CHAPTER 3: RESOURCES AND ENVIRONMENTAL IMPACTS

Introduction

<u>Scope of Environmental Issues</u>

The SCR or NO_XTech systems would physically be a minor addition to an expansive heavy industrial facility having a significant property buffer area. The plant areas proposed for installation of the SCR reactors or NO_XTech equipment, ammonia storage and unloading area, inter-connecting ammonia and service water piping, electrical conduits, retention basin, wastewater piping, construction staging area, and temporary or permanent office building, activities associated with implementation of the mitigation actions (i.e., re-routing of the ash pond discharge or implementation of dry fly ash stacking) , have been heavily disturbed by previous plant development activities (see Figure 2-3). No new facilities would be required to unload large equipment transported to the site by barge. As a result, the potential would be small for on-site construction impacts to terrestrial ecology, aquatic ecology, noise, land use, air quality, visual aesthetics, and archaeological and historic resources. The potential off-site construction and operational impacts of the proposed natural gas pipeline necessary for installation of the NO_XTech system was evaluated for all of the resource areas.

Operational impacts are primarily dependent on the engineering features and safeguards of the proposed SCR or NO_XTech systems. These features and safeguards would control the probability and extent of accidental or unintentional releases of anhydrous or aqueous ammonia to the environment. These potential releases and attendant impacts would be:

- Excessive ammonia slip passing through could result in ammonia contamination of the air heater wash causing potential effluent toxicity and/or odor.
- Additionally, fly ash could become contaminated with ammonia and sluiced to the ash pond causing potential effluent toxicity.
- Accidental releases of anhydrous ammonia to the air from the storage and unloading system or truck causing a potential hazard to plant operating personnel, the public, and the environment.
- Direct accidental releases of anhydrous ammonia or aqueous ammonia to surface water causing damage to aquatic life.

A number of assumptions concerning the proposed SCR and NO_XTech systems and their operation are necessary to establish the basis for analyzing the potential environmental impacts of the proposed action. These assumptions are summarized here and addressed in more detail as appropriate in subsequent sections analyzing specific resource areas. Some of these assumptions and other measures are also environmental commitments listed under **Summary of Environmental Commitments** in Chapter 2.

<u>SCR Reactor</u>

Design, Construction and Operational Assumptions

1. A 90% NO_X removal rate would be achieved throughout the life of the system.

2. The SCRs would operate as needed to meet air quality requirements. Although the SCRs are designed for year round operation, their operation during the ozone season of May through September is expected to be adequate to address the concerns for ambient air quality with respect to ozone.
3. An ammonia slip of 2 ppm would not be exceeded during normal operation of SCRs.
4. Catalyst disposal would be managed by a catalyst contractor in compliance with applicable regulations.

NO_XTech System

1. The NO_XTech systems would operate as needed to meet air quality requirements. Although the NO_XTech system is designed for year round operation, its operation during the ozone season of May through September is expected to be adequate to address the concerns for ambient air quality with respect to ozone.
2. An ammonia slip of 5 ppm would not be exceeded during normal operation.

Anhydrous Ammonia System

Design, Construction and Operational Assumptions

1. Three 30,000 gallon (nominal) storage tanks would be installed for the SCR-only installation (Alternative A). For the hybrid NO_XTech/SCR installation (Alternative B) as many as six 30,000 gallon tanks would be installed.
2. A water fogging system with both automatic and manual activation would protect both the storage tanks and the truck/railcar off-loading area by limiting the hazard from large ammonia leaks or catastrophic tank failure.
3. The drainage from the proposed ammonia unloading and storage area would be re-configured to contain the aqueous ammonia generated by operation of the fogging system within the compacted *in situ* earth berm surrounding the Ammonia unloading and discharge facility.
4. The applicable chemical accident prevention measures required under 40 CFR 68 would be implemented prior to filling of the anhydrous ammonia storage system or receipt of ammonia in quantities exceeding 10,000 lbm.
5. Appropriate personal protective equipment (respirators, self-contained breathing apparatus, protective clothing) and training would be provided to operating personnel consistent with Occupational Safety and Health Administration (OSHA) regulations.

Air Quality

Resource Description

The air quality in the vicinity of KIF is generally good, with the area in compliance with all air quality standards. Regionally, air quality is also generally good. For some urban areas, however, attainment of the 1-hour ozone standard has been difficult. Knox County, Tennessee is currently classified as a marginal ozone maintenance area. The area is, however, likely to experience periods when ozone levels will be above the recently adopted 8-hour ozone standard of 80 ppb. In addition, some areas—including

Knox County--are expected to experience periods when fine particulate concentrations will be above the recently adopted annual PM-2.5 standard.

Impacts of No Action

Under the no action alternative current air quality in the vicinity of KIF is expected to continue.

Construction Impacts

Under either action alternative transient air pollutant emissions would occur during the construction phase of this project. Since the KIF 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% 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%.

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 (CO), volatile organic compounds (VOCs), and SO_2 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 manmade 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.

Plant Vicinity Operational Impacts

Operation of the SCR or NO_XTech for either of the options under consideration would not adversely impact local air quality. There would be the possibility, however, of slight increases in ammonia concentrations downwind of the plant site. This possibility is discussed below. Overall, SCR or NO_XTech operation would improve air quality.

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 km 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 in areas previously affected by ozone scavenging, they are not expected to increase above background ozone levels.

Plume Opacity and Plume Blight

Plume opacity is determined by the amount of NO_X and PM emitted. Due to the optical properties of NO_X and fine particulate, these pollutants tend to give a plume a slight reddish-brown color when viewed against a clear sky. Since the SCR or NO_XTech will greatly reduce NO_X emissions, it is also expected to reduce plume opacity and plume blight. There is a possibility that operation of either technology will be accompanied by an increase in SO_3 emissions which could result in some offset of the plume visibility improvements due to NO_X reduction. Since there is no experience with NO_XTech and little with SCRs on large utility boilers, quantification of this potential increase in SO_3 emissions is not possible. The potential exists, however, for minor increases in plume visibility and plume blight under some meteorological and operational conditions.

<u>Regional Operational Impacts</u>

Introduction

The primary purpose of the SCR or NO_XTech installation is to reduce emissions of NO_X, a pollutant which 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 KIF will have on ambient ozone levels. In addition, the potential impact of the operation of NO_X reduction technology on secondary particulate formation and regional haze is described.

Ozone

Ozone is a pollutant which is formed in the atmosphere as the result of exposure to sunlight of a mixture of NO_X and VOCs. 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 national ambient air quality standard (with the exception of a few urban centers). With the recent revision of the ozone standard from a 1-hour average concentration of 120 ppb to an 8-hour average of concentration of 80 ppb, 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 emissions reductions at KIF, 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 km downwind from KIF.

Secondary Particulate and PM-10/PM-2.5

Operation of an SCR or NO_XTech requires the use of ammonia. Although almost all of the ammonia 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 a small increase in particulate due to ammonia emissions would be more than offset by the decrease in particulate due to NO_X reductions associated with SCR or NO_XTech operation (NO_X is a source of secondary particulate).

Cumulative Impacts to Air Quality

Introduction—TVA's Proposed NO_X Control Strategy

TVA is considering the installation of additional NO_X controls, using SCR or other technologies, at up to six other coal-fired power plants (Allen, Cumberland, Paradise Widows Creek, Bull Run and Colbert). Table 3-1 lists all units being considered including the proposed action at KIF. This strategy, which goes beyond current regulatory requirements, would reduce TVA coal-fired power plant NO_X emissions by 51,725 metric tons (57,000 tons) during the ozone season (May to September) beginning in 2003. When combined with other controls already planned to meet the acid rain requirements under the CAA Title IV, the total NO_X reduction during the 2003 ozone season will be 152,450 metric tons (168,000 tons). To meet Title IV requirements, low NO_X burners have already been installed or will be installed by 2000 on 34 TVA boilers with over-fire air on 6 units and combustion optimization on an additional 18 units. The controls would reduce TVA's seasonal NO_X emissions roughly 71% below 1990 levels.

Because the SCR or NO_XTech installations listed in Table 3-1 would satisfy most if not all of TVA's requirements, there are currently no plans to install SCR systems at other units at Johnsonville, Widows Creek units 1-6, Gallatin, John Sevier, and Shawnee Fossil plants. NO_X reduction from these units using SCR systems is more costly and produces less significant environmental benefit than the units identified in Table 3-1.

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 EPA in 1997. The strategy is also consistent with the types of controls that would be needed to comply with EPA's proposed rule for ozone transport, known as the ozone transport SIP call.

NO_X emitted into the atmosphere leads to the formation of ozone and fine particulate, as well as contributing to increased acidity of precipitation. Thus, the cumulative impact on air quality (due to a reduction in NO_X emissions) would be beneficial.

Table 3-1. TVA Fossil Plant Units Planned for Installation of SCR Systems.

Unit	State	Generation Capacity (MW)	Estimated Installation
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	Tennessee	900	2003
Kingston 5-9	Tennessee	800	2004
Colbert 5	Alabama	575	2004
Colbert 1-4	Alabama	800	2005

Ozone Reduction

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 OTAG work which considered the NO_X and VOC emissions in the eastern half of the U.S. 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. (It is important to note that the modeling did not account for additional NO_X emissions reductions that are likely to occur from other utilities as a consequence of recent EPA action establishing statewide NO_X budgets in the eastern states.

Ammonia Storage and Handling Safety

<u>Introduction</u>

Anhydrous ammonia is 99.5% commercial grade ammonia (with 0.5% water) as compared to aqueous ammonia which is a solution of ammonia and water. A saturated aqueous ammonia solution is 47% ammonia by weight at 32°F and at atmospheric pressure (by comparison household ammonia is a 5% solution). Anhydrous ammonia is very volatile and boils at –33.3°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 autoignition temperature is 650°C. The lower explosive level is 16% by volume and the upper explosive level is 27% by volume. The reportable quantity (RQ) under the Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA) for release of ammonia is 100 lbm.

