM	Holston River Mile

IC_{25}	25 percent inhibition concentration
ICBO	International Conference of Building Officials
i.e.	Latin term, id est, meaning “that is”
IMP	Internal monitoring point
JSF	John Sevier Fossil Plant
kg/ha-y	Kilogram per hectare per year
Lb	Pound
LC_{50}	An estimate of the effluent concentration that is lethal to 50 percent of the test organisms in the time period prescribed by the test, expressed as the LC_{50}
Liquefaction	The sudden large decrease of the shearing resistance of a cohesionless soil, caused by a collapse of the structure by shock or strain, and associated with a sudden but temporary increase of the pore fluid pressure. It involves a temporary transformation of the material into a fluid mass.
LOI	Loss on ignition
LOS	Level of service
MCTP	Metal cleaning treatment pond
mg	Milligrams
mg/m^3	Milligrams per cubic meter
MG	Million gallons
MGD	Million gallons per day
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
mg N/L	Milligrams nitrogen per liter
MSDS	Material safety data sheet
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NH_3	Ammonia
NH_3-N	Ammonia nitrogen as nitrogen
NIOSH	National Institute for Occupational Safety and Health
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_3	Nitrogen trioxide
NO_X	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
OSHA	Occupational Safety and Health Administration
OTAG	Ozone Transport Assessment Group
PDCH	Proposed designated critical habitat
PM	Particulate matter
$PM_{2.5}$	Particulate matter with aerodynamic diameter of 2.5 microns or less
PM_{10}	Particulate matter with aerodynamic diameter of 10 microns or less
ppm	Parts per million
ppmv	Parts per million by volume

RM	River mile
SCR	Selective catalytic reduction
SFI	Sport Fishing Index
SHPO	State Historic Preservation Officer
SNCR	Selective noncatalytic reduction
SO_3	Sulfur trioxide
SPP	Standard Programs and Processes
SWPPP	Storm water pollution prevention plan
TDEC	Tennessee Department of Environment and Conservation
TN	Tennessee State Route
TVA	Tennessee Valley Authority
U.S.	United States
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	Volatile organic compound
WET	Whole effluent toxicity
WSP	Waste stabilization pond

APPENDIX A – DESCRIPTIVE MATERIAL – AFFECTED ENVIRONMENT

Determination of Ammonia-Nitrogen Concentration Limits Which Would be Protective of Aquatic Life at Extreme Ambient Conditions for the Holston River and Polly Branch in the Vicinity of JSF

As discussed in section 3.2, both acute and chronic toxicity of ammonia to aquatic life is pH-dependent, such that at higher pH levels toxicity increases. Chronic toxicity is also temperature dependent, with toxicity increasing with increasing temperature. In addition, the presence of salmonids is a factor in determining the acute criterion, and the presence of early life stages of fish at cool temperatures is a factor in determining the chronic criterion. Aquatic life acute and chronic criteria are, therefore, based on pH, temperature, and the presence or absence of certain fish species or life stages. Formulae for calculating the acute criterion, or CMC, and the chronic criterion, or CCC, for ammonia are provided in the recently revised criteria document (EPA-822-R-99-014, December 1999). The acute CMC is the 1-hour average concentration of total ammonia nitrogen (in mg N/L) that should not be exceeded more than once every three years on the average. The chronic CCC is the 30-day average concentration not to be exceeded more than once every three years. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the CCC.

In conjunction with thermal compliance monitoring for DSN 002, the CCW discharge, TVA collects data on the temperature of the Holston River and the CCW discharge. These data was used in conjunction with flow data to calculate water temperatures downstream of the CCW. Records of pH readings were matched with the corresponding downstream water temperatures and this information was used to calculate the CCC, for ammonia nitrogen for the Holston River downstream of the CCW. These calculated CCC values are plotted in Figure A-1. When viewing Figure A-1, concentrations less than or equal to the plotted diamond data points are considered adequately protective for the conditions. As can be seen in Figure A-1, for the 30 months ending in early October 2005, the minimum protective CCC for the dataset spanning the 30-month period was 0.41 mg/L NH_3-N. All but two of the calculated protective concentrations from this dataset are 0.5 mg/L NH_3-N or higher. Based on this data, for 98.4% of the time, a continuous concentration limit of 0.5 mg/L NH_3-N in the Holston River would be adequately protective of the aquatic life. Since the USEPA Water Quality Criteria document for ammonia (USEPA, 1999) specifies that the CCC should not be exceeded more than once every three years, and conditions occurred twice in 30 months of data which would require a lower concentration than 0.5 mg/L NH_3-N, the minimum protective CCC value calculated from the dataset of 0.41 mg/L seems more appropriate as an estimate of a concentration level in the Holston River which would have negligible and insignificant impacts on aquatic life. Since the 30-month dataset used to calculate this value included the extremely warm temperatures from the summer of 2005, the warmest time period since implementation of the minimum flow guidelines in the River Operations Study Programmatic EIS, which took effect June 1, 2004, the concentration of 0.41 mg/L NH_3-N would be adequately protective of the Holston River below the JSF CCW discharge channel. This section of the river includes the riverbank adjacent to the dry fly ash landfill, through which ammonia-contaminated groundwater may eventually enter the Holston River, and also the portion of the river where the proposed diffuser for mitigating ammonia-contaminated storm water runoff may be installed.

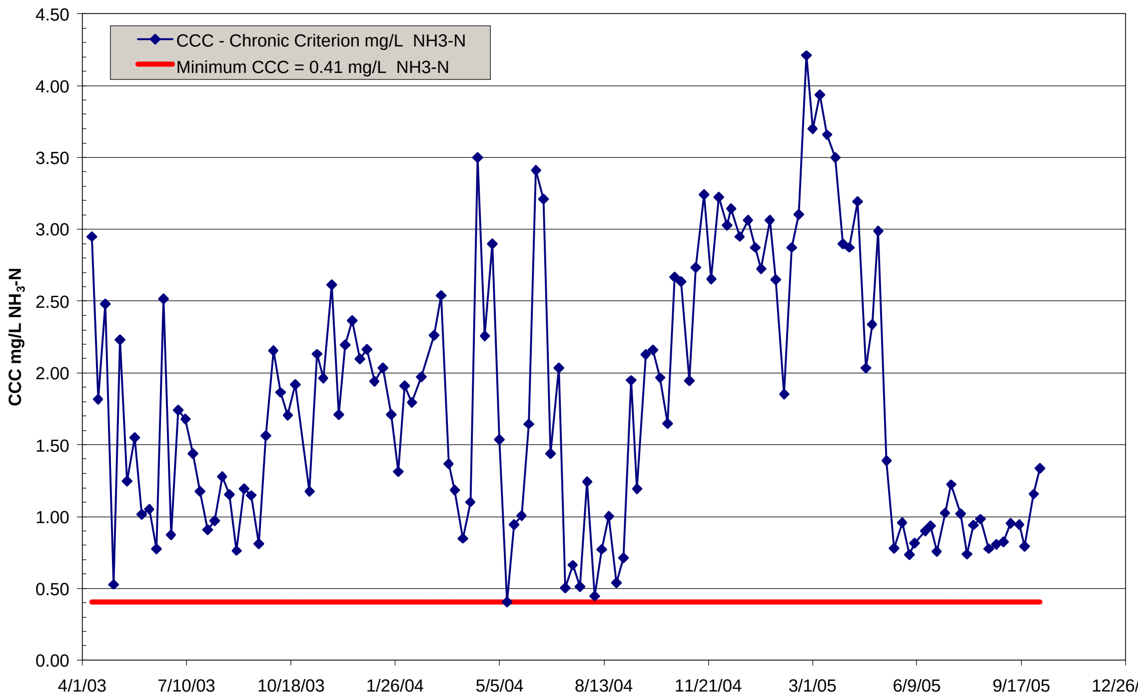

Figure A-1. Continuous Criterion Concentration of NH_3-N Protective of Holston River Below JSF

Polly Branch, which receives water from JSF DSN 001, the ash pond discharge, is considered a zero flow stream. So discharges from DSN 001 that might potentially contain ammonia nitrogen would be expected to meet the USEPA Water Quality Criteria for ammonia at the discharge point. TVA records pH and temperature measurements at JSF DSN 001 several times per month. These data were used to calculate the CCC, for ammonia nitrogen for the ash pond DSN 001 discharge. Since the ash pond is relatively shallow, subject to heat gain in the summer, and has significantly less flow than the Holston River, the limiting concentrations calculated as being necessary to be protective of aquatic life in Polly Branch are somewhat lower than those for the Holston River. This would be expected, since most rivers have much greater assimilative capacity than their smaller tributary streams. The lowest calculated CCC for the ash pond effluent from 20 months worth of data, which included the extremely warm conditions of the summer of 2005, was 0.29 mg/L NH_3-N. Figure A-2 shows the CCC values calculated for the ash pond discharge. As can be seen in Figure A-2, even for the extremely warm conditions in July 2005, a protective limit concentration value of 0.29 mg/L NH_3-N would have been adequately protective of aquatic life in Polly Branch.

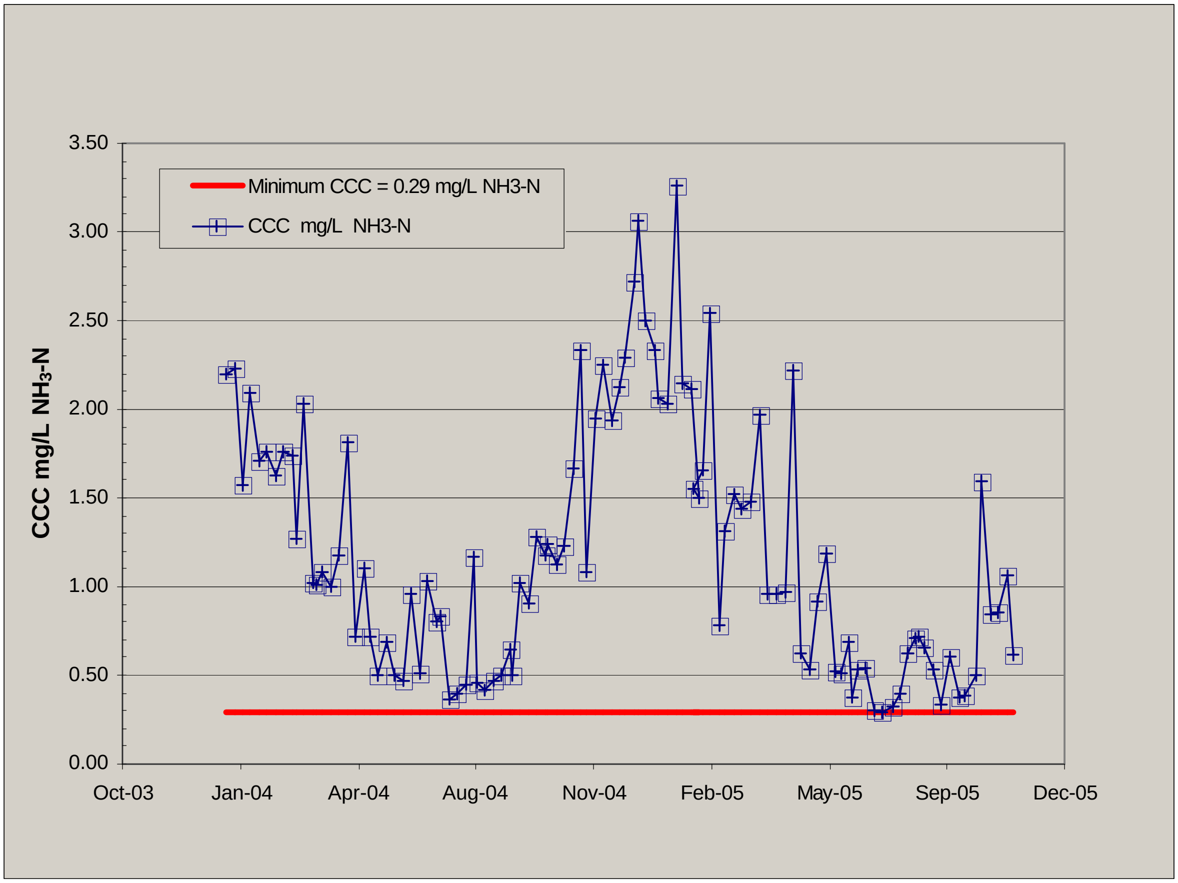

Figure A-2. Continuous Criterion Concentration of NH_3-N Protective of Polly Branch Below DSN 001 at JSF