A typical material safety data sheet (MSDS) for anhydrous ammonia is given in Appendix A. Excerpts from the MSDS 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 build up 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 emergency planning. These threshold concentration values for ammonia vapor, their application, and the reference guideline, standard or regulation are listed in Table 3-2.

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

Table 3-2. Ammonia Concentration Limits.

Concentration	Application	Reference
25 ppm (17.75 mg/m^3)	Recommended exposure limit for 10 hour work day 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

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 (ANSI) Standard K61.1 (Compressed Gas Association (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 3-3.

The proposed storage quantity for the Kingston SCR systems (90,000 gallons or 289,883 lbm) would exceed threshold quantities. In addition to on-site storage, anhydrous ammonia must be transported to the plant site to replenish system storage. Railcars with a capacity of 124,919 L (33,000 gallons) would be used.

Table 3-3. Regulatory Threshold Quantities for Ammonia.

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

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
- Transportation mode for ammonia deliveries—rail or truck, and the frequency of deliveries (see **Transportation**)
- 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 protect 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 a surrounding retention basin constructed on *in situ* compacted earth. 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% ammonia by weight. Thus, 3.5 pounds of water must be combined with each pound of ammonia vapor boiling off of a spill to simply achieve a saturated solution. The deluge system would limit the impact of an ammonia leak, though it would not be designed to completely mitigate the worst-case failure of a storage tank or other catastrophic release.

Accidental Release of Anhydrous Ammonia

A Risk Management Plan (RMP) for the storage of anhydrous ammonia will be developed in compliance with 40 CFR 68 and 29 CFR 1910.119. The worst-case scenarios for accidental release of ammonia would be the sudden and complete failure of a railcar or storage tank resulting in the release of a full tank of ammonia. A railcar failure could result in the release of up to 33,000 gallons and a storage tank failure could result in the release of up to 30,000 gallons. Catastrophic releases of ammonia, such as by railcar failure or storage tank failure, could be caused by a major earthquake or a tornado. To judge the risk of these accidents, the probability of major earthquakes and tornadoes were evaluated.

Evaluation of Seismic Hazard

KIF is located in the Appalachian Valley Ridge physiographic province. Bedrock at the KIF site is the Conasauga Formation of Cambrian age. The Conasauga Formation is comprised primarily of a blue-gray shale that contains many lenses of limestone, siltstone and conglomerate (TVA 1965).

The geologic structure in this area is controlled by a large thrust fault located northwest of the site. Rocks at the site above the thrust fault dip to the southeast an average of 45 to 50 degrees. This thrust fault was active hundreds of millions of years ago. Further movement along this fault is not expected because modern day earthquakes in East Tennessee tend to occur several miles beneath the surface, and no recent movement has been observed on similar surface faults in East Tennessee.

The primary source of earthquake hazard to the KIF site is the East Tennessee Seismic Zone (ETSZ). The ETSZ is a 300 km 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 structure at this site will be founded on shallow (less than 14 feet deep), firm soils. Due to the relatively thin soil layer, the effect of soils on earthquake ground motion is negligible. There appears to be no possibility of earthquake-induced liquefaction of the foundation materials based on borings acquired to investigate foundation conditions for this project (LawGibb 2001).

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 USGS performed probabilistic seismic hazard analyses throughout the United States to prepare the 1996 national seismic hazard maps (USGS 1996). The USGS's analysis assumes that foundation conditions correspond to NEHRP B-C site conditions. The hardest rock conditions are category A and the softest soils fall in category F on this scale.

Table 3-4 presents the USGS's seismic hazard values for a location (35.9° N, -84.5° W) that is very near KIF. The USGS expresses seismic hazard as the minimum horizontal ground motion that would be expected to occur during three time spans (return periods): 475, 950 and 2375 years. The ground shaking is computed at four different frequencies of motion: PGA, 5.0, 3.3 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 3-4 shows that at a frequency of 1.0 Hertz, the ground should shake with a force of at least 8.1% 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 3-4. Probabilistic Ground Motion Values

	Ground Accelerations in %g		
Ground Motion Frequency (Hertz)	**10% Probability of Exceedance in 50 yr**	**5% Probability of Exceedance in 50 yr**	**2% Probability of Exceedance in 50 yr**
	(475 year return period)	**(950 year return period)**	**(2375 year return period)**
Peak Ground Acceleration	8.1	13.6	25.6
5.0	17.2	27.1	47.5
3.3	13.0	20.9	36.7
1.0	5.4	8.5	14.0

Source: USGS 1996

The earthquake hazard to ordinary buildings at the proposed project site will be addressed through adherence to the seismic provisions of the UBC (ICBO 1997). The earthquake hazard at the KIF relative to other locations in the United States is moderate (zone 2A) based on the 1997 UBC (ICBO 1997). Special structures that house hazardous processes or sensitive equipment may require additional considerations. Storage of hazardous substances, for example, ammonia, or transportation of such substances through underground or aboveground piping may require special designs and careful siting to address seismic hazards.

Evaluation of 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 KIF, a study area was defined as a box of one degree of latitude by one degree of longitude containing the county (84°W to 85°W by 35°N to 36°N). This resulted in a study area of approximately 3,887 square miles which is equivalent to a square with sides about 62 miles in length.

The average tornado path affects an area of 2.28 square miles (Thom 1963). As an example, this would be equivalent to a tornado with a path width of 0.25 miles and a travel distance of 11.28 miles (0.25 miles x 11.28 miles = 2.28 square miles). For the study area, 28 tornadoes occurred during the 30 year period 1954 to 1983. This results in a tornado frequency of 0.93 tornadoes per year (28 tornadoes/30 years = 0.93). The annual probability of affecting a particular site in the study area, such as KIF may be calculated as follows:

ANNUAL PROBABILITY =

$$\frac{(0.93\ tornadoes\ /\ year) \times (2.82\ square\ miles\ affected\ /\ tornado)}{(3{,}887\ square\ miles\ study\ area)}$$

= **0.00067** *per year*.

In other words, there is a 0.067% chance each year of a tornado affecting a particular site in the study area. This is less a tenth of one 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/(0.00067 *per year*) ~ **1493** *years*.

So, on average, a tornado would be expected to affect a site in the study area, such as KIF, once every 1,493 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 1×10^{-4}.

In summary, the risk of a catastrophic release and related impacts are considered minimal based on the following factors:

- Development of a RMP in compliance with 40 CFR 68 and 29 CFR 1910.119.
- Low probability of a tornado or major earthquake.
- Commitment to earthquake resistant design of the ammonia storage facility.

Terrestrial Ecology

Resource Description

Terrestrial Plants and Animals

The terrestrial ecology resources that characterize the surrounding vicinity of KIF have been addressed in an evaluation of the environmental impacts of a previous project proposal at this site (TVA 1997). The following description is partially based upon the 1997 review, in addition to literature reviews and field surveys conducted in association with the present project proposal. The following is a general description of the area in which the KIF and the proposed natural gas pipeline are located.

The area on the developed portion of the KIF site has been heavily impacted and altered as a result of the construction and operation of the facility. No natural landscape remains in the immediate vicinity of plant site areas that would be used for construction and operation of the SCRs or NO_XTech facilities or actions associated with the impact mitigation options. In those areas, vegetation, where present, is maintained by mowing and other routine landscaping procedures. No uncommon plant communities or otherwise unusual vegetation occurs on or immediately adjacent to the proposed project facilities. Although substantial wildlife habitat occurs nearby (see **Managed Areas**), habitat in the immediate area where construction activities would occur and facilities would be located is very limited.

The proposed project including the proposed pipeline occurs within the Ridge and Valley Physiographic Province as defined by Fenneman (1938). This province lies between the Blue Ridge Mountains and the Cumberland Plateau and is characterized by prominent, northwest trending ridges and their adjacent valleys. The Tennessee River flows through this region, roughly paralleling the alignment of the valleys. The ridges are occasionally bisected by streams or rivers flowing into the Tennessee River. The Emory River, which flows from the Cumberland Plateau, is an example of such a river.

The project lies within the Ridge and Valley Section of the Oak-Chestnut Region. This section is characterized in Tennessee by red oak, white oak, red maple, black gum, sourwood, sassafras, and dogwood. Forested slopes along streams are usually mixed mesophytic forests. On the valley floor, oaks are prevalent with white oak being the dominant species.

Generally, the valleys and lower ridge slopes of this region have been cleared for agricultural use. The broader valleys support the more productive farms, yet even the narrowest valleys support subsistence farming. Lower slopes and in some cases, the side-slopes and ridges have been cleared for pasture or hay production. Row crops are typically restricted to the broad valley floors. The ridges are predominantly forested, although repeated timber harvests have occurred on many sites.

With respect to vegetation, the lands to be affected by the proposed project have been severely altered from their natural condition by decades of timbering, agriculture, and residential development. Because of past and current disturbances, the percentage of weedy species, both natives and exotics, is high. In general, the vegetational communities of the area can be broadly categorized into three types: early successional habitats, floodplain or riparian forests, and mixed deciduous woodlands.

Early successional habitats comprise approximately 65 percent of the project area and include a variety of plant communities such as pasture, row crops, residential or commercial lawns, fence rows and old fields in various stages of succession. With the exception of fence rows and old fields, these areas are usually maintained in an early stage of vegetation succession through mowing and other agricultural practices. These highly modified habitats are typically dominated by grasses such as fescue, orchard grass, crab grass, Bermuda grass, foxtail grass and Johnson grass, as well as numerous herbaceous weeds including plantain, dandelion, and various species of vetch, goldenrod, and aster. Birds that commonly nest in early successional habitats include indigo bunting, eastern towhee, field sparrow and northern bobwhite. Amphibians and reptiles that occur in this habitat type include spring peeper, common garter snake and black racer. Mammals commonly found in this habitat type include white-tailed deer, short-tailed shrew and eastern cottontail rabbit.

Forested riparian habitats are present along portions of the Emory River spanned by the project route, corresponding to approximately 30 percent of the project area. These areas do not form a contiguous riparian corridor, but are instead highly fragmented and interspersed between early successional habitats. Common or representative tree species include sycamore, sweet gum, winged elm, hackberry, hornbeam, bitter-nut hickory, white and northern red oak. Several invasive exotics are present along the shoreline, including princess tree, mimosa, and tree-of-heaven. The shrub and herbaceous layer of these riparian forests is also characterized by invasive exotics such as privet, bush honeysuckle, and Japanese grass. Birds found in floodplain forests and riparian habitats include wood duck, Carolina wren, barred owl and American woodcock. Amphibians and reptiles that commonly use these habitats include American toad, upland chorus frog, gray treefrog, broad-headed skink and northern water snake. Mammals that utilize these habitats include beaver, white-tailed deer, raccoon and muskrat.

The remainder of the project area, less than five percent, consists of mixed deciduous woodlands. These habitats support the greatest diversity of native plant species and the lowest density of invasive plants. The canopy of these forests is shared by various oaks, hickories, red maple, tuliptree, black gum, and white ash, with an understory shrub layer of dogwood, red bud and sassafras. Muscadine and Virginia creeper vines form an extensive ground cover that is interrupted by numerous ferns and woodland wildflowers such as wild ginger, spotted wintergreen, wild geranium, Indian cucumber-root and wood anemone. Birds that nest in mixed deciduous woodland habitats include red-eyed vireo, downy woodpecker, eastern tufted titmouse and Carolina chickadee. Amphibians and reptiles common to this habitat include slimy salamander, Woodhouse's toad, eastern box turtle and worm snake. Mammals found in these areas include white-footed mouse, gray squirrel and eastern chipmunk.

Managed Areas

A review of the TVA Natural Heritage database indicated that portions of the proposed project site are located within one managed area and immediately adjacent to two other managed areas.

All project activities, excluding those associated with the majority of the gas pipeline, would take place within the formal boundaries of the Kingston Steam Plant State Wildlife Refuge. The Refuge consists of 800 acres and includes the Plant grounds, the uninhabited peninsula east of the plant and the surrounding waters of the Emory River and the Clinch River. However, project activities would take place approximately 400 feet from a 300-acre area on the peninsula actively managed by the Tennessee Wildlife Resources Agency (TWRA) as a waterfowl and wildlife refuge. Managed hunts typically include two archery deer hunts, early season dove hunts and Canada goose hunts. From October 15 to February 1 of each year, TWRA closes the area to public use, creating a refuge for migrating waterfowl. The refuge is also a popular site for birdwatchers. Public access to the area is by boat only.

A portion of the gas pipeline would be located on the western edge of the plant's ash disposal site, while all other project activities would take place south of the site. The ash ponds and adjacent habitats, encompassing about 400 acres, are renowned statewide for their wildlife viewing opportunities and are recognized by TWRA as a State Wildlife Observation Area. The large expanses of shallow water, moist flats, and open water provide resting and feeding places for a wide variety of migratory and resident shorebirds, wading birds and waterfowl. Over 30 bird species frequent the flats and shallow water during the spring and fall. In recent years, the grassy areas and wetlands have attracted several uncommon bird species. During warmer months, osprey and numerous species of wading birds can be observed along with hosts of dragonflies. Peregrine falcons can be seen during their migration, while red-shouldered hawks and Canada geese are present year-round.

The barge unloading area would be located on the opposite bank of the Clinch River from the Rayburn Bridge TVA Habitat Protection Area, a distance of approximately 0.2 mile. Situated under the bridges of Interstate 40 and U.S. Highway 70, the 8.6-acre parcel provides habitat for false foxglove (*Aureolaria patula*), a state-listed threatened plant species.

Additionally, there are six managed areas or ecologically significant sites within three miles of the project site. These are:

- Stowe Bluff TVA Habitat Protection Area;
- Sugar Grove TVA Habitat Protection Area;
- Kingston City Park;
- Southwest Point Park;
- Spotfin Chub Designated Critical Habitat; and,
- Clifty Creek Gorge Tennessee Protection Planning Site.

<u>Potential Impacts</u>

Plants

No impacts to the terrestrial ecology would occur under the No Action Alternative.

No uncommon plant communities, or otherwise significant plant habitats, were observed in areas to be affected by the activities proposed under the two Action Alternatives. Therefore, no impacts to these resources are anticipated under either of these Action Alternatives.

However, under both Action Alternatives, some forested areas would be converted to early successional habitats as a result of the construction and maintenance of the proposed gas pipeline. This has the potential to impact the terrestrial ecology of the region, particularly through the introduction and spread of invasive exotic plant species. Because invasive plant species are already well established in the forested riparian areas within the project lands, any impacts related to the introduction or spread of such species are expected to be insignificant in these areas. However, invasive plant species are not yet established in the mixed deciduous woodlands spanned by the proposed pipeline ROW. The potential for impacts related to the introduction or spread of invasive exotic plants altering the composition of native plant communities in these areas, will be reduced by the following commitment:

- Areas subject to soil disturbance and/or vegetation removal will be replanted and/or re-seeded with native plant species as soon as possible.

With respect to vegetation, if the commitment described above is followed, impacts to the terrestrial ecology of the region are expected to be insignificant under both of the proposed Action Alternatives.

Terrestrial Animals

Under the No Action Alternative, the pipeline would not be constructed; therefore, terrestrial animals or their habitats would not be directly affected. However, any indirect or cumulative impacts to terrestrial animals, as a result of the continuous production of NO_X would continue to occur.

Due to improvements in air quality, completion of the project could result in some minor beneficial effects on terrestrial animals at the state and regional level. Many habitats that occur along the proposed pipeline, and particularly those maintained or developed areas within the KIF, have been previously disturbed and provide limited wildlife habitat.

Although many areas along the gas pipeline route consists of relatively open habitats, construction of the pipeline would remove some forested habitats. Clearing would result in some increased habitat fragmentation and would increase the amount of forested edge habitat along the proposed route. Although some species prefer edge habitat, other species could be negatively affected by these habitat changes. Small animals that have relatively small home ranges or that require specific structural habitat characteristics may be affected by these conditions. However these impacts are expected to be insignificant.

A portion of the northern pipeline route that travels along the Clinch River primarily consists of riparian and floodplain forest. These habitats are of higher quality than the more recently disturbed early successional habitats along the southern route. Therefore, selection the southern pipeline route is expected to have a lesser affect on terrestrial animals in the area.

Ash disposal ponds and surrounding habitats at the KIF serve as foraging, breeding and resting areas for a variety of birds throughout the year. Because the proposed pipeline would travel adjacent to these areas, construction of the gas pipeline is not expected to affects birds that use these areas or habitats found there. The proposed 161-kV transmission line would transect a portion of the embayment south of the disposal area near the plant. Although some waterfowl may use this area during certain periods of the year, any potential disturbances to these birds are expected to be minimal and temporary; and therefore, insignificant.

Construction activities within the plant site are expected to disturb very few terrestrial animals. Construction of the gas pipeline would disturb some wildlife habitat and would likely displace, or perhaps destroy, some small animals that occur along the route. Because the majority of the these areas have been disturbed by previous land use activities and because the wildlife habitats that occur on the site are common from a state or regional perspective, impacts to terrestrial animals and these habitats are expected to be insignificant.

Managed Areas

Under the No Action Alternative, wildlife habitat would remain unchanged including those habitats associated with the plant grounds and the ash disposal site. The following consequences are anticipated for either of the action alternatives.

The proposed project site, excluding most of the gas pipeline route, is located within the Kingston Steam Plant Wildlife Refuge. However, project activities will take place within the existing plant facilities and not on lands actively managed by TWRA or frequented by the public. Because BMPs will be implemented, wildlife habitat at the plant site and on the Emory and Clinch Rivers would be protected.

The gas pipeline will be located immediately adjacent to the Kingston Steam Plant State Wildlife Observation Area. The route is situated along Swan Pond Road, on the western slope of a large ash pile. This particular section of the ash disposal area is relatively dry and does not provide quality habitat. Visitor access is discouraged because of safety concerns.

The existing barge unloading area is located across the Clinch River from the Rayburn Bridge TVA Habitat Protection Area. The distance from the Rayburn Bridge area across the Clinch River to the project site is sufficient to avoid significant impacts to this habitat protection area.

Because project activities will not take place in areas of primary habitat management or visitor use within these managed areas, and because BMPs will be implemented, no significant impacts are anticipated to occur to these managed areas as a result of the proposed action. Additional managed areas and ecologically significant sites within three miles of the proposed project site are located at a sufficient distance to avoid significant impacts.

Protected Species

Resource Description

Plants

The proposed project area occurs within Roane County, Tennessee. Review of TVA Regional Natural Heritage files indicates that three federally-listed and an additional 33 Tennessee state-listed plant species are known from this county (see Table 3-5). This list, combined with regional information on additional species likely to occur on the

proposed project lands, provided a focus for field surveys conducted in August, 2001. Prior to these surveys, none of these rare plant species were known to occur on or immediately adjacent to the proposed project lands.

Terrestrial Animals

A review of the TVA Regional Natural Heritage Project database indicates that two federally protected terrestrial animal species and ten state-listed terrestrial animal species have been reported from Roane County (Table 3-6). None of these protected animals have been reported from the immediate vicinity of the proposed project.

Based on the natural history, geographic range, documented records and suitable habitat present for federal- and state-listed terrestrial animals, most of the species in Table 3-6 are not expected to occur on or near the proposed activities, including the federal-listed gray bat and bald eagle.