Table A-1. Species of Fish Collected in Holston River Near JSF (3-2003)

Species	Presence		
	HRM 100.0	HRM 102.5	HRM 105.5
Longnose gar		X	
Gizzard shad	X	X	X
Central stoneroller			X
Goldfish	X	X	
Spotfin shiner	X	X	X
Common carp	X	X	X
Bigeye chub			X
Striped shiner			X
Warpaint shiner			X
Silver shiner			X
Rosyface shiner	X		
Telescope shiner	X	X	X
Mimic shiner			X
Bluntnose minnow	X	X	X
Fathead minnow	X		
Bullhead minnow		X	X
River carpsucker	X	X	X
Quillback	X	X	X
Highfin carpsucker	X		X
Northern hogsucker	X	X	X
Smallmouth buffalo		X	X
Black redhorse		X	X
Golden redhorse	X	X	X
Golden shiner	X	X	
Yellow bullhead		X	X
Channel catfish	X	X	X
Flathead catfish			X
White bass	X	X	X
Striped bass	X		X
Hybrid white x striped bass			X
Rock bass	X	X	X
Redbreast sunfish	X	X	X
Green sunfish	X	X	X
Warmouth	X		X
Bluegill	X	X	X
Redear sunfish	X	X	X
Smallmouth bass	X	X	X
Spotted bass	X	X	X
Largemouth bass	X	X	X
White crappie	X	X	X
Black crappie	X	X	X
Snubnose darter			X
Logperch			X
Sauger	X		X
Walleye			X
Freshwater drum	X	X	X
Number Samples	15	15	15
Number Fish Collected	967	920	847
Species Collected	30	29	41

APPENDIX B - FLUE GAS, WASTEWATER, STORM WATER, AND FLY ASH MONITORING, SAMPLING, AND REPORTING PLAN - JOHN SEVIER FOSSIL PLANT - NO_X REDUCTION SYSTEM - MARCH 2006

Objective

This sampling plan has three objectives: (1) to measure ammonia compound deposition on fly ash, (2) to assess potential impacts on the receiving streams, and (3) to establish a correlation between operational parameters (including ammonia compound deposition on fly ash) and ammonia-nitrogen (NH_3-N) concentrations in wastewater, storm water runoff, Dry Fly Ash Landfill (DFAL) subsurface leachate. This sampling plan would also help determine whether mitigation measures would be necessary, or which ones were necessary, to ensure no significant adverse impact to the ground water, surface water, and air quality during this test. The data from the proposed one-unit, one-year test would also be used to evaluate potential impacts, as well as aid in decision-making on which NO_X-reduction option to fully implement, and to help define mitigation measured for four-unit, continuous operation of NO_X reducing system(s).

Scope of Work

The scope of work to be conducted as outlined in this workplan includes, developing detailed operating procedures for sampling (i.e., identifying responsible persons, costs, Quality Assurance/Quality Control protocol, equipment/container needs, etc.); implementing the sampling effort; delivering of samples for analysis to TVA Central Laboratories – Environmental Chemistry (ECHEM), and/or approved contract laboratories; tracking of trends, adjustments to sampling scheme as needed based on results, and determination if, or what, mitigation measures are needed; and reporting of results to the appropriate staff.

Project Description

Flue gas would be sampled during baseline testing to determine ammonia slip rates under various operational modes and stack emissions of NO_X and ammonia.

Fly ash samples would be collected from designated ESP hoppers on the NO_X reduction unit and from the dry ash disposal silo.

Water samples would be collected from the ash pond and the wastewaters entering the ash pond including:

- APH wash wastewater and
- Waste Stabilization Pond (WSP) IMP 008
- Dry Fly Ash Landfill (DFAL) Leachate Collection System discharge to the WSP

It would be impractical to collect samples of wet-sluiced fly ash before it entered the ash pond so the impact of this waste stream will be derived from the other ash pond system samples.

Samples would also be collected from the DFA Landfill storm water runoff system including:

- Runoff ditch near active area,
- Sediment pond
- Wetland ditch (JSW001), and
- Dry Stack Stilling Pool

The purpose of these samples would be to measure ammonia compound deposition on the fly ash and subsequent potential impacts on the wastewater and storm water treatment systems at JSF. The sampling would begin once the NO_X reduction operation commences. However, until ammonia is detected at a level of 5 mg/kg (ppm) in the hopper fly ash samples, neither storm water sampling nor ammonia analysis on the silo fly ash samples is necessary. The frequency of sample collection, location/number of sample sites, and the overall sampling scheme can be altered to provide the best data for decision-making and to reduce/eliminate unnecessary sampling and analyses.

Flue Gas

Baseline flue gas emission testing would be conducted at normal full load to determine stack ammonia emissions. The baseline testing would involve analysis of flue gas using Conditional Test Method 027. Flue gas samples from the stack would be analyzed to ascertain the impact of the single unit on stack emissions (see Table B-1). Visible emission evaluations of plume opacity would be conducted during each emission test run using USEPA Method 9.

Fly Ash

Operational fly ash samples would be collected from the NO_X reduction unit's ESP hoppers. The following samples would be collected from the ESP for each of the two furnaces for this unit. Samples would be collected from the unit's ESP hoppers. One sample would be collected from the first row of hoppers, and another sample would be collected from the second row of hoppers. The fly ash samples collected from the hoppers would be discrete samples (i.e., samples would not be composited) that would be split to allow a set of samples to be field tested for ammonia and a set of samples to be shipped to the laboratory for ammonia analysis. The fly ash samples would be collected on a daily basis (when NO_X reduction systems are in operation) for at least the first two to three weeks of the high ammonia slip operation to try to establish a correlation between the data derived in the field with the laboratory data. Thereafter, the fly ash samples will be collected daily (when in operation) for field testing, and once per week, the samples would be split--one set for field testing, the other for laboratory analyses for verification. At the date/time of the sample collection, the sampler would note the ammonia/urea injection rate, unit load, and type of coal being burned.

If ammonia is detected at a level of 5 mg/kg (as indicated by the field test method) in the samples from the NO_X reduction unit's ESP hoppers, samples would also be collected from the dry fly ash handling system silo (after mixing). As above, the fly ash samples collected from the silo would be discrete samples (i.e., samples would not be composited) that would be split to allow a set of samples to be field tested for ammonia, and a set of samples to be shipped to the laboratory for ammonia analysis. This will allow a correlation to be established between the two methods specific to this fly ash. The fly ash samples would be collected on a daily basis (when NO_X reduction systems are in operation) for at least the first two to three weeks of the high ammonia slip operation to try to establish a correlation between the data derived in the field with the laboratory data. Thereafter, the fly ash samples will be collected daily (when in operation) for field testing, and once per week the samples would be split--one set for field testing, the other for laboratory analyses for verification.

Receiving Streams

To establish existing concentrations of ammonia and other related constituents, samples will be collected during Spring 2006 from Polly Branch upstream of the Bottom Ash Pond Discharge (DSN 001) and from the Holston River at the JSF Intake. These samples will be analyzed for pH, temperature, alkalinity, dissolved oxygen, ammonia as N, Nitrate-Nitrite as N, and Total Kjeldahl Nitrogen.

Ash Pond

Background samples from the ash pond discharge (DSN 001) would be evaluated prior to commencement testing of NO_X reduction equipment, which might result in deposition of ammonia or ammonia compounds on fly ash. TVA may elect to collect and analyze additional background samples depending on results of this evaluation. The retention time of the ash pond will be measured at least twice to attempt to capture conditions expected to produce both the minimum retention time and the average retention time.

Potential sources of ammonia compounds in the ash pond after operation of SNCR or high-dust SCR begins include the following: intermittent wet-sluicing of fly ash, discharge of air preheater wastewater (APH) from a Metal Cleaning Treatment Pond (MCTP), and discharge of Dry Fly Ash Landfill (DFAL) leachate through the Waste Stabilization Pond. Sampling of each of these individual wastewaters will be discussed in more detail later in this appendix.

When operation of SNCR or high-dust SCR begins, samples would be collected once every two weeks and continue for at least one week after the operation of the SNCR one-unit test ceased. Samples would be collected near the ash pond inflow and near the outflow of the ash pond. If the proposed one-unit SNCR test is not conducted TVA may elect another sampling plan such as biweekly sampling during the first ozone season of full-unit implementation for either SNCR or high-dust SCR and quarterly sampling thereafter. The samples would be analyzed for the parameters listed in Table B-1.

Wet-sluicing Fly Ash (intermittent)

This sometimes happens during unit start-up or shut-down. The SNCR or High-Dust SCR would probably not be in operation during start-up and so should not contribute ammonia compounds to the ash pond. If a scheduled shutdown occurs, the plant should have time to shut down the SNCR or High-dust SCR prior to shutdown, and again, no ammonia compounds should be added to the ash pond.

However, during an unscheduled shutdown of the unit equipped with the SNCR or high-dust SCR, fly ash that is wet-sluiced to the ash pond could contain ammonia compounds. During such an event, both the ash pond influent and effluent should be sampled for pH and ammonia-nitrogen. The ash pond influent should be sampled during the wet-sluicing event. The ash pond effluent should be sampled later at the estimated time when this wastewater may reach the ash pond discharge based on the time-of-travel studies mentioned earlier. The most recent sample of fly ash from the units ESP hoppers will be used to estimate the ammonia concentration on the fly ash wet-sluiced to the ash pond. The combination of estimated fly ash ammonia concentration together with ash pond influent and effluent samples should help determine the levels of treatment or removal of ammonia compounds provided by the existing ash pond for this wastewater stream.

Air Preheater (APH) Wash

The first APH wash after installation and operation would be sampled to determine whether ammonia nitrogen is present. The APH wash wastewater would be discharged to a Metal Cleaning Treatment Pond (MCTP). After all the APH washwater was in the MCTP, the APH wash wastewater would be recirculated to mix the contents of the MCTP. Before discharge, a sample would be collected from the mixed APH wash water in the MCTP and analyzed for ammonia and pH (Table B-1). Volume in the MCTP would be recorded. The ammonia and pH levels and the volume of wash water would determine the appropriate release rate to the ash pond. If no ammonia nitrogen is present and pH levels are comparable to previous APH washes, direct discharge to the ash pond may be feasible for future APH washes. If the time frame for disposal of APH washwater by slowly pumping to the ash pond is less than 120 days, no additional sampling would be necessary. If ammonia nitrogen concentrations are such that more than 120 days would be necessary to slowly release the APH wash water to the ash pond without additional treatment, the plant may elect to evaluate a future APH wash to determine appropriate APH washing schedules and washing procedures (e.g., handling of 1st wash containing concentrated ammonia contamination differently from additional washing) to reduce the risk of accumulating excessive quantities of ammonium compounds in the APHs or the JSF wastewater treatment system. If NO_X reduction Alternatives C, E, or F were installed at JSF, TVA would monitor and evaluate APH wash water to ensure compliance with anticipated NPDES limits.

<u>Dry Fly Ash Landfill Leachate</u>
This wastewater stream is collected by the DFAL Leachate Collection System. Pumping stations direct it to the Waste Stabilization Pond (WSP, IMP 008) which then discharges to the ash pond. Quarterly samples should be collected at the following locations:

- DFAL influent to the WSP,
- Other wastewater influents to the WSP, including the domestic wastewater or sewage (appropriate personal protection equipment [PPE] to protect against potential biological contamination from sewage shall be used when collecting and handling this sample), ash runoff from the silo sump (enters pond on southwest end) as well as civil drainage from the silo area,
- Discharge of the WSP to the ash pond (appropriate PPE to protect against potential biological contamination from sewage shall be used when collecting and handling this sample)

The samples would be analyzed for the parameters listed in Table B-1. Data from these locations should allow evaluation of ammonia removals in the WSP.

<u>Ash Pond Contingency Sampling and Actions</u>
If the ammonia nitrogen concentration reaches or exceeds 0.15 mg/L (half the target level of 0.29 mg/L) at pH of less than 9.0 or 0.6 mg/L at a pH of less than 8.0 at the discharge of the ash pond, then the ash pond discharge shall be monitored on a daily basis until the levels return to 0.15 mg/L. If the ammonia nitrogen concentration reaches 0.22 mg/L, then appropriate action to ensure that the ash pond discharge does not exceed 0.29 mg/L will be implemented. Options include reducing or discontinuing the wastewater sources containing ammonia (such as the APH), stopping operation of the NO_X Reduction System, or enhancing ammonia removal in the ash pond system. Should these trigger levels be exceeded, then the ash pond discharge shall be monitored on a daily basis until the levels return to the applicable ammonia toxicity concentration.

Dry Fly Ash Landfill (DFAL)

<u>DFAL Storm Water Runoff</u>

After operation of SNCR or high-dust SCR began has begun and ammonia is detected at a level of 5 mg/kg (as indicated by the field test method) in at least one of the NO_X reduction unit’s ESP hopper samples, thereafter, storm water samples would be collected during rain-induced runoff events whenever practicable. When there is flow in the runoff ditch or discharge piping, samples would be collected from:

- Rainfall drainage ditch near the working face of the DFAL,
- Influent to the DFAL sediment pond,
- Effluent from the DFAL sediment pond,

- Influent to the DFAL stilling pond,
- Discharge of the DFAL stilling pond.

The samples would be analyzed for the parameters listed in Table B-1. Data from these five locations should allow evaluation of ammonia removals in the successive components of this wastewater system (e.g. runoff ditches, sediment pond, wetland JSFW01, and DFAL stilling pond). Relevant local meteorological data will be collected and tracked with the data described above to determine conditions that usually lead to discharge of the DFAL stilling pond. All the storm water runoff data will be tracked to determine trends or correlations with NO_X Reduction System and Dry Ash Landfill operations.

<u>DFAL Stilling Pond (F-16A) Contingency Sampling and Actions</u>

If the influent to the DFAL Stilling Pond contains an ammonia nitrogen concentration exceeds 0.36 mg/L (half the 0.72 mg/L conservative target level), then the discharge from F-16A shall be monitored on a daily basis until the influent levels return to 0.36 mg/L. If the ammonia nitrogen concentration at the discharge reaches 0.54 mg/L, then appropriate action to ensure that the DFAL Stilling Pond discharge does not exceed 0.72 mg/L will be implemented. Polly Branch would also be sampled for pH, temperature, and ammonia nitrogen to calculate the applicable toxicity level for ammonia. Options include reducing or stopping operation of the NO_X Reduction System or enhancing ammonia removal in the DFAL storm water runoff system. Should these trigger levels be exceeded, then the DFAL Stilling Pond discharge shall be monitored on a daily basis until the levels return to the applicable ammonia toxicity concentration.

<u>Dry Fly Ash Landfill (DFAL) Groundwater</u>

Rigorous groundwater monitoring will be conducted to provide on-going evaluation of concentration trends of ammonia and its reaction products in the region immediately downgradient of the ammoniated fly ash disposal area to assess need for remediation to protect aquatic life in Holston River. The program is designed to ensure adequate time to implement remediation before concentration entering river exceeds NH_3-N CMC of 2.09 mg/L.

Initially, existing groundwater monitoring well No. 1 and wells 28 through 32 will be sampled semiannually to determine baseline groundwater ammonia nitrogen concentrations.
A network of observation and control wells (OWs) spaced 300 ft apart will be installed in phases over time along downgradient boundary of the ammonia-contaminated dry fly ash stacking area in the DFAL. The initial network will be located just downgradient of the portion of DFAL receiving ammonia-contaminated fly ash during the first 3-4 years of SNCR (or high dust SCR) operation. Wells will be screened to intercept shallow groundwater just below water table. The need for additional wells will be determined on the basis of monitoring results at initial wells. Observation and Control Wells will initially be sampled quarterly. More frequent monitoring will occur if results indicate upward NH_3-N trends. In addition, sampling of leachate directly beneath ammonia-contaminated fly ash storage areas would be performed annually using either permanent or temporary suction lysimeters.

An action limit of 2.09 mg/L NH_3-N will be applied at observation wells. Modeling analyses (Appendix D) indicate that once NH_3-N levels reach the action level, remediation must be implemented within 300-400 days to avoid aquatic impacts. Should the action limit be exceeded at any of the observation wells, TVA is committed to installation of a remediation system within one year.

Table B-1. Sampling Locations and Parameters

Sampling Event	Location	Frequency	Parameter	Method*
Baseline Flue Gas or Stack	Stack	At full load with and without ammonia/urea injection	Ammonia Stack Flow, NO_X, other relevant operating parameters	Conditional Test Method 027
Baseline Flue Gas or Stack	After stack exit	During each source test	Opacity	EPA Method 9
Visible Emission Evaluation	After stack exit	30 minutes each day that meteorological conditions permit	Opacity	EPA Method 9
Fly Ash Sampling (two furnaces so from each furnace's ESP)	NO_X Reduction Unit one Hopper from 1st Row and one Hopper from 2nd Row	Daily, Monday-Friday (when in operation and after significant changes in injection rates)	Ammonia as N [?]	Field Test (Hach Colorimetric Test or other); TVA CLS Method
Receiving Streams	Polly Branch upstream of DSN 001	Once prior to operation (Spring 2006)	Ammonia as N	EPA 350.1
"	"	"	Nitrate-Nitrite as N	EPA 353.2
"	"	"	Total Kjeldahl Nitrogen	EPA 351.2
"	"	"	pH	In-Situ Probe
"	"	"	Temperature	In-Situ Probe
"	"	"	Alkalinity	EPA ? titration
"	"	"	Dissolved Oxygen	In-Situ Probe
"	Polly Branch upstream of DSN 001	Daily when NH_3-N concentration at the DFAL stilling pool discharge equals or exceeds 0.54 mg/L NH_3-N	Ammonia as N	EPA 350.1
"	"	"	Nitrate-Nitrite as N	EPA 353.2
"	"	"	Total Kjeldahl Nitrogen	EPA 351.2
"	"	"	pH	In-Situ Probe
"	"	"	Temperature	In-Situ Probe
"	"	"	Alkalinity	EPA ? titration
"	"	"	Dissolved Oxygen	In-Situ Probe
"	Holston River at JSF Intake	Once prior to operation (Spring 2006)	Ammonia as N	EPA 350.1
"	"	"	Nitrate-Nitrite as N	EPA 353.2
"	"	"	Total Kjeldahl Nitrogen	EPA 351.2
"	"	"	pH	In-Situ Probe
"	"	"	Temperature	In-Situ Probe
"	"	"	Alkalinity	EPA ? titration
"	"	"	Dissolved Oxygen	In-Situ Probe

Table B-1. Sampling Locations and Parameters

Sampling Event	Location	Frequency	Parameter	Method*
Ash Pond Sampling	ash pond inflow	once every 2 weeks	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe
Ash Pond Sampling	ash pond discharge (001)	once every 2 weeks	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe
NO_X Reduction Unit's APH Wash Water Sampling: Post Wash	Contents of Metal Cleaning Pond	After Mixing and Before Discharge	Ammonia as N	EPA 350.1
DFAL Leachate Collection Sampling	Inflow to the Waste Stabilization Pond	Quarterly	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe
Waste Stabilization Pond Sampling	Near (IMP 008) to the ash pond	Quarterly	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe
Dry Fly Ash Stack Storm Water Runoff Event Sampling	dry fly ash ditch near working face	During Rain Induced Runoff Events	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe
	dry fly ash sediment pond inflow	During Rain Induced Runoff Events	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe

Table B-1. Sampling Locations and Parameters				
Sampling Event	**Location**	**Frequency**	**Parameter**	**Method***
	dry fly ash sediment pond effluent	During Rain Induced Runoff Events	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe
	dry fly ash stilling pond inflow	During Rain Induced Runoff Events	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe
	dry fly ash sediment ponds discharge (F-16A)	During Rain Induced Runoff Events	Ammonia as N	EPA 350.1
	"	"	Nitrate-Nitrite as N	EPA 353.2
	"	"	Total Kjeldahl Nitrogen	EPA 351.2
	"	"	pH	In-Situ Probe
	"	"	Temperature	In-Situ Probe
Groundwater	Wells # 1, 28-32	semi-annually (2 times per year)	Ammonia as N	EPA 350.1
		"	Nitrate-Nitrite as N	EPA 353.2
		"	Total Kjeldahl Nitrogen	EPA 351.2
	New Observation Wells	quarterly	Ammonia as N	EPA 350.1
		"	Nitrate-Nitrite as N	EPA 353.2
		"	Total Kjeldahl Nitrogen	EPA 351.2
Vadose Zone Water	Suction lysimeters	annually	Ammonia as N	EPA 350.1
		"	Nitrate-Nitrite as N	EPA 353.2
		"	Total Kjeldahl Nitrogen	EPA 351.2

Sampling

In the event of operational changes or an emergency, plant personnel would need to notify the sampling team. This includes unit operation changes that would affect ammonia loading.

Each water sample would be collected as a grab sample, using either automatic or manual sampling techniques, as necessary. Samples would be collected in appropriate containers and either hand-delivered or shipped via Federal Express to ECHEM or an approved contractor laboratory. Samples of dry fly ash would be collected at the appropriate NO_X reduction unit's hopper locations and the fly ash silo and remain as separate, discrete samples. The solid ash samples would be sent to ECHEM in wide-mouth glass jars, Boston-Round poly bottles, or other appropriate containers.