Gray bats utilize caves year-round, usually occupying different caves during the summer and winter. These colonial bats typically roost in caves along rivers and reservoirs. Caves have not been reported from the immediate vicinity of the proposed project and none were not identified during field investigations; therefore, gray bats are not expect to occur in the project area.

Table 3-5. Federally and state-listed plant species known from Roane County, Tennessee.

Common name	Scientific name	Federal status	State status
American hart's-tongue fern	*Asplenium scolopendrium* var *america*	LT	END
Barbara buttons*	*Marshallia grandiflora*		END
Barrens silky aster	*Aster pratensis*		THR
Branching whitlow-wort	*Draba ramosissima*		SPCO
Bugbane*	*Cimicifuga rubifolia*		THR
Bush honeysuckle*	*Diervilla lonicera*		THR
Butternut	*Juglans cinerea*		THR
Canada lily	*Lilium canadense*		THR
Cylindric blazing star	*Liatris cylindracea*		THR
Earleaf foxglove	*Agalinis auriculata*		END
Everlasting*	*Gnaphalium helleri*		SPCO
False foxglove*	*Aureolaria patula*		THR
Fetterbush*	*Leucothoe racemosa*		THR
Ginseng	*Panax quinquefolius*		S-CE
Goldenrod*	*Solidago ptarmicoides*		END
Goldenseal	*Hydrastis canadensis*		S-CE
Loesel twayblade	*Liparis loeselii*		END
Monkey-face orchid	*Platanthera integrilabia*	C	END
Northern white cedar	*Thuja occidentalis*		SPCO
Pale green orchis	*Platanthera flava* var *herbiola*		THR
Pink lady-slipper	*Cypripedium acaule*		E-CE
Pursh petunia	*Ruellia purshiana*		SPCO
River bulrush	*Scirpus fluviatilis*		SPCO
Riverbank bush honeysuckle	*Diervilla rivularis*		THR
Sedge*	*Carex gravida*		SPCO
Sedge*	*Carex oxylepis* var *pubescens*		SPCO
Shining ladies-tresses	*Spiranthes lucida*		THR
Short-head rush	*Juncus brachycephalus*		SPCO
Smoothleaf honeysuckle	*Lonicera dioica*		SPCO
Southern rein orchid	*Platanthera flava* var *flava*		SPCO
Swamp lousewort	*Pedicularis lanceolata*		THR
Tall larkspur	*Delphinium exaltatum*		END
Three-parted violet	*Viola tripartita* var *tripartita*		SPCO
Virginia spiraea	*Spiraea virginiana*	LT	END
Waterweed*	*Elodea nuttallii*		SPCO
Witch-alder*	*Fothergilla major*		THR

*No unique common name is routinely applied to this species.
federal status codes: LT = federally threatened; C = candidate for federal listing.
state status codes: END = endangered; E-CE = endangered (commercially exploited); THR = threatened; SPCO = special concern; S-CE = special concern (commercially exploited).

Table 3-6. Rare Terrestrial Animals Reported from Roane County, Tennessee			
Common Name	**Scientific Name**	**State Status**	**Federal Status**
Amphibians			
Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	In Need of Management	—
Tennessee cave salamander	*Gyrinophilus palleucus*	Threatened	—
Four-toed salamander	*Hemidactylium scutatum*	In Need of Management	—
Reptiles			
Eastern slender glass lizard	*Ophisaurus attenuatus attenuatus*	In Need of Management	—
Northern pine snake	*Pituophis melanoleucus melanoleucus*	Threatened	—
Birds			
Sharp-shinned hawk	*Accipiter striatus*	In Need of Management	—
Bachman's sparrow	*Aimophila aestivalis*	Endangered	—
Bald eagle	*Haliaeetus leucocephalus*	In Need of Management	Threatened
Mammals			
Gray bat	*Myotis grisescens*	Endangered	Endangered
Southeastern shrew	*Sorex longirostris*	In Need of Management	—

Bald eagles nest near reservoirs, rivers, swamps and large lakes where they forage. Although this bird is known to nest on Watts Bar Reservoir, nesting activity for this species has not been reported near the project area. Most of the forested riparian communities within the project area contain low quality, young woodlands that do not offer suitable nesting habitat for this bird.

Three state-listed terrestrial animals may occur within the proposed project area: eastern slender glass lizard, sharp-shinned hawk and southeastern shrew. Eastern slender glass lizards require forests or grassy fields with a fairly open canopy. This species is generally found in dry habitats with loose soil. One occurrence of this species has been reported from Roane County. Marginal habitat for this species occurs where the proposed pipeline route crosses several patches of grassy fields along the Clinch River. Sharp-shinned hawks nest in both coniferous and pine-oak woodlands. Mixed deciduous forest and edge habitats within the project area provide suitable habitat for this species. Southeastern shrews can be found in moist woodlands with decaying logs or leaf litter and in more open habitats near water resources. Riparian or deciduous forest habitats within the project area provide suitable habitat for this species.

Many of the other species listed in Table 3-6 have unique habitat requirements that are not present within the area potentially affected by the proposed activities. These species and their habitats include:

- Eastern hellbenders inhabit large, clear, fast-flowing streams that contain large flat rocks and logs.
- Tennessee cave salamanders are found in clean, permanent streams and pools in limestone caves of central and southwest Tennessee.
- Four-toed salamanders are found beneath rocks, logs or leaves in hardwood and occasionally coniferous forests where mosses occur in wet habitats.
- Northern pine snakes prefer loose sandy soils in open, dry pine or oak woodlands, especially in areas maintained by fire.
- Bachman's sparrows occur in pine forests associated with grassy openings. This bird inhabits both young and older, open pine forests with dominant grass.

Aquatic Species

Construction of the gas pipeline needed to supply this facility would involve one directional bore crossing under the Swan Pond embayment of Watts Bar Reservoir (Tennessee River) and one directional bore crossing under the Emory River at approximately ERM 10. Several federally and state-listed fish and mussel species are historically known to occur in Watts Bar Reservoir and the Emory River (Tables 3-7 and 3-8)

No federally or state-listed aquatic species are currently known to occur in the Tennessee River (Watts Bar Reservoir) in the vicinity of KIF. In the early 1980s, TVA conducted mussel surveys in the Emory River at several localities from Emory River Mile (ERM) 8.2 to ERM 14. No Federally or State-listed mussel species were collected during this survey work, and no viable populations of listed mussel species are currently known to be present in this portion of the Emory River.

Populations of the federally listed spotfin chub (*Cyprinella monacha*) and state-listed tangerine darter (*Percina aurantiaca*) are known from the Emory River. However, there are no recent records for these species downstream of ERM 18.3.

Table 3-7. Sensitive aquatic animals reported from the Tennessee River (Watts Bar Reservoir) in the vicinity of Kingston Fossil Plant, Roane County, Tennessee.

Common Name	**Scientific Name**	**Federal Status**	**State Status**	**Present in recent surveys?**
Fish				
Blue sucker	*Cycleptus elongatus**	-	T	No
Mussels				
Fine-rayed pigtoe	*Fusconaia cuneolus*	E	E	No
Shiny pigtoe	*Fusconaia cor*	E	E	No
Orange-foot pimpleback	*Plethobasus cooperianus*	E	E	No

E - Endangered, T - Threatened
*Blue suckers may enter this area, but are not known to occupy this portion of Watts Bar Reservoir with any regularity.

Table 3-8. Sensitive aquatic animals reported from the Emory River, Roane County, Tennessee.

Common Name	Scientific Name	Federal Status	State Status	Present in recent surveys at or below ERM 10?
Fish				
Spotfin chub	*Cyprinella monacha**	T	T	No
Tangerine darter	*Percina aurantiaca**	-	NMGT	No
Mussels				
Purple bean	*Villosa perpurpurea*	E	E	No
Cumberland bean	*Villosa trabalis*	E	E	No
Tennessee clubshell	*Pleurobema oviforme*	-	POTL	No
Alabama lampmussel	*Lampsilis virescens*	E	E	No
Turgid blossom pearlymussel	*Epioblasma turgidula*	E	E	No
Fine-rayed pigtoe	*Fusconaia cuneolus*	E	E	No

E - Endangered, T - Threatened, NMGT - In Need of Management, POTL - currently being considered for potential state status
* These two fish species are reported from ERM 18.3, but are not known to occur in the project area.

Construction of the SCR unit would occur on the existing KIF site. KIF is located adjacent to the Tennessee River (Watts Bar Reservoir). Three federally endangered mussels species, and one state-listed fish species are reported from Watts Bar Reservoir in the vicinity of this proposed construction (Table 3-7). None of these species has been reported during recent surveys in the area potentially impacted by construction of the NO_X reduction project activities. Blue suckers are very mobile, and may enter the area around KIF periodically.

Potential Impacts

Plants

No impacts to rare (federal- or state-listed) plant species or their habitats would occur under the No Action Alternative. No rare (federal- or state-listed) plant species, or suitable habitats for such species, were observed in any of the areas to be affected by the proposed Action Alternatives. For this reason, no impacts to these species or their habitats would occur under either of the proposed Action Alternatives.

Terrestrial Animals

Under the No Action Alternative, direct impacts to rare terrestrial animals would be insignificant. Any indirect or cumulative impacts to rare terrestrial animals, as a result of the continuous production of NO_X would continue to occur and be lessened by either action alternative.

Due to improvements in air quality as a result of NO_X reduction, completion of the project could result in some minor beneficial effects on rare terrestrial animals at the state and regional level. No effects to any federally-listed species are anticipated. Ten species of rare terrestrial animals have been reported from Roane County. Most of these species are unlikely to occur in the project area. Three state protected terrestrial animals may find suitable habitat in the project area: eastern slender glass lizard, sharp-shinned hawk and southeastern shrew. If present, individual eastern slender glass lizards may be destroyed by construction. However, creating and maintaining open-field habitat could also benefit this species. Therefore, effects to this species as a result of pipeline construction are expected to be minor and temporary, and perhaps beneficial to any existing populations over the long-term.

Similarly, if southeastern shrews occur within the project area, some individuals may be destroyed by construction activities. Because this mammal has relatively broad habitat requirements and has a wide geographic distribution, potential affects to this species are not expected to adversely affect populations of this species.

Clearing for the gas pipeline would increase the amount of foraging habitat for sharp-shinned hawks and ample nesting habitat for this bird occurs in the surrounding area; therefore, any disturbances to this species are expected to be minimal and temporary.

Aquatic Animals

Because no federally or state-listed aquatic species are known to occur in the Watts Bar Reservoir in the vicinity of KIF, no significant impacts to sensitive aquatic animals would result from construction associated with the installation of the NO_XTech or SCR units. Blue suckers may periodically enter waters near KIF, but would not be impacted provided appropriate measures are employed during construction to ensure that water quality is not affected by silt or other construction-related run-off from this site.

Waste ammonia is produced by the NO_X reduction systems. The potential to impact sensitive aquatic animals exists if an ammonia spill were to occur. Although ammonia is highly toxic to fishes, the likelihood of a major spill entering the waterway directly is minimal. The commitment for spill containment around the storage and loading area for ammonia, combined with the fact that state-threatened blue suckers, if present, would be able to escape or avoid the impacts of any ammonia entering a waterbody during a spill, would additionally provide adequate protection to avoid possibility of impacts.

Additionally, because no federally or state-listed aquatic species are known to occur in the section of the Emory River potentially affected by this action, no significant impacts to sensitive aquatic animals would result from construction and operation of this gas pipeline.

Wetlands

Resource Description

The proposed Kingston NO_X reduction project is located in the Emory River drainage in the Ridge and Valley Physiographic Province. Wetlands in the Ridge and Valley province are mostly small in size and are typically found in low-lying poor drained areas or where seepage is unusually strong or constant (Weakley and Schafale 1994).

Wetlands are areas that are saturated with or covered by shallow water for at least part of the year. Their soil conditions, and the types of plant and animal life they support, are determined mainly by the amount of water that is present. Most wetlands are dominated by plants that can live in areas that are frequently flooded or have standing water for long periods of time. These habitats are generally habitat for a wide variety of both aquatic and terrestrial plant and animal species because of the abundant water and nutrient supplies that are available. In many places, established wetlands also are important in controlling erosion, preventing flooding and storm damage, improving water quality, and helping to recharge ground water.

Some wetlands are protected under both state and federal laws because of the benefits they provide. These "jurisdictional wetlands" meet specific criteria established by the U.S. Army Corps of Engineers (USACE) (Environmental Laboratory 1987). Jurisdictional wetlands are protected under Section 404 of the Clean Water Act, which is administered by the USACE. In addition, Executive Order 11990 (Protection of Wetlands) addresses wetlands located on federal property or affected by federal projects. In Tennessee, activities in wetlands also are regulated by the Tennessee Department of Environment and Conservation under the authority of Section 401 of the Clean Water Act's Water Quality Certification.

Areas to be impacted by the proposed project include the proposed SCR/NO_XTech components within the KIF boundaries (including SCR reactors or NO_XTech equipment, transmission lines, minor rail spur and service road, ammonia storage tanks and unloading/spoil areas), mitigation actions and the proposed northern and southern gas pipeline routes.

A review of National Wetland Inventory (NWI) maps of the general project area identified potential wetlands adjacent to the Emory River, along and up-gradient of Swan Pond embayment, and in association with the ash ponds on the plant site. Field surveys of these sites indicated no jurisdictional wetlands occurred in the immediate project area. Wetland determinations were made based on the USACE criteria, which requires the presence of wetland vegetation, hydric soils, and wetland hydrology. A wetland vegetation community is one that is dominated by species that are classified as Obligate Wetland, Facultative Wetland, and Facultative according to the wetlands plant list developed by the U.S. Fish and Wildlife Service (Reed 1997). Hydric soils are those that meet the indicators described in the USACE manual. These include the presence of low chroma color in the soil matrix, mottles, and soil concretions. Wetland hydrologic evidence includes recorded data (stream gages, etc.), surface water, saturated soils, drift lines, watermarks on trees, and oxidized rhizospheres.

<u>Potential Impacts</u>

No Action Alternative

Under the No Action Alternative, no NO_X reduction systems would be installed, including construction of the proposed gas pipeline. No wetland impacts would occur as the result of the No Action Alternative.

Proposed Actions

Construction of either one of the two proposed alternative systems (installation of SCRs or NO_XTech technology) and the associated components (transmission lines, rail spurs, ammonia storage tanks, and unloading / spoil areas and mitigation actions) will not have any impacts to wetlands. Construction activities will occur within the KIF boundaries on previously disturbed areas and will not occur within or adjacent to wetlands.

The proposed northern and southern gas pipeline routes will not result in any impacts to wetlands, as no jurisdictional wetlands were found to occur within the proposed gas line ROW.

Floodplains and Flood Risk

Resource Description

The KIF is located on the right bank of Watts Bar Reservoir at about Clinch River (CRM) mile 2.8 in Roane County, Tennessee. The 100-year floodplain for the Clinch River at mile 2.8 would be the area below elevation 747.1. The TVA Flood Risk Profile (FRP) elevation on the Clinch River at mile 2.8 would be elevation 748.4. The FRP is used to control flood damageable development for TVA projects, and residential and commercial development on TVA lands. At this location, the FRP elevation is equal to the 500-year flood elevation. The plant site could also be flooded from an unnamed tributary to the Emory River at mile 1.8. The 100-year floodplain for this tributary would be the area below elevation 747.8. The FRP elevation at this location would be elevation 750.2.

Either route for the natural gas pipeline that would be constructed to support the proposed system for NO_X emission reduction, would involve construction in the floodplains of Bullard Branch, the Emory River, Swan Pond Creek, and an unnamed tributary to Swan Pond Creek.

Potential Impacts

Location of either of the alternative systems for NO_X emission reduction would not involve construction within the 100-year floodplain which would comply with Executive Order (EO) 11988. For either alternative route, portions of the gas pipeline would be constructed within the 100-year floodplain. For compliance with EO 11988, an underground pipeline is considered to be a repetitive action 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.

In order to mitigate potentially toxic ammonia levels in ash pond discharge resulting from the NO_X alternative, two options were identified. The mitigation option including re-routing of the ash pond discharge to the CCW discharge would involve the construction of a new pump platform outside the 100-year floodplain, but the underground pipeline would involve construction in the 100-year floodplain of the unnamed tributary to the Emory River at mile 1.8. For compliance with EO 11988, an underground pipeline is considered to be a repetitive action 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

Land Use, Visual Aesthetics, and Noise

Resource Description

The plant site is generally surrounded by low wooded hills, gently-sloping pasture lands, sparse residential development, and several transmission line corridors. The Emory River arm of the reservoir borders the east side of the plant, with wooded hills and open valleys on the opposite bank. The main reservoir borders the south side with the town of Kingston on the opposite shore. The large scale industrial facilities of the plant

provide a significant visual contrast to the surrounding rural landscape. The most dominant visual features include nine old stacks at 250' and 300' heights, transmission line towers, and two recent stacks 1000' high which can be seen above the hills for several miles. Other principal features include the powerhouse and related structures, coal handling operations, rail yards, switchyard, and ash disposal area.
The area proposed for SCR/NO_XTech facilities is located along the west side of the powerhouse, near about a 1/4 acre of mostly evergreen trees. The group of trees provides a pleasing visual buffer for the adjacent structures and parking when seen by visitors and employees approaching on the main access road. This area, the trees, and most other plant features are seen by motorists the few residents along Swan Pond Road west of the plant. Roadside vegetation provides partial screening when leaves are present. Portions of the plant are also seen from homes on Lakewood Road in Kingston, boat traffic on the reservoir, and motorists about 3000 feet distant on Interstate highway 40.

The proposed underground gas pipeline route runs generally north from the SCR area along the rail yard and earth slopes of the ash disposal area. The route crosses a small embayment and Swan Pond Circle Road, then follows a gravel road north through an open rural valley. It includes a small embayment surrounded by grass land, some cropland, and occasional groups of deciduous and evergreen trees. The route continues across one front yard and a corridor of 7 power lines, passes a farmstead and a couple homes, then crosses Swan Pond Circle Road again and across some wooded hillsides to the Emory River. This area is visible from three large homes to the east, the homes to the west and farm to the north, and to motorists on Swan Pond Circle Road.

At the Emory River the proposed pipeline route turns west and parallels the river along the south side. It runs through open grassland and some occasional trees then crosses the river near river mile 10. It is visible from the river and at least two homes that set back from the south bank. The route then continues north across an eastern arm of Bullard Branch and Fiske Road, then parallels an existing pipeline to the junction point. The narrow corridor lies between the railroad tracks and Webster Pike, and is covered with grass, brush and occasional groups of trees. The route is partially visible from the local road and can be seen from several homes along it.

As part of either action alternative one of two actions would be implemented to mitigate potential impacts to waste water stream, i.e., either the ash pond discharge would be re-routed and pumped to the CCW discharge via an underground pipeline, or dry fly ash stacking would be implemented.

The SCR or NO_XTech systems would be installed near the main plant buildings in an area that is committed to industrial use and is already quite noisy.