APPENDIX C – SUBSURFACE TRANSPORT OF AMMONIATED ASH LEACHATE FROM DRY STACKING FACILITY TO HOLSTON RIVER

Groundwater Computer Modeling Analyses for
Alternative C- Install SNCR on Units 1 – 4,
Alternative E-Install High-Dust SCR on Units 1 – 4,
and Alternative F if SNCR or High-Dust SCR are Included

Since SNCR would operate at a constant ammonia slip rate, fly ash produced by these processes would be expected to contain approximately the same ammonia content. High-dust SCR would be expected to produce fly ash with less ammonia on the ash when the catalysts are new with increases as the catalyst ages. Dry ammoniated fly ash produced by the SNCR or high-dust SCR systems would be stacked directly on top of existing ash in the dry stacking area. The total area proposed for future dry stacking is approximately 63 acres. This area generally includes the region encompassed by the 1,130-foot elevation contour of the existing dry stack. No more than approximately 10 acres of dry ash would be exposed at any time during the stacking process. Six to 12 inches of interim cover in compliance with the facility operations plan would be applied to inactive disposal areas. At current rates of fly ash production and marketing, the disposal area would reach maximum capacity after about 10 years. The ash stacking facility would then be closed. Final cover would include (in ascending order) 1 foot of compacted soil cover, a geosynthetic clay liner, a geotextile drainage layer, followed by a 1-ft layer of vegetated topsoil (Tribble & Richardson, Inc., and Law Engineering, Inc., May 1997).

<u>General Approach</u>

The effects of ammoniated ash leachate seepage from ash generated during a one-year SNCR demonstration on groundwater resources and water entering the Holston River were evaluated using two coupled numerical models. The analysis assumed ash produced during the demonstration would be deposited over a 10-acre area within the existing dry stack as shown on Figure C-1. Downward transport of leachate produced by rainfall percolating through variably-saturated ash deposits to the groundwater table was simulated with the HYDRUS-1D variably-saturated flow and transport code (Simunek et al., 2005). The predicted time series of leachate rate and NH_3-N concentration at the water table were subsequently incorporated as boundary conditions into a revised three dimensional groundwater flow model (Boggs and Reeves, 1998) previously developed for a portion of the JSF reservation (including the ash dry stack).

Numerical simulations involving three-dimensional steady-state groundwater flow and transport modeling of the saturated overburden were conducted using MODFLOW (McDonald and Harbaugh, 1984) and MT3DMS (Zheng and Wang, 1999), respectively. Simulations using MODFLOW and MT3DMS were intended to provide temporal predictions of NH_3-N mass flux rates to the Holston River following deposition of ammoniated ash. The transport model conservatively assumes no sorption and no kinetic reactions of NH_3-N, but allows dispersion of NH_3-N with ambient groundwater flowing beneath the stack toward to the Holston River. Estimates of the maximum NH_3-N concentration entering the river were subsequently used to evaluate potential aquatic impacts of ammoniated ash leachate in the Holston River (see Section 4.3 and Appendices A and H).

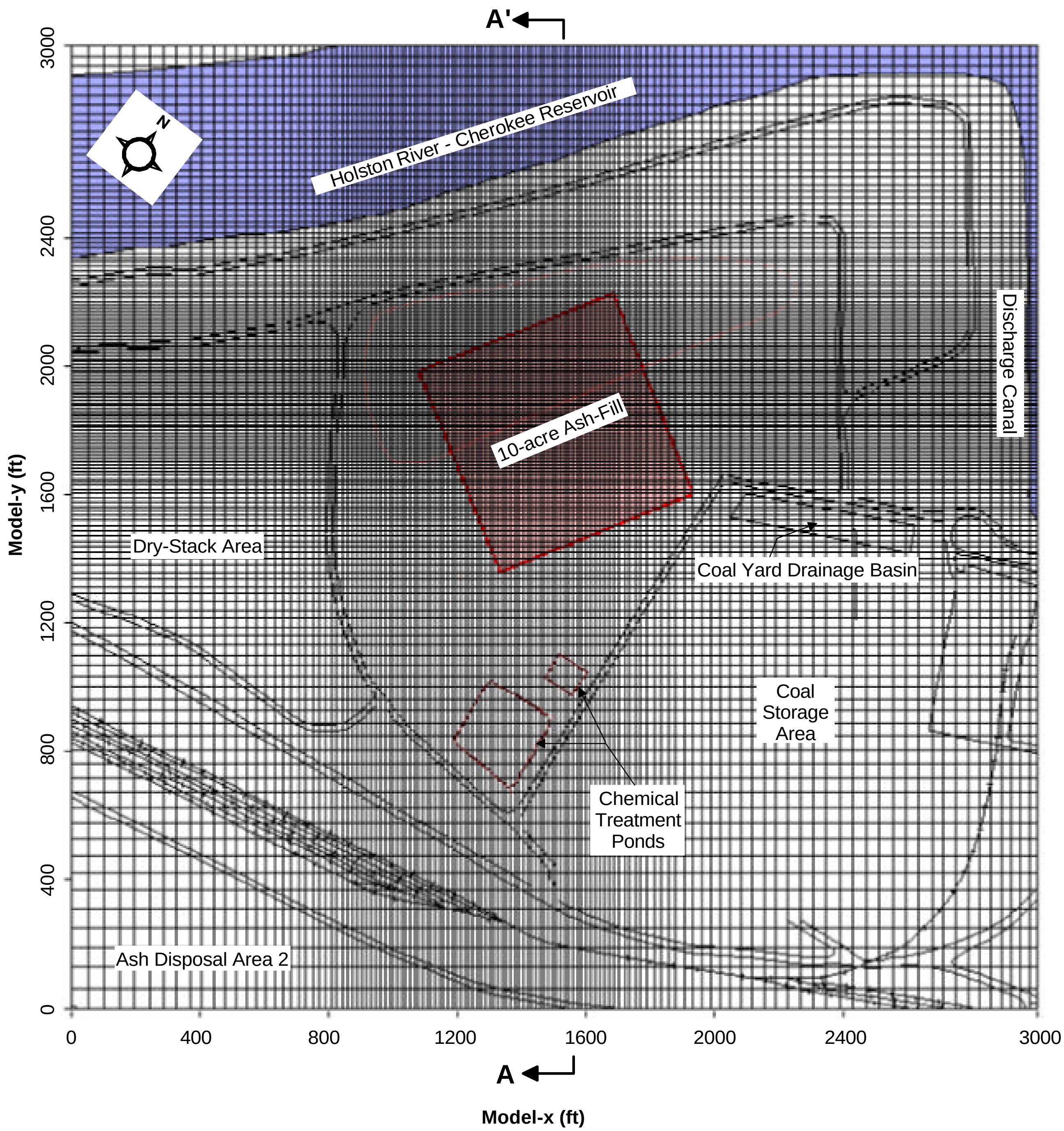

Figure C-1. Plan View of 3D Model Grid Showing Ammoniated Fly Ash Demonstration Area

Vertical Transport of Ammoniated-Ash Leachate to the Groundwater Table

HYDRUS-1D simulates water, heat, and solute movement in one-dimensional variably-saturated media. The program solves Richards' equation for variably-saturated water flow and convection-dispersion type equations of heat and solute transport using the finite element method. The solute transport equations consider convection and dispersion in the liquid phase, as well as diffusion in the gaseous phase. A complete description of the code is presented in Simunek et al. (2005).

The conceptual model profile of the 10-acre area receiving ammoniated ash during the demonstration is presented in Figure C-2. The upper layer of the model consists of 12.7 feet of ammoniated ash, representing the average ash thickness resulting from application of 236,000 tons of ash per year over 10 acres. The ammoniated ash resides above elevation 1130 ft on older ash deposits. The water table beneath this portion of the ashfill averages about 1100 feet and forms the lower model boundary. A 30-foot section of nonammoniated ash is present between the water table and the overlying ammoniated ash. A uniform nodal spacing of 2 cm was applied over the 1302 cm (42.7 ft) vertical dimension of the model.

Hydraulic properties used in model are given in Table C-1. Reported data are for nonammoniated ash samples, but are also assumed to apply to ammoniated ash. Parameters required for ammonia transport simulations are presented in Table C-2. No adsorption of ammonia (or ammonium) on underlying nonammoniated ash is conservatively assumed in the analysis even though some ammonium adsorption would be expected.

The HELP model was used to obtain daily water budget predictions of the ash dry-stack (described in Appendix H). These results were used to provide daily estimates of precipitation, evaporation, and runoff for upper boundary conditions of the HYDRUS-1D model. Precipitation data measured at the Greenville agricultural experiment station from 1990-99 were used. Simulations were initiated on 5/1/1990 (i.e., beginning of the normal ozone season) to approximate meteorological conditions during the first year of the SNCR demonstration. The layer of ammoniated ash was initially saturated with leachate containing 31.4 mg/L of NH_3-N in order to approximate leaching of ammonia from ash. (The initial NH_3-N concentration assumes complete leaching of each unit volume of ash having NH_3 content of 12.5 mg/kg by one pore volume of water.) A uniform moisture content of 0.22 was initially applied to all ash below the ammoniated ash layer (Velasco and Boggs, 1992). Infiltrating precipitation at the upper boundary was assumed to contain no NH_3-N. A zero concentration gradient was applied at the lower model boundary.

The predicted breakthrough of NH_3-N at the water table ammoniated-ash disposal area is shown on Figure C-3. A maximum NH_3-N concentration of 31.1 mg/L reaches the water table after 1950 days (5.3 years) after which concentrations steadily decline. Note that the ash disposal area is assumed to remain uncapped and exposed to further infiltration after the one-year SNCR test period. Consequently, the simulation results reflect complete leaching of ammonia from ash produced during the demonstration. Simulation mass balances for water and solute were 0.001% and 0.013%, respectively.