Potential Impacts

The long term visual impacts of either action alternative and associated mitigation would be insignificant. The SCR alternative would include duct and equipment structures not required for the NO_XTech alternative, but other visible changes would be identical. The SCR equipment, ammonia storage, power line, small switchyard, and gas metering station would be located fully within the plant area and near existing facilities. Most features would be relatively small scale and generally compatible with the industrial site. The additions would be seen by visitors and employees entering the plant, but they would appear visually subordinate to the large scale structures nearby. Possible removal of the tree group near the proposed metering station would adversely change the views of approaching traffic by eliminating the only visual buffer of foreground vegetation near the entrance. Piping and other equipment for the NO_XTech alternative would be relatively obscure. The SCR units for the other alternative would have an appearance quite similar to the adjacent structure, but the size would be smaller. Their similarity and scale would make these additions hardly noticeable next to the existing buildings and stacks. Residents and motorists along Swan Pond Road would have occasional views of the various additions but the discernible differences would be minor. The roadside vegetation would partially screen their views and screening may increase as the vegetation matures or fills in. Although visible details of the plant site would change somewhat, the overall industrial character would remain the same.

The visual impact of construction activities, materials, and equipment at the plant would be temporary and relatively minor. Some activities and laydown areas for the NO_XTech alternative would be located among existing facilities and generally not visible to the public. The SCR alternative and option for mitigating impacts by use of dry fly ash stacking would provide more discordant contrast due to greater visibility. The activities, equipment, and main laydown area would be seen from Swan Pond Road. The storage area south of the plant would be visible to fishermen at the discharge channel, but screened from Interstate 40 by existing vegetation. Intermittent activities and material at the barge unloading area would be seen from homes and traffic along Lakewood Road. Temporary storage buildings north of the plant would be visually similar to warehouses nearby, and would be seen primarily by visitors and employees.

The visual consequences of building an underground natural gas pipeline would be insignificant, and impacts of permanent aboveground features or signs related to pipeline operation would be negligible. Construction activities would add minor visual discord and would temporarily reduce scenic coherence and harmony. Tree removal, trench excavation, material stockpiles, equipment operations, and reclamation activities would be seen during installation. Disturbed areas other than pavement crossings would be reclaimed to grass.

Pipeline installation on the southern part of the route would be in open areas and would be visible in the foreground by traffic on local roads, and from the few nearby residences. The middle part across wooded slopes would have several turns, so the adverse contrast created by clearing long vertical openings would not be visible except to someone out in the woods. Construction along the south side of the river would require very little tree removal, and would be seen from boats and at least one home. A river crossing at either point would be bored so the natural river character currently seen by boat traffic would remain relatively undisturbed. A cleared approach for boring on one side may also be noticeable. If the north side route is centered between the river and Fiske road, the existing vegetation could screen construction in most locations by controlled clearing. Occasional views may still be seen from the river, as well as homes and motorists to the north. Construction clearing may also provide additional views of the river from those homes. Installation of the most northern part would be visible to motorists at the road crossing, along Webster Pike, and to several nearby homes.

No unusual changes or noticeable increases in plant noise are anticipated for the proposed action as compared to those existing under the no action alternative. There would be temporary and minor noise increases from construction activities. During system operation, there would be additional sound from new ammonia transfer pumps and air dilution fans operated continuously as well as minor increases in rail or truck traffic for delivery of ammonia or activities associated with dry fly ash stacking (if implemented). However, these should be minor sources of noise and not noticeable to the public.

Cultural Resources

Resource Description

For at least 12,000 years, the lands along the Clinch and Emory Rivers have been an area for human occupation which became more intense through succeeding cultural periods. In the East Tennessee area, archaeological investigations have demonstrated that Tennessee and the eastern Ridge and Valley region were the setting for each one of these cultural/temporal traditions, from the Paleo-Indian (10,000-8000 BC), the Archaic (8000-1200 BC), the Woodland (1200 BC-AD 1000), the Mississippian (AD 1000-1500), to the Protohistoric-Contact Period (AD 1500-1750). Prehistoric archaeological stages are based on changing settlement and land use patterns and artifact styles. Each of these broad periods is generally broken into sub-periods (Early, Middle, and Late), which are also based on artifact styles and settlement patterns. Smaller time periods, known as "Phases" are represented by distinctive sets of artifactual remains. In addition, historic era cultural traditions have included the Cherokee (AD 1700-present), European- and African-American (AD 1750-present) occupations.

The Paleo-Indian period (10,000-8000 BC) represents the documented first human occupation of the area. The settlement and land use pattern of this period was dominated by highly mobile bands of hunters and gatherers. The subsequent Archaic period (8000-1200 BC) represents a continuation of the hunter-gatherer lifestyle. Through time there is increasing social complexity and the appearance of horticulture late in the period. The settlement pattern during this period is characterized by spring and summer campsites. Increased social complexity, reliance on horticulture and agriculture, and the introduction of ceramic technology characterize the Woodland Period (1200 BC-AD 1000). The increased importance of horticulture is associated with a less mobile lifestyle as suggested by semi-permanent structures. The Mississippian Period (AD 1000-1500), the last prehistoric period in East Tennessee, is associated with the pinnacle of social complexity in the Southeastern United States. This period is characterized by permanent settlements, maize agriculture and chiefdom level societies. The Protohistoric-Contact Period (AD 1500-1750) consisted of the effects of European contact in the region. During this period, European contact arose through trade and construction of European settlements along the borders of Native American territory. Euro-American settlement increased in the early 19th century as the Cherokee were forced to give up their land. Roane County was established in 1801 (Hall and Parker 1998). The county was characterized by a rural agrarian economy and later industry.

TVA is mandated under the NHPA of 1966 and the Archaeological Resources Protection Act of 1979 (ARPA) to protect significant archaeological resources and historic properties located on TVA lands or affected by TVA undertakings. A historic property is defined, under 36 CFR § 800.16 (l), as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places."

For the undertaking addressed in this EA, the Area of Potential Effect (APE) is all proposed pipeline routes and any areas that may have ground disturbance associated with the installation of the gas pipeline. This would include, but not be limited to, trenching, drilling, grading, etc. The APE, as defined in 36 CFR § 800.16(d), is "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist." An Undertaking is defined, under 36 CFR § 800.16(y), "as a project, activity or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval; and those subject to state or local regulation administered pursuant to delegation or approval by a Federal agency."

Two segments of the proposed pipeline route were previously investigated during the *Archaeological Reconnaissance Survey and Limited Deep Testing of the Proposed Kingston Fossil Plant Rail Spur Corridor* (Franklin and Frankenberg 2000). Recently, TVA contracted with Louis-Berger Group, Inc. to conduct an intensive Phase I archaeological resources survey (including deep testing) in the remaining portion of the APE (Ahlman 2001). The surveys were conducted by means of a systematic shovel testing recovery from existing humus to culturally sterile subsoil and deep testing trenches in areas that had a potential for buried archaeological deposits. If sterile subsoil was not encountered (because colluvial or alluvial soils were present) shovel testing was terminated at 75 centimeters below the ground surface. The soil matrix was screened through a ¼" wire mesh screen. Crew members walked the areas in 30 meter transects and excavated shovel tests pits on 30 meter centers along each transect in zones of low slope (less than 15°) and/or high site probability. Trenches were placed every 40 meters and documentation and photographs of one profile per trench were recorded. This survey identified four sites eligible or potentially eligible for listing in the National Register of Historic Places (NRHP).

Roane County, Tennessee currently has 15 historic properties listed in the NRHP. None of these properties are located in the APE. Existing data along with the recent survey results were reviewed, and from this data, four sites were recommended as either eligible or potentially eligible for listing on the NRHP are located within the APE. All of these sites contain intact deposits that have a potential to provide additional information to the archaeological record in the region. TVA Cultural Resources has consulted with the Tennessee State Historic Preservation Officer (SHPO), appropriate Indian tribes, and other consulting parties regarding these resources and the proposed routes. The proposed routes were altered to avoid any impacts to eligible or potentially eligible historic properties.

Potential Impacts

TVA is conducting a phased identification and evaluation procedure to effectively preserve historic properties on TVA fee lands. Archaeological resources within these areas are avoided and protected whenever possible. If avoidance is not possible, then consultation with the SHPO and other consulting parties would be initiated and proper procedures would be followed to minimize or mitigate any adverse effects on historic properties. TVA will take necessary steps to ensure compliance with regulatory requirements of NHPA and the ARPA.

Under the No Action Alternative no historic properties would be affected because the pipeline would not be installed. However, TVA will take necessary steps to ensure compliance with regulatory requirements of NHPA and the ARPA to effectively preserve historic properties on TVA fee lands.

Either of the action alternatives incorporates the Phased identification and evaluation procedure to effectively preserve historic properties. The proposed natural gas pipeline pipeline route and equipment staging areas have been routed and located to effectively avoid all eligible or potentially eligible historic properties within the APE. The Tennessee SHPO concurred (Appendix B) with these findings and proposed natural gas pipeline route.

SOLID AND HAZARDOUS WASTE – COAL COMBUSTION BY-PRODUCTS

Existing Conditions

KIF is expected to burn between 3.2 and 4.4 million tons of coal annually through at least 2015. The coal averages 12.5% ash, therefore total ash production will range from approximately 400,000 to 550,000 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 80% fly ash and 20% bottom ash.

Prior to 1989, a small dry fly ash silo was operated at KIF, and small quantities of dry fly ash were marketed and utilized in TVA construction projects. This system is no longer operational, and the plant has determined that, based on high operation and maintenance costs, it is not economical to restore and maintain this system in order to market fly ash. In 1990, TVA evaluated the cost/benefit of installation of new equipment to collect dry fly ash but determined that it was not economical based on fly ash marketing alone. Due to the absence of an operational dry fly ash collection system at KIF, none of the fly ash has been marketed since 1990.

All fly ash and bottom ash produced at KIF is currently sluiced to the active ash pond. Bottom ash is reclaimed for use in dike construction for the two dredge cells which were developed on part of the inactive ash pond area. Periodically, fly ash is hydraulically dredged from the active ash pond into either of two active dredge cells. Decant water from the dredge cells drains by gravity back to the active ash pond for discharge. Between 320,000 to 440,000 tons of fly ash and 80,000 to 110,000 tons of bottom ash are handled in this manner annually.