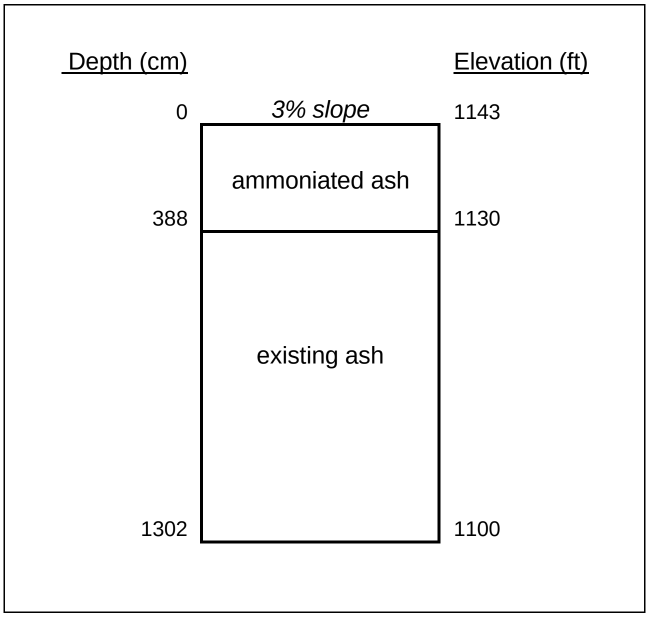

Figure C-2. Conceptual Model of Ash Disposal Area

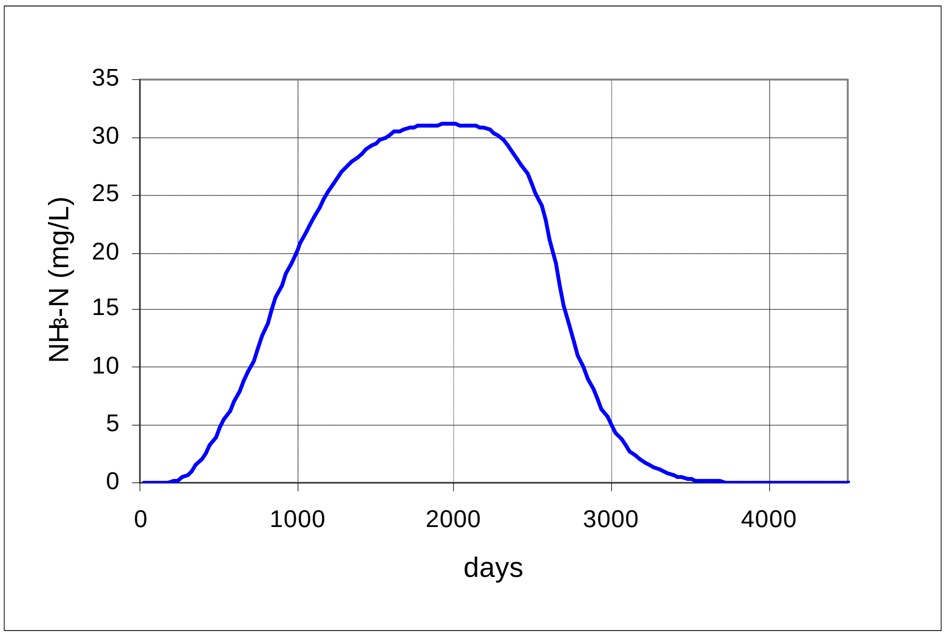

Figure C-3. NH_3-N Breakthrough at the Groundwater Table

Table C-1. Hydraulic Properties of Fly Ash for HYDRUS-1D Simulation

Parameter	Value	Source
Total Porosity	0.44	D. B. Stephens & Associates (1991)
Residual Saturation	0.05	D. B. Stephens & Associates (1991); value is average of main wetting and main drainage curves
Saturated Hydraulic Conductivity (cm/day)	15.6	D. B. Stephens & Associates (1991)
van Genuchten - a (cm^{-1})	0.0012	D. B. Stephens & Associates (1991); based on main wetting curve
van Genuchten - N	2.53	D. B. Stephens & Associates (1991); based on main wetting curve

Table C-2. Ammonia Transport Parameters

Parameter	Value	Source
Aqueous Diffusion Coefficient of Ammonia (cm^2/day)	1.54	Hodgman (1951)
Dispersivity (cm)	100	Based on field data reported by Gelhar et al. (1992)
Distribution Coefficient (cm^3/mg)	0.0	(No adsorption assumed)
Ash Dry Bulk Density (g/cm^3)	1.33	D. B. Stephens & Associates (1991)

Transport of Ammoniated-Ash Leachate to the Holston River

Three-dimensional steady-state groundwater flow and transport modeling of the saturated overburden were conducted using MODFLOW (McDonald and Harbaugh, 1984) and MT3DMS (Zheng and Wang, 1999), respectively. Both of these models have been thoroughly validated and provide global mass balance information. Figure C-1 provides a plan view of the model grid showing the footprint of the 10-acre disposal area.

The current model is subdivided into 131 columns, 152 rows, and 24 layers (477,888 cells). The conceptual model includes four unique hydrogeologic units: ashfill, alluvium, terrace deposits, and bedrock (Sevier Shale) and encompasses an area of about 207 acres. A representative cross section (A-A') of the model showing these hydrogeologic units is shown in Figure C-4. Ground surface for the model is variable and was imported into the model from recent 3D topographic map files. Layering within the model was derived from interpolation three-dimensional surfaces of hydrogeologic units originally developed by Boggs and Reeves (1998) from site boring data.

Recharge boundary conditions for the model were obtained from HELP and HYDRUS-1D simulations described above. HELP predictions of net infiltration result in an average recharge distribution of 3.75 in/yr over nonash portions of the site and 5.5 in/yr over the existing ash disposal area. HYDRUS-1D predictions of net infiltration result in an average recharge distribution of 12.5 in/yr over the 10-acre demonstration area. The constant head boundary prescribed for the Holston River and discharge channel was 1065 ft-msl (historical median elevation). A linear varying constant head boundary (1115 – 1125 ft-msl) was stipulated along the southern margin of the model based on groundwater level measurements and potentiometric mapping described by Boggs and Reeves (1998).

Uniform hydraulic properties were assumed for each hydrogeologic unit in accordance with the model-input data shown in Table C-3. These values are based primarily on aquifer testing and laboratory measurements described by Boggs and Reeves (1998). Note K_v and K_h represent the vertical and horizontal components of hydraulic conductivity, respectively. Longitudinal dispersivity was uniformly applied as 3.28 ft (1 meter) across the model domain. The ratios of horizontal and vertical dispersivity to longitudinal dispersivity are conservatively assumed to equal 0.1 and 0.001, respectively.

For transport simulations of NH_3-N, a transient recharge concentration boundary condition was applied to across the 10-acre demonstration disposal area. Time-series values of NH3-N were imported into the model from the HYDRUS-1D predicted breakthrough of NH_3-N at the water table (Figure C-3).

Model Results

Figure C-5 shows model predicted breakthrough curves of NH_3-N at the Holston River near x = 1400 ft (plume centroid). Note that layers 5 – 13 extend from top to bottom through the alluvium horizon at this location. As shown in Figure C-5, a maximum (peak) NH_3-N concentration of 16.9 mg/L is predicted to reach the Holston River after 3300 days (9 years), with subsequent steadily declining concentrations.

Table C-3. Hydraulic Properties Applied in MODFLOW Simulations

Hydrogeologic Unit	K_h (cm/s)	K_v (cm/s)	Specific Storage (ft^{-1})
Ash Fill	2.0E-4	2.0E-4	3.E-05
Alluvium	3.E-03	6.E-04	3.E-05
Terrace Deposits	6.E-04	6.E-05	3.E-05
Bedrock	1.E-05	1.E-07	1.E-05

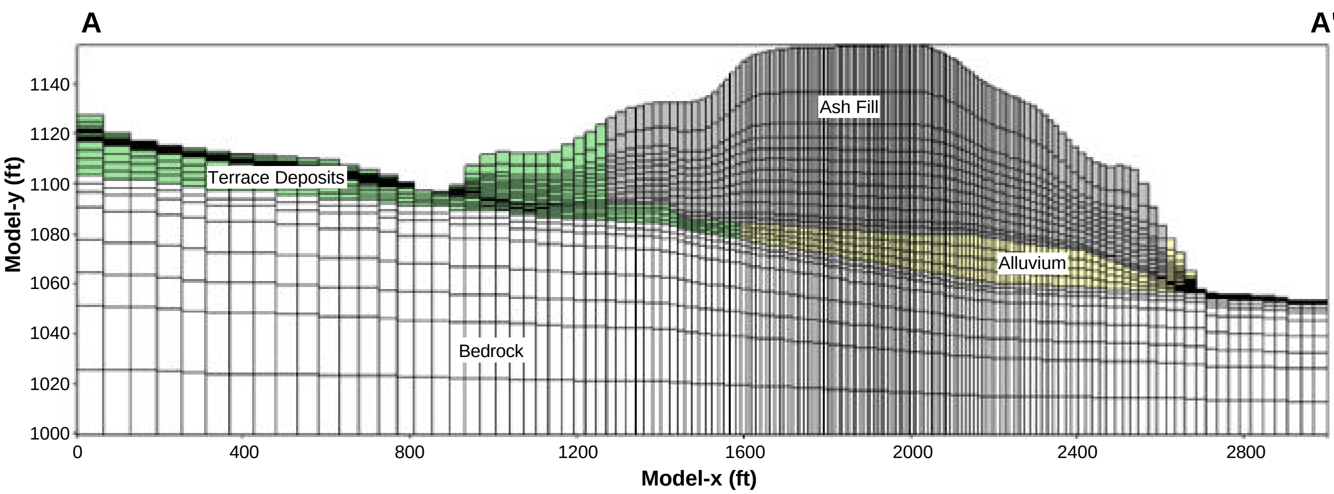

Figure C-4. Profile (A-A') Showing Hydrogeologic Units and Layer Scheme (vertical exaggeration 1:4)

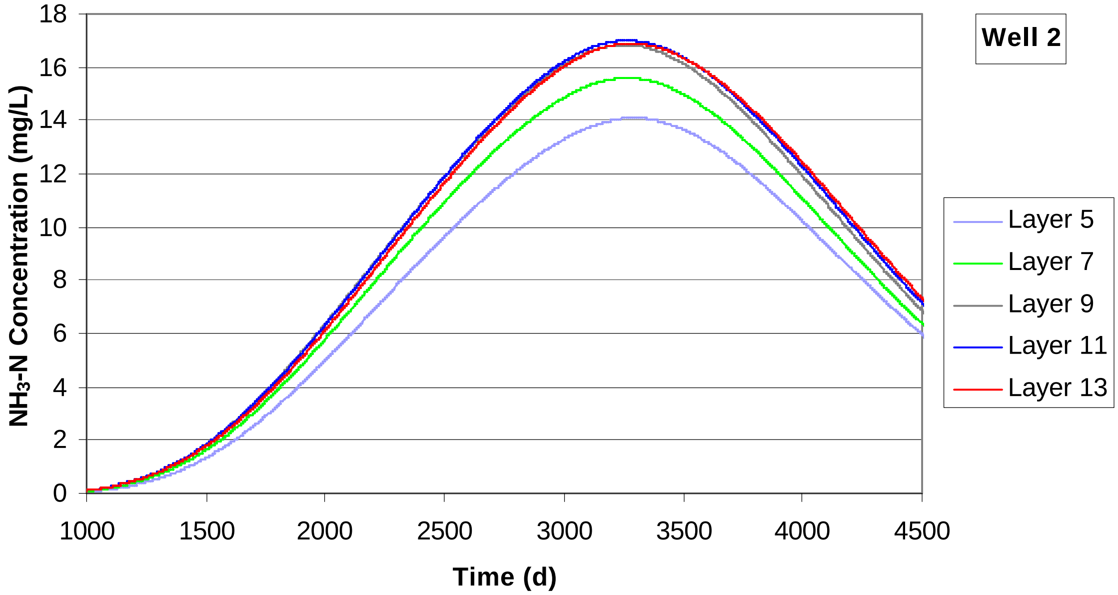

Figure C-5. NH_3-N Breakthrough at the Holston River near x = 1400 ft (Plume Centroid)

Figure C-6 depicts the NH_3-N plume at 3300 days in alluvium of model layer 14. Results indicate leachate seepage would emerge through the riverbed along approximately 1,250 feet of river frontage opposite the stack. For conservatism, no capture of leachate by the existing LCS was assumed. Figure C-7 provides a profile of the NH_3-N plume at 3300 days along x = 1400 ft. This profile exemplifies the plume trend in the vertical; i.e., lateral advective transport via relatively transmissive alluvium. NH_3-N concentrations at 3300 days (peak) and steady-state flux values were extracted from model output along the river seepage face (x=1000 to X=2200 ft). The resulting matrix was used to obtain a peak (3300 day) flow-weighted average NH_3-N concentration entering the Holston River of 7.64 mg/L at a total seepage flux of 3631 ft^3/d.

Table C-4 shows the dimensions of the resulting plume of NH_3-N concentrations in the Holston River, that exceeds applicable water quality criteria.

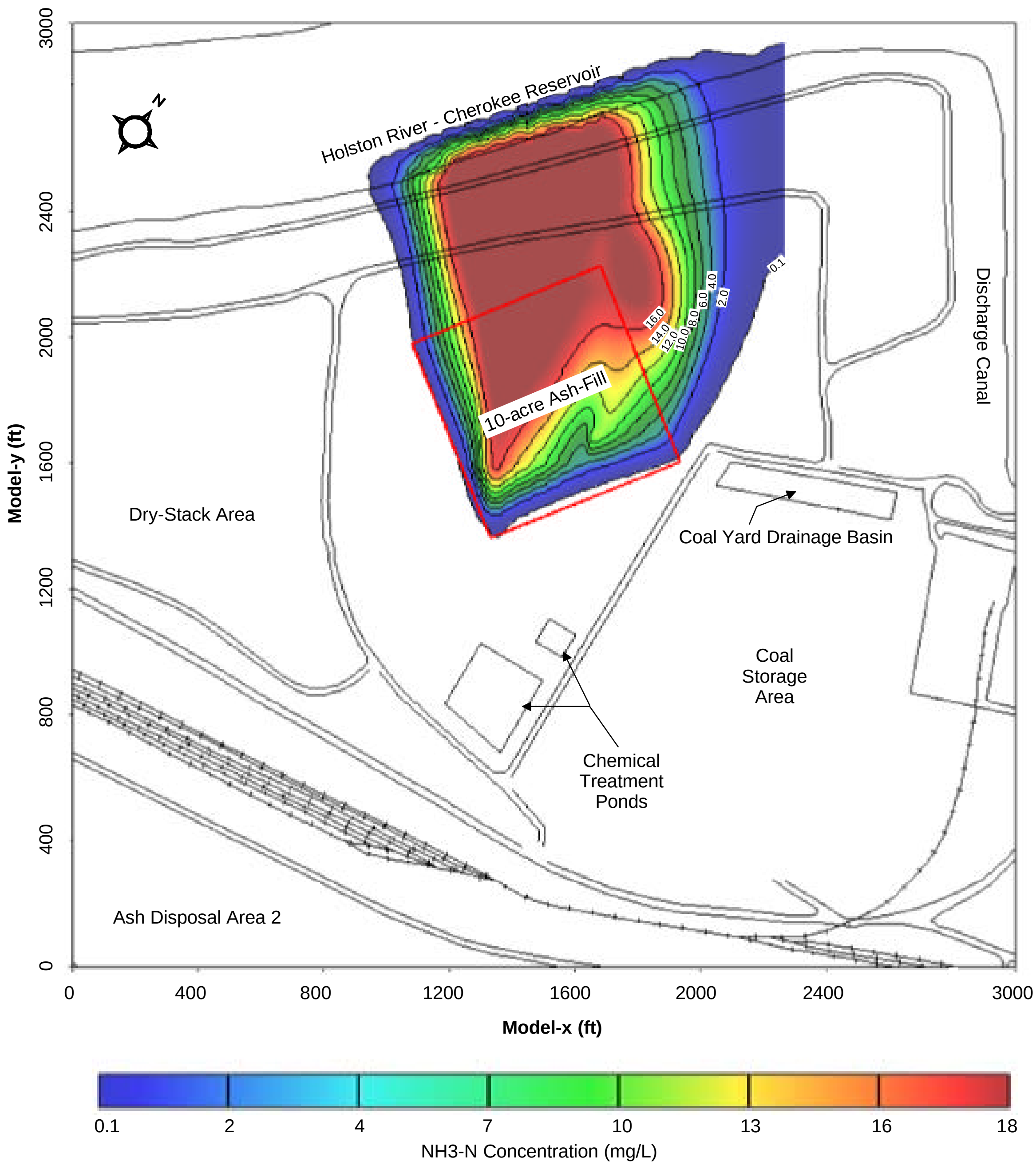

Figure C-6. NH_3-N Plume at 3300 days in Alluvium of Model Layer 14

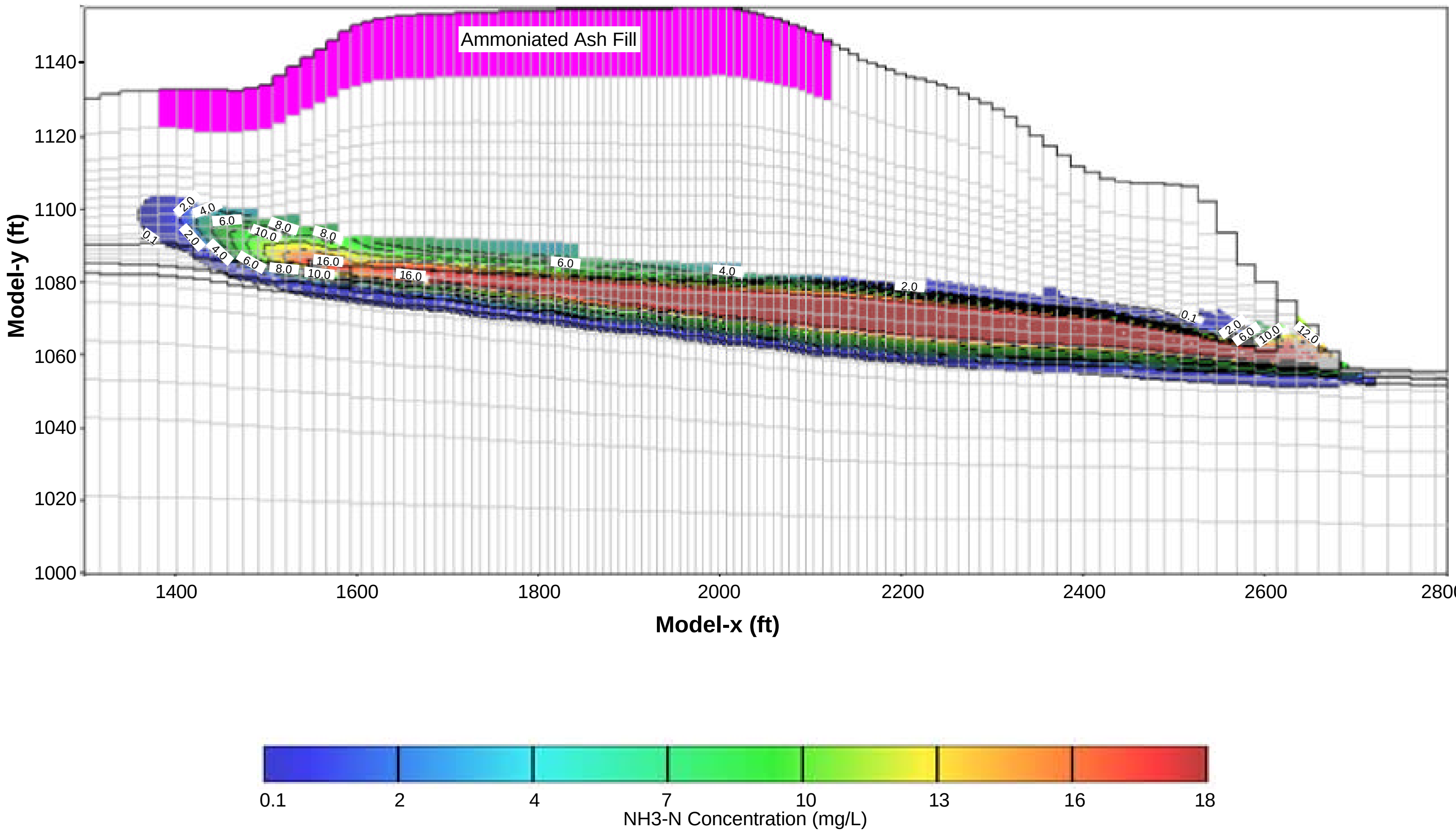

Figure C-7. NH_3-N Plume at 3300 days (Peak Time) along x = 1400 ft (vertical exaggeration 1:4)

Table C-4. Computer Modeling Results of Anticipated Ammonia Leaching From the Left Bank of Holston River Between Miles 106 to 105

River and Flow Characteristics					Groundwater Modeling			3-D Modeling of the NH_3 Plume at Holston River			
								Distance to Reach NH_3 = 0.41 mg/L			
								Perpendicular to Left Bank			
Holston River Flow			River Elev.	Depth	Net Rainfall Recharge (Infiltration)	Flow Q	NH_3-N	Surface	Mid-Depth	Bottom	Along Left Bank
-	Percent of Time	(cubic feet per second)	(feet)	(feet)	(inch/year)	(cfd)	(mg/L)	(feet)	(feet)	(feet)	(feet)
1Q10	<0.03	877	1058	4	5.1	3630	7.6	20	< 1	< 1	1255
Avg	33.0	4000	1059	5	8.5	3630	7.6	10	< 1	< 1	1253

7.6 mg/L NH_3-N corresponds to 12.5 mg/kg NH_3-N on ash (for one-unit operation for a one-year period)

There would be no potential for contamination of off-site water supply wells due to ammoniated ash leachate seepage from the dry stack. Groundwater flow patterns in the stack vicinity suggest that ammonia-affected leachate entering the groundwater system below the base of the dry ash stack would be transported about 500 feet north by shallow groundwater to the Holston River. All leachate seepage would discharge into the river through the riverbed along approximately 1,250 feet of river frontage opposite the dry stack. No impacts to existing or future groundwater users in the site vicinity would occur since all property downgradient of the ash stack lies within the plant reservation. Furthermore, there would be no opportunity for development of large production wells in the vicinity of the plant reservation that could alter existing groundwater gradients and induce off-site movement of contaminated groundwater. Bedrock in the site vicinity is comprised of the Sevier Shale, which is not an aquifer, and is capable of supporting only small domestic water-supply wells.

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APPENDIX D – CORRESPONDENCE RECEIVED FROM AGENCIES DURING INTER-GOVERNMENTAL REVIEW

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
Regulatory Branch
3701 Bell RD
Nashville, TN 37214

January 10, 2006

Regulatory Branch

SUBJECT: File No. 1temp2006; Draft Environmental Assessment - Control Systems for Reduction of Nitrogen Oxides at John Sevier Fossil Plant (JSF) Units 1-4, Near Rogersville, in Hawkins County, Tennessee

RECEIVED
Environmental Policy and Planning

JAN 17 2006

Doc. Type: EA - Admin Record
Index Field: Consultation / Interagency
Project Name: John Sevier (JSF) NOx Reduction
Project No.: 2004-100

Mr. Bruce L. Yeager
Tennessee Valley Authority
400 Summit Hill Drive, WT 9B
Knoxville, Tennessee 37902

Dear Mr. Yeager:

This refers to your recent request for comments to the subject Draft Environmental Assessment (DEA). The DEA considers options for additional removal of nitrogen oxides (NO_x) from coal combustion flue gases at JSF. The TVA is considering four alternative technologies either alone or in combination (six total alternatives including No Action). The systems under consideration would be primarily installed within the existing plant structure. In the future, please reference File No. 1temp2006 when writing or calling us about this work.

The regulatory authorities and responsibilities of the Corps of Engineers (Corps) in inland waters are based on two laws: Section 404 of the Clean Water Act (33 USC 1344) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403). Section 404 requires a Corps permit for any discharge of dredged or fill material into waters of the United States (WUS) including wetlands. Section 10 prohibits the obstruction or alteration of navigable WUS without a Corps permit. Since TVA is not required to obtain Section 10 permits for work within the Tennessee River Basin, the work described in the DEA would only be subject to Section 404.

Figure 2.2 of the DEA shows that two wetlands, totaling approximately 5.9 acres, have been identified within the plant property. From the information provided in the DEA, we were unable to determine if these wetlands are jurisdictional WUS. However, the DEA states that these areas would experience negligible to no impacts.