Currently, no fly ash is being marketed or utilized at KIF. A market for bottom ash is being developed in 2002 which should result in sale of about 60,000 tons of bottom ash per year for the next five to ten years. As part of this project a pyrite separation system is being installed in the bottom ash handling equipment at the plant. Pyrites and mill rejects will be segregated from the bottom ash and used in construction of dredge cell dikes.

In 2001, KIF status was Conditionally Exempt Small Quantity Generator of hazardous waste. The types of these wastes currently generated include small quantities of: waste paint; waste paint solvents; mercury contaminated debris; sandblasting, scraping, paint chips; solvent rags due to cleaning electric generating equipment; Coulomat (used as moisture removal from oil); and liquid filled fuses.

Pipeline

Construction of the pipeline and metering station (which includes the access road and transmission line to the metering station) would generate small amounts of both hazardous and solid waste streams. The waste streams would result from both the actual construction of the facilities and the clearing process associated with the ROW. The majority of the solid waste generated would be construction scrap, used oil, lumber, and timber and slash from sections of the ROW. The hazardous waste generated would be predominantly paint, coating wastes, and solvents. All waste by-products would be re-used, managed and disposed of in an approved landfill, or reduced onsite through burning, in accordance with applicable state and local regulations. Through the implementation of these procedures, environmental impacts resulting from solid and hazardous waste for the pipeline activities would be insignificant.

Potential Impacts

For the No Action alternative KIF could continue to handle fly ash by sluicing to the pond and dredging to the dredge cells until capacity in these cells is exhausted. Bottom ash marketing would continue without being affected.

Use of either SCR systems or the NO_XTech system would result in “ammonia slip” or excess unreacted ammonia being deposited on the dry fly ash collected in the plant. As the fly ash is mixed with water to sluice it to the ash pond the ammonia would dissolve rapidly in the sluice water. The concentration of ammonia in the sluice water would be dependent upon the concentration of ammonia on the fly ash, the amount of fly ash sluiced to the pond, the volume of water sluiced and the volume of water in the ash pond. (see Surface Water Quality section).

Ammonia levels in the ash pond discharge are projected under worst case conditions to potentially cause aquatic toxicity without implementation of mitigation measures (see **Surface Water Quality**). Therefore, one of two options (see **Summary of Environmental Commitments** in Chapter 2) for avoiding or mitigating this potential impact would be implemented as part of the project. The mitigation option involving re-routing of the ash pond discharge to the CCW discharge would not involve any changes to handling of fly ash. The other mitigation option would involve installation of a new dry fly ash collection system capable of handling all of the fly ash without sluicing to a pond. Under this latter option, it would then be possible to market small quantities of the fly ash for some uses in construction materials such at autoclaved cellular concrete where the manufacturing process would not be affected by excess ammonia in the fly ash. However, the high levels of ammonia would prohibit use of this fly ash in most markets such as ready-mix cement because of odor problems associated with the ammonia in the fly ash.

Therefore, it would be necessary to develop a dry fly ash stacking area for disposal of this material at KIF. The existing dredge cells would be converted to receive dry fly ash for some period of time before developing a new stacking area. Conversion of the dredge cells or siting of a new dry fly ash stacking area would require a Class II solid waste disposal permit from the State of Tennessee Division of Solid Waste Management. A Class II permit would require installation of at least a three foot clay geologic buffer to separate the bottom of the stacking area from the seasonal high water table elevation. Groundwater monitoring would also be required. During operation, as described in the Surface Water Quality section, ammonia would be captured and discharged from the dry fly ash stacking areas. With careful management these discharges would be limited or treated (see **Summary of Environmental Commitments**) and discharged through permitted NPDES outfalls. A closure plan would also be required as part of the solid waste permitting process. Bottom ash marketing is not expected to be impacted by the SCR or NO_XTech installation at KIF since the bottom ash is collected in the boiler prior to ammonia injection.

The status of KIF as a Conditionally Exempt Small Quantity Generator of hazardous waste will not change as a result of the action alternatives.

Catalyst Recycling and Disposal

The catalyst for the SCR system would be vanadium pentoxide. This chemical falls in a unique class of hazardous waste under the Resource Conservation and Recovery Act (RCRA). The classification is as a listed P120 RCRA waste, which refers only to unused product. If it is a used product (spent catalyst), normal special waste rules apply. Any unused product, other than a *de minimis* amount, must be treated as a hazardous waste. There is also some potential that spent catalyst could have an accumulation of heavy metals found in coal combustion flue gas.

TVA has a catalyst management contract with the catalyst vendor. These services would include acceptance and ownership of spent catalyst by the vendor. If the spent catalyst is classified as a hazardous waste, TVA would have responsibility for proper disposal. It is common practice to recycle the catalyst thus minimizing the need for waste disposal. Should TVA become the custodian of any hazardous waste associated with the catalyst, a qualified hazardous waste disposal facility would be used for ultimate disposal. Spent catalyst handling would likely require respiratory protection of workers to prevent inhalation of dust or fines. The MSDS (Appendix A) for vanadium pentoxide lists a 3 ppm limit for respiratory protection.

Aquatic Ecology

Resource Description

In the reach of Watts Bar adjacent to KIF, the reservoir transitions from the riverine reach that extends upstream to Melton Hill Dam, to the more lacustrine conditions found nearer the dam. The Emory River embayment enters the reservoir on the right bank about 2.0 river miles (3.2 kilometers) upstream of the KIF CCW discharge. The dominant factor influencing aquatic resources in nearby reaches of Watts Bar Reservoir is the discharge from Melton Hill Dam, which is about 20 river miles (32 kilometers) upstream. Flow into the Tennessee River arm of Watts Bar is influenced by releases from Fort Loudoun Dam, which is about 35 river miles (56 kilometers) above the confluence of the Tennessee and Clinch river arms of the reservoir.

TVA began a program to systematically monitor the ecological conditions of its reservoirs in 1990. Previously, reservoir studies had been confined to assessments to meet specific needs as they arose. Reservoir 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 2000).

Benthic (lake bottom) macroinvertebrate and fish samples were taken in four areas of Watts Bar Reservoir from 1991 through 1994, and again in 1996, 1998, and 2000 as part of TVA's Reservoir Vital Signs monitoring program. Areas sampled included the forebay (area of the reservoir nearest the dam), a mid-reservoir transition station in the vicinity of TRM 560.0, and upper-reservoir inflow stations at TRM 600.0, below Fort Loudoun Dam, and CRM 19-22, below Melton Hill Dam. Although any fish species (and most benthic species) know from elsewhere in the reservoir could occur in the vicinity of KIF, results of sampling at the transition and Clinch inflow stations are presented here because they would be more representative of fish and benthic communities in the vicinity of KIF.

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 indicate species diversity, abundance of selected species that are indicative of good (and poor) water quality, total abundance of all species except those indicative of poor water quality, and proportion of samples with no organisms present. Compared to the transition stations of other TVA run-of-the-river reservoirs, the transition station benthic community has rated good in 1994 and 1996, and fair in 1998 and 2000. The benthic community at the Clinch River inflow has rated poor in 1994 through 2000 compared to the inflow stations of other TVA run-of-the-river reservoirs (Dycus and Baker 2000 and TVA unpublished data).

The Reservoir Vital Signs monitoring program also has included annual fish sampling at Watts Bar from 1990 through 1994, and in 1996, 1998, and 2000. Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life cycle which 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 other run-of-the-river reservoirs, the fish assemblage at the Watts Bar mid-reservoir station rated good in all years sampled except 1993, when it rated excellent. At the Clinch River inflow the fish assemblage has rated fair in 1991, 1992, and 1994, and good in 1990, 1993, 1996, 1998, and 2000. Better aspects of these ratings in 2000 at the transition station were species diversity, particularly among sunfish and piscivores, and low percentage of fish exhibiting anomalies; at the Clinch River inflow better scores were for number of omnivore and insectivore species, and lower occurrence in the sample of species considered tolerant of degraded environmental conditions. A total of 38 fish species was collected at the transition and inflow stations in TVA's fish collections in the fall of

2000 (Appendix C, Table C-1). More abundant species in the sample were gizzard shad, emerald shiner, spotfin shiner, bluegill, and largemouth bass (TVA unpublished data).

Watts 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 1999, Watts Bar rated above average for largemouth and smallmouth bass, crappie, walleye/sauger, striped bass, white bass, and bluegill, but below average for channel catfish. 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.

The proposed natural gas pipeline alternative routes would cross the Swan Creek and Emory River embayments using directional boring techniques (Appendix D, Tables D-1 and D-2). Aquatic communities at these locations are likely similar to aquatic life found in other similar habitats in Watts Bar. Other than a crossing of a flowing section of Swan Creek, water courses crossed are primarily constructed drainage ditches on the KIF site and near roads, and natural wet weather conveyances.

Construction Impacts

Potential construction impacts to Watts Bar Reservoir would include temporary erosion and siltation resulting from soil disturbing activities associated with installation of the SCR reactors or NO_XTech equipment, ammonia storage and unloading area, interconnecting ammonia and service water piping, electrical conduits, retention basins and the potential re-routing of the ash pond discharge (see **Surface Water Quality**). These areas have previously been disturbed by plant construction and modification activities. Temporary erosion may also originate from the barge unloading and equipment storage areas, as well as from the natural gas pipeline route. These impacts would be minimized by implementation of BMPs to control erosion during construction and stabilize disturbed areas after construction is complete, and by routing surface runoff to existing treatment facilities that meet regulatory requirements. Impacts associated with natural gas pipelne construction would be reduced to insignificant levels with the implementation of BMPs and other precautions outlined in TVA's guidelines for natural gas pipeline construction (TVA 2000). These measures would substantially reduce the potential impacts in Watts Bar Reservoir, to the point of causing only minor and temporary effects on fish and other aquatic life.