The DEA indicates that under certain alternatives an outfall would be constructed in the Holston River upstream of Polly Branch Creek. The outfall would be installed by either the open-cut or the directional drilling method. Under the open-cut option, two 15" diameter pipes would be buried in the bank and then laid/anchor on the channel bottom up to the middle of the Holston River. A multi-port diffuser structure would be attached at the end of the pipes. A sign would be posted on the bank and buoys placed in the river spaced every 75 to 100'. Under the second option, the pipes would be installed by the directional drilling method to avoid obstruction of the river channel. We recommend that the directional drilling option be selected to minimize navigation and water quality impacts.

Thank you for including us in your scoping process. When available, we would appreciate a copy of the final EA for our files. If you have any questions, please contact me at the above address or telephone (615) 369-7519.

Sincerely,

J. Ruben Hernandez
Project Manager
Operations Division

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

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Doc. Type: EA - Admin Record
Index Field: [illegible]
Project Name: [illegible]
Project No.: 2004-190

January 10, 2006

Mr. Jon M. Loney
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

Re: FWS No. 2006-FA-0213

Dear Mr. Loney:

Thank you for your letter and enclosure received on December 7, 2005, regarding the Draft Environmental Assessment (EA) entitled John Sevier Fossil Plant Units 1 through 4 Control Systems for Reduction of Nitrogen Oxides. The John Sevier Fossil Plant is located near Rogersville, Hawkins County, Tennessee. The proposed action includes the implementation of various nitrogen oxide control technologies, including low nitrogen oxide burners and boiler modifications, selective non-catalytic reduction, and selective catalytic reduction. The proposed action may eventually improve air quality by reducing nitrogen oxide emissions from the plant by approximately 90%. U.S. Fish and Wildlife Service (Service) personnel have reviewed the information submitted and offer the following comments for consideration.

The draft EA is adequate and supports the conclusion of "no effect" for the federally endangered gray bat (*Myotis grisescens*) and Indiana bat (*Myotis sodalis*), and the federally threatened bald eagle (*Haliaeetus leucocephalus*), with which we concur. In view of this, we believe that the requirements of section 7 of the Endangered Species Act of 1973, as amended, are fulfilled. Obligations under section 7 of the Act must be reconsidered if (1) new information reveals impacts of the proposed action that may affect listed species or critical habitat in a manner not previously considered, (2) the proposed action is subsequently modified to include activities which were not considered during this consultation, or (3) new species are listed or critical habitat designated that might be affected by the proposed action.

Thank you for the opportunity to comment on this action. If you have any questions, please contact Steve Alexander of my staff at 931/528-6481 (ext. 210) or via e-mail at *steven_alexander@fws.gov*.

Sincerely,

Lee A. Barclay

Lee A. Barclay, Ph.D.
Field Supervisor

November 2, 2004

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

Mr. J. Bennett Graham
Tennessee Valley Authority
Post Office Box 1589
Norris, Tennessee, 37828-1589

RE: TVA, SEVIER FOSSIL PLANT/NOx REDUCTION/AMMONIA STORAGE TANKS, UNINCORPORATED, HAWKINS COUNTY

Dear Mr. Graham:

In response to your request, received on Friday, October 29, 2004, we have reviewed the documents you submitted regarding your proposed undertaking. Our review of and comment on your proposed undertaking are among the requirements of Section 106 of the National Historic Preservation Act. This Act requires federal agencies or applicant for federal assistance to consult with the appropriate State Historic Preservation Office before they carry out their proposed undertakings. The Advisory Council on Historic Preservation has codified procedures for carrying out Section 106 review in 36 CFR 800. You may wish to familiarize yourself with these procedures (Federal Register, December 12, 2000, pages 77698-77739) if you are unsure about the Section 106 process.

After considering the documents you submitted, we determine that THERE ARE NO NATIONAL REGISTER OF HISTORIC PLACES LISTED OR E LIGIBLE PROPERTIES AF FECTED BY THIS UNDERTAKING. We have made this determination either because of the specific location, scope and/or nature of your undertaking, and/or because of the size of the area of potential effect; or because no listed or eligible properties exist in the area of potential effect; or because the undertaking will not alter any characteristics of an identified eligible or listed property that qualify the property for listing in the National Register or alter such property's location, setting or use. Therefore, we have no objections to your proceeding with your undertaking.

If you are applying for federal funds, license or permit, you should submit this letter as evidence of consultation under Section 106 to the appropriate federal agency, which, in turn, should contact us as required by 36 CFR 800. If you represent a federal agency, you should submit a formal determination of eligibility and effect to us for comment. You may find additional information concerning the Section 106 process and the Tennessee SHPO's documentation requirements at www.state.tn.us/environment/hist/sect106.shtm. You may direct questions or comments to Joe Garrison (615) 532-1550-103. This office appreciates your cooperation.

Sincerely,

Herbert L. Harper

Herbert L. Harper
Executive Director and
Deputy State Historic
Preservation Officer

HLH/jyg

APPENDIX E - LIMITATIONS ON HOW FAST AMMONIA CAN BE AIR-STRIPPED - AMMONIA RELEASES TO THE AIR FROM PH ADJUSTMENT AND AIR STRIPPING OF AMMONIA IN THE IRON POND

Expected amounts of ammonia from the washing of the APHs every six months at JSF are 778 to 3,888 lbs of ammonia for each of the four units. The estimated worst-case scenario for all four units would be 15,552 lbs of ammonia. An alternative scenario for all four units would be 3112 lbs of ammonia. The tables below show the evaporation rate required to evaporate the ammonia over a certain number of days and the corresponding concentration at an elevation of 1.5 meters at a distance of 86 meters (282 feet) and 500 meters (1,640 feet) away from the chem pond. The distance of 86 meters is for someone relatively close to the pond and the distance of 500 meters is the distance to a fisherman. The ammonia is assumed to evaporate over the whole area (1.55 acres) of the pond.

Table E-1. Ammonia Concentration at Various Distances from Iron Pond Assuming Worse Case of 15552 Lbs of Ammonia (3888 Lbs Ammonia from each Unit)

Number of Days Required for Evaporation	Ammonia Evaporation Rate, lbs/hr	Ammonia Concentration at 86 m (282 ft), ppm	Ammonia Concentration at 500 m (1640 ft), ppm
2	324	279	72
7	93	80	21
13	50	43	11
21	31	27	7
60	11	9	2
180	4	3	1
324	2	2	0.4

Table E-2. Ammonia Concentration at Various Distances from Iron Pond Assuming Alternative Scenario of 3112 Lbs of Ammonia (778 Lbs Ammonia from each Unit)

Number of Days Required for Evaporation	Ammonia Evaporation Rate, lbs/hr	Ammonia Concentration at 86 m (282 ft), ppm	Ammonia Concentration at 500 m (1640 ft), ppm
2	65	56	14
7	19	16	4
13	10	9	2
21	6	5	1
60	2	2	0.4
180	1	1	0.2
324	0.4	0.3	0.1

People can smell ammonia at a 2-ppm concentration. The following table lists threshold concentration values for ammonia vapor.

Table E-3. Threshold Concentration Values for Ammonia Vapor		
Concentration	**Application**	**Reference**
25 ppm	Recommended exposure limit for 10-hour workday during a 40-hour work week.	NIOSH Guide and ACGIH
35 ppm	Short-term exposure limit not to be exceeded in a 15-minute period.	NIOSH Guide and ACGIH
50 ppm	Permissible exposure limit	OSHA
197 ppm	The concentration that defines the endpoint for a hazard assessment of off-site consequences.	40 CFR 68
500 ppm	Concentration that is immediately dangerous to life or health for a worker without a respirator with an exposure time greater than 30 minutes.	NIOSH Guide and ACGIH

Therefore, for the worse case scenario the ammonia would need to be evaporated over a 60-day period to stay at a concentration where the ammonia could be detected by smell at 500 meters. The ammonia could be evaporated over a 13-day period for the alternative scenario to stay at a concentration where the ammonia could be detected by smell at 500 meters.

APPENDIX F – PRELIMINARY DRY STACK STILLING POND DISCHARGE DIFFUSER DESIGN

When setting up an Appendix cover page, put an odd page section break before and after the cover page. Go to page setup, and on the layout tab, choose vertical alignment as center. Choose APPENDIX from the style menu before typing the appendix title.

Two routes for diffuser feed pipes were evaluated in the design of a diffuser for JSF.

1. Reduce the two existing 36-inch outflow dry stack stilling (DSS) pond concrete pipes to two 15-inch diameter schedule 40 polyethylene pipes; the bank would be bored from the outflow to the middle of the Holston River, using the Horizontal Directional Drilling (HDD) technique. This technique would be recommended because it would avoid obstruction of the river channel. See Figures F-1 and F-2. A 10-foot diffuser with 20, 4-inch-diameter ports, located at the bottom channel in the same direction of the flow (to minimize river obstruction) would be attached to each of the pipes. Lubricants used when boring should conform to site environmental procedures (i.e., not result in a reportable sheen).

2. Reduce the two existing 36-inch outflow DSS pond concrete pipes to two 15-inch diameter schedule 40 polyethylene pipes; the two pipes would be buried from the outflow on the bank and laid on the bottom channel to the middle of the Holston River (see Figure F-2). A 10-foot diffuser with 20, 4-inch-diameter ports, located at the bottom channel in the same direction of the flow (to minimize river obstruction) would be attached to each of the pipes. The TVA navigation group specified that a sign on the bank and buoy in the river spaced every 75 to 100 feet should be at all times visible to the public. However, many problems could be created with exposed pipes.

   - Hydraulics, obstruction to the river flow
   - Deterioration of the pipes due to exposure (solar) and to debris (tree trunks)
   - Scouring
   - Sediment deposition
   - Safety issues boats, fisherman, “stumbling” on the pipes (during low level river conditions)
   - Yearly maintenance of the buoy since the water level at that location varies up to 17 feet from winter to summer pool and during flood conditions.

Hydraulically, both routes for diffuser feed piping would be feasible; however, the cost vs. possible environmental impacts should be carefully studied to make a decision on the final design.

Computer modeling of the mixing of NH_3-N contaminated storm water with the Holston River flow after discharge from the diffuser for several flow and concentration scenarios indicated the protective CCC concentration of 0.41 mg/L NH_3-N would quickly be reached for all potential scenarios, i.e. varying concentrations of NH3-N in the DSS pond which could be expected to result from varying concentrations of NH_3-N on the fly ash..

Hydraulic Computations for Diffuser Pipe Sizing

The flow through the diffusers is gravity flow. The pipe sizing is directly dependent on the existing available total head, which is from the top of the weir in the DSS pond to the Holston River channel water surface. The 100-year Holston River pool elevation was used to design the diffuser system because that is when the minimum available head occurs. The top of the DSS pond elevation corresponding to the 100-year storm event is 1,094.4 feet and 1,076.6 feet at the Holston River pool, thus, the minimum design available head is 17.8 feet. The total head loss through the pipes and diffuser ports should be less than 17.8 feet to avoid an elevation higher than 1,094.4 feet in the DSS pond and unnecessary stress on dikes.