Operational Impacts

Ammonia is very toxic to fish and other forms of aquatic life. Because provisions have been made for prevention and containment of accidental spills from storage tanks, aquatic life should not be impacted by spills. During routine operations at KIF, establishment of appropriate effluent toxicity limits, implementation of either of the two options for limiting ammonia concentrations of wastewater discharges, combined with monitoring of the ash pond and condenser cooling water discharges, will result in insignificant impacts to aquatic life that use adjacent areas of Watts Bar Reservoir for spawning or feeding.

Wastewater

<u>Existing Coal Combustion By-products (CCB) Wastewater Treatment Facilities</u>

Fuel burning at KIF is described in the **Solid and Hazardous Waste** section. The CCB handling systems include the following areas that receive and treat resulting wastewater effluents: Ash Pond, Chemical Treatment Ponds, and CCW. The ash pond receives all of the fly ash and bottom ash wastewater. The chemical treatment ponds currently do not receive intermittent non-chemical wastewater from the APH washes, but if the SCR and/or NO_XTech systems are installed, this treatment pond will be required to accept any wastewater that potentially contains ammonia from an APH wash.

Ash Pond

Ash is periodically dredged to either of the two active dredge cells on the north side of the ash pond. This is estimated to provide capacity for ash storage until 2012; however, the actual closure date will be affected by both ash production and utilization. The TDEC issued a solid waste disposal permit for the ash pond and dredge facility in September 2000.

Bottom ash, along with pyrites from the reject hoppers in the plant, are wet-sluiced to a separate, unlined channel parallel to the fly ash sluice channel. Most of the bottom ash settles in the sluice channel, is removed with a drag line, and used to raise the dredge cell dikes. In order to reduce the contribution of bottom ash to the generation of red water, pyrites must be separated from the wet ash sluicing system.

Currently approximately 32 mgd of ash sluice water and other constituent flows are discharged from the ash pond via DSN 001. DSN 001 discharges directly into the 1,346 mgd plant intake. TVA is required to meet effluent characteristics as shown in Table 3-9 for DSN 001. Flow distribution to the ash ponds is shown in Table 3-10.

TVA is currently looking at the option of redirecting the ash pond discharge (DSN 001) to the CCW discharge channel. In doing so, discharging any potential ammonia nitrogen from NO_XTech and/or high dust SCR operation to the plant intake could be avoided. Flow distribution to the ash pond for this configuration would remain as they currently are today as reflected in Table 3-10.

Other options include a dry fly ash handling system which would replace wet fly ash sluicing. By eliminating the wet sluicing with a dry stacking configuration, any ammoniated ash would be isolated. The potential for ammonia releases would be managed by maintaining the exposed area to 10 acres or less thus reducing runoff and infiltration.

Condenser Cooling Water (CCW)

The primary use of raw water from the plant intake is for condenser cooling. The condenser cooling system discharges approximately 1,315 mgd. At the present configuration, potential ammonia from slip is possible in the condenser cooling water (DSN 002) from ash pond discharge. Alternatives for remedying the potential re-circulation of ammonia resulting from slip through the plant intake are examined throughout this section. TVA is required to meet effluent characteristics as shown in Table 3-9 for DSN 002.

Table 3-9. DSN001 discharge requirements (Source: NPDES Permit No. TN005452).

DSN 001

Effluent Characteristics	Effluent Limitations: Monthly Average mg/l	Effluent Limitations: Daily Maximum mg/l	Monitoring Requirements: Measurement Frequency	Monitoring Requirements: Sample Type
Flow (MGD)	Report	Report	1/week	Instantaneous
pH		minimum 6.0	1/week	Grab
Oil and Grease	14.4	19.4	1/month	Grab
Total Suspended Solids	29.9		1/month	Grab

DSN002 discharge requirements (Source: NPDES Permit No. TN005452).

DSN 002

Effluent Characteristics	Effluent Limitations: Daily Minimum mg/l	Effluent Limitations: Daily Maximum mg/l	Monitoring Requirements: Measurement Frequency	Monitoring Requirements: Sample Type
Flow (MGD)			1/day	Instantaneous
pH	6.0	9.0	1/week	Grab
Intake/Effluent Temperature		36.1 ^{o}C	Continuous Daily	
Total Residual Oxidant	if flow $\geq$ 654 mgd limit = 0.019	if flow > 654 mgd limit = 0.066	If adding oxidants	Grab
IC25 Toxicity – survival, reproduction, and growth in 100% effluent)			Annual	Grab

Table 3-10. Inflow Sources to the KIF DSN 001 & DSN 002 (Source of Flow Rates: Kingston Fossil Plant Storm Water and Wastewater Flow Schematic, NPDES Permit No. TN0005452).

Ash Pond (DSN 001)	Inflow to Pond (MGD)
Ash Sluice Water	24.029
Station Sumps	7.130
NLDF Sump	0.267
Redwater Wetlands	0.180
Coal Pile Pumping Basin	0.145
Chemical Treatment Pond	0.005
Non-Chemical Treatment Pond	0.002
Precipitation	0.574
Evaporation	-0.238
Total	32.09
Condenser Cooling Water Discharge Channel (DSN 002)	Inflow to Pond (MGD)
Condenser Cooling Water	1296.627
Equipment Cooling Water & Precipitator Area Runoff	18.286
Intake Screen Backwash	0.243
Boiler Blowdown	0.014
Lab Sample Station	0.010
Underflow Ponds	0.010
Precipitation	0.018
Total	32.094

Chemical Treatment Pond

The chemical treatment ponds receive the intermittent wash-water from the unit air pre-heater wash and boiler wash. The copper pond discharges to the iron pond before discharging to the ash pond. The remaining discussion will refer to the iron chemical treatment pond since the APH wash is a non-chemical wash and currently is directed to the iron pond or straight to the ash pond.

To ensure potential ammonia levels in the ash pond discharge are kept below levels that can affect aquatic life, management of the chemical treatment pond will be required after an APH wash containing ammonia. Necessary management practices may include one or more of the following:

- Managing the number of APH's washed and held in the chemical treatment ponds at one time
- redirecting the chemical treatment pond away from the ash pond
- staging the release of the chemical treatment pond over an extended period of time
- increasing the chemical treatment pond volume so that ammonia is not as concentrated

<u>Construction Impacts</u>

Surface Runoff

All construction activities related to the NO_XTech and/or SCR installation would be performed within the existing plant site. Surface runoff would flow to existing facilities that meet regulatory requirements. Appropriate best management practices would be adopted and all construction activities would be conducted in a manner to ensure that waste materials are contained and that the introduction of polluting materials into the receiving waters would be minimized.

Construction Workforce Domestic Sewage Disposal

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

<u>Operational Impacts</u>

Wastewater Management of Ammonia Slip

Ammonia slip, the emission of unreacted ammonia (NH_3), is caused by the incomplete reaction of injected ammonia with NO_X present in the flue gas. In high dust SCR and NO_XTech configurations, the ammonia slip could enter the ash and be discharged to wet or dry handling systems through the precipitators. For the high dust SCR arrangement, it is estimated that the worst case slip rate at 2 ppmv is approximately 12.31 lb NH_3/hr units 1-5 and 10.88 lb NH_3/hr units 6-9 for a total of 23.19 lb NH_3/hr to all nine units. For the combination high dust SCR on units 1-4 (2 ppmv) and NO_XTech on units 5-9 (5ppmv), the resultant slip rate would be 13.34 lb NH_3/hr and 20 lb NH_3/hr respectively, for a total slip rate of 33.34 lb NH_3/hr.

The unreacted residual NH_3 might react with available gaseous sulfuric acid to form ammonium bisulfate (NH_4HSO_4). The resulting ammonium bisulfate can potentially mix in with the sluiced fly ash or build up on the air pre-heater elements.

$$NH_3 + H_2O + SO_3 \Leftrightarrow NH_4HSO_4$$

European experience on SCR’s using low sulfur coals led to a recent study conducted by ABB Environmental Systems in which, about 20% of the NH_3 slip adhered to the heating surfaces in the air pre-heater, and about 80% adhered to fly ash (ABB Environmental Services 1999). No known ammonia partitioning study for NO_XTech has been performed. As for this assessment, it is assumed that the partitioning will remain the same as for the ABB SCR study. Until there is further experience with U.S. coal types, there is no certainty of the exact mechanism or extent of APH problems TVA will face.

The best way to prevent ammonia salts from forming is to control the amount of ammonia slip. Consequently, there is the potential for a concentrated slug of ammonia to enter the wastewater stream when the air pre-heaters are being washed following the accumulation over an extended period.

Air/Water Distribution for Ammonia Slip

As discussed above, the ammonia slip will be captured with ash by the either ESP’s or build-up in some form on the APH’s. In either case, the eventual fate is one of the treatment ponds.

Factors controlling the air/water distribution of the ammonia slip at any location include pH, temperature of the ash fluid and the air above, mixing, and chemical nature of the gas, as indicated by the Henry's Law coefficient.

The aqueous equilibrium between the unionized molecular ammonia and the ionized ammonium is given by the equation:

$$NH_4^+(aq) \Longleftrightarrow NH_3(aq) + H^+(aq)$$

Thus, the higher H^+ concentrations, i.e., lower pH values, favor the ionized or ammonium form. Conversely, the lower H^+ ion concentrations or higher pH values favor the unionized molecular or ammonia form. The tendency of the above equation to go to the right as written is positively related to temperature, so that higher temperatures favor the molecular ammonia form.

Mitigation Option Including Re-routing of Ash Pond Discharge to the CCW

Due to the temperature and pH during sluicing, there should be little loss of ammonia through volatilization in the sluicing