Figure F-1. **Aerial Schematic of Proposed Pipe Layout**

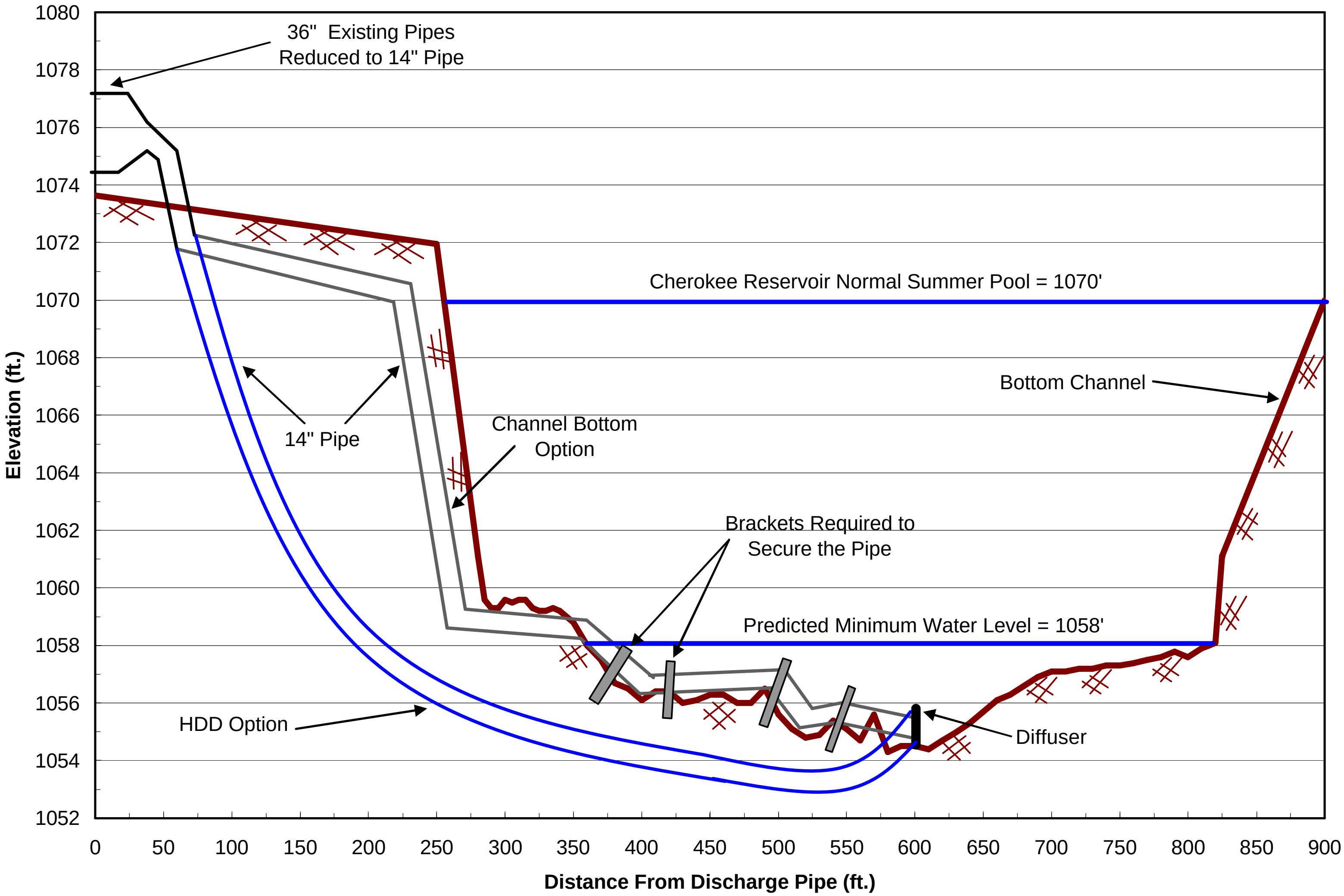

Figure F-2. Schematic of JSF Proposed Pipe Layout

APPENDIX G – AMMONIATED ASH LEACHATE SEEPAGE AND RUNOFF ESTIMATION

This appendix describes the methodology followed in estimating daily rates of ammoniated-ash leachate seepage and storm runoff associated with the dry flyash stack. Also described is the method of estimating the daily average ammonia-nitrogen concentration in storm runoff. This material provides supporting detail for the evaluation of potential impacts of ammoniated ash disposal on local surface water and groundwater resources considered in Sections 4.2.3 and 4.3.2.

Estimation of Daily Leachate Seepage and Runoff Rates

The HELP model of Schroeder et al. (1994) was used to estimate leachate seepage and runoff rates from the dry flyash stack. To facilitate modeling, the 63-acre ashfill proposed to receive ammoniated flyash was divided into two subregions based on waste thickness, surface cover, and surface slope. These include a 10-acre active stacking area having ammoniated ash exposed at the surface and the remaining 53-acre area, which is either temporarily or permanently covered. The schematic profiles of these two subregions shown on Figure G-1 provide the assumed layering and dimensions used in separate HELP models of these areas.

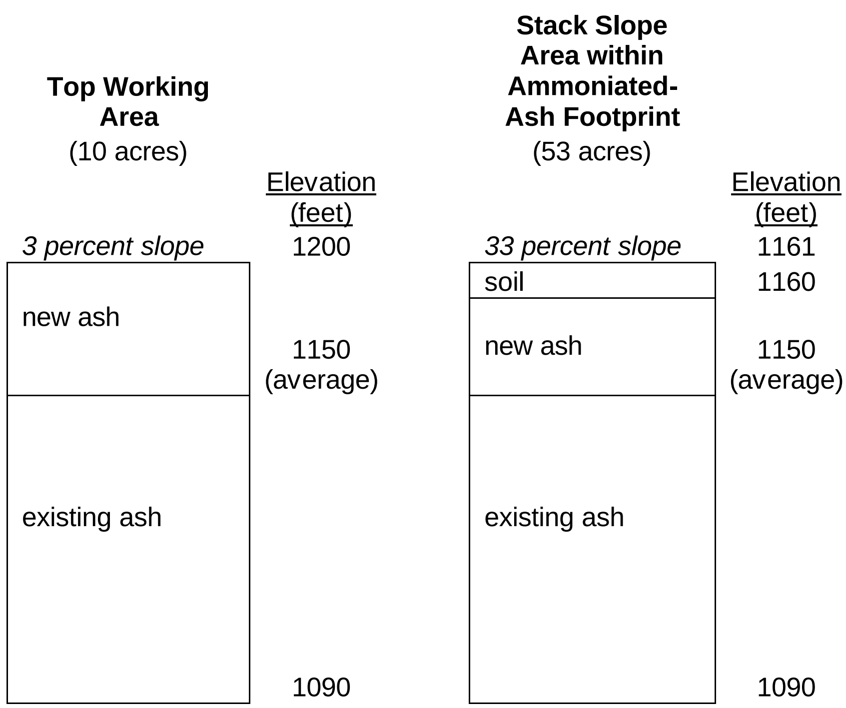

Figure G-1. Conceptual Model Profiles of Ashfill Subregions

Hydraulic properties used in the HELP simulations are presented in Table G-1. Ash data represent average characteristics derived from laboratory testing of three JSF flyash samples (D. B. Stephens & Associates, Inc., 1991). The top soil properties, except for hydraulic conductivity, were obtained Schroeder et al. (1989) for a soil loam. Top soil hydraulic conductivity was set to $1.0x10^{-5}$ based on the dry stack facility operations plan (Tribble & Richardson, Inc. and Law Engineering, Inc., 1997).

Table G-1. Hydraulic Properties Applied in HELP Simulations

Media Type	Total Porosity	Field Capacity[1]	Wilting Point[2]	Initial Moisture Content (cm^3/cm^3)	Hydraulic Conductivity (cm/s)
Top Soil	0.46	0.23	0.12	0.23	1.0×10^{-5}
Existing Ash	0.44	0.33	0.05	0.22	1.8×10^{-4}
Ammoniated Ash	0.44	0.33	0.05	0.25	1.8×10^{-4}

[1]*Moisture content at pressure head of -0.33 bar.*
[2]*Moisture content at pressure head of -15 bars.*

Initial volumetric moisture content for the top soil layer was arbitrarily set at field capacity. The design moisture content of dry-stacked fly ash at the time of emplacement will be 0.25, whereas an initial moisture content of 0.22 was applied to existing fly ash based on average field water contents measured for JSF ash samples (Velasco and Boggs, 1992).

Soil Conservation Service curve numbers (CN), used by HELP to estimate surface runoff, were estimated on the basis of vegetative cover and soil texture relationships provided by Schroeder et al. (1994, Figure 7, p. 39). CN values of 90 were used for exposed fly ash surfaces. Temporary cover consisting of top soil and a fair grass cover was assigned a CN of 80 and a leaf area index of 2.2.

Laboratory measured values of evaporation coefficient of 14.5 mm/day 0.5 and evaporation depth of 30 inches for JSF ash samples, as reported by Velasco and Boggs (1992), were applied to exposed ash surfaces in the current simulations. Cases involving top soil cover assumed 12-inch evaporation depths and an evaporation coefficient of 5.1 $mm/day^{0.5}$ in accordance with guidance provided by Schroeder et al. (1994).

Daily precipitation data recorded at the Greenville agricultural experiment station from January 1990 through December 1999 were used in performing daily water budget estimates for the ash fill. This station is located approximately 25 miles southeast of the plant. Corresponding daily temperature and solar radiation data were internally generated by HELP from site latitude and daily rainfall.

Prediction of Daily Average Ammonia Concentration in Runoff

Estimates of NH_3-N concentrations associated with rainfall runoff from exposed areas of the flyash stack were made using the runoff solute transport model of Wallach et al. (1988), referred to here as WJS88. Transfer of ammonia from the ash pore water to storm runoff is described as a soil molecular diffusion process coupled at the surface with a laminar runoff layer, which is treated as a well-mixed reactor. Daily runoff rates (Q_r) obtained from the HELP model along with measured physical and hydraulic properties of the flyash were applied to the Wallach model to estimate daily runoff ammonia concentrations (C_r). Model input parameters are summarized in Table G-2. Predicted daily C_r and Q_r values for the exposed 10-acre working area of the stack were combined with daily estimates of unaffected runoff from vegetated and/or bottom-ash covered portions of the 53-acre stacking facility to obtain daily flow-weighted average C_r associated with total daily stack runoff.

Table G-2. WJS88 Model Input Parameters

Parameter	Value	Source
Characteristic Length of Runoff Domain (m)	25	Estimated from disposal area dimensions
Slope of Runoff Domain (m)	3%	Tribble & Richardson, Inc. and Law Engineering, Inc., (1997)
Ash Total Porosity	0.44	D. B. Stephens & Associates, Inc. (1991)
Ash Bulk Density (g/cm^3)	1.33	D. B. Stephens & Associates, Inc. (1991)
Ammonia Diffusion Coefficient in Water (m^2/s)	1.78E-09	Hodgman (1951)
Kinematic Viscosity of Water (m^2/s)	1.02E-06	Hodgman (1951)
Friction Factor	0.02	Wallach et al. (1988)
Ash Leachate NH_3-N (mg/L)	31.4	Estimated assuming complete leaching of NH_3-N from unit volume ash by 1 pore volume water

References

Schroeder, P. R., T. S Dozier, P. A. Zappi, B. M. McEnroe, J. W. Sjostrom, and R. L. Peyton. 1994. Hydrologic Evaluation of Landfill Performance Model (HELP): Engineering Documentation for Version 3. U.S. Environmental Protection Agency.

Wallach, R., W. A. Jury, and W. F. Spencer. 1988. Transfer of Chemicals from Soil Solution to Surface Runoff: A Diffusion-Based Soil Model. Soil Science Society of America Journal, 52:612-618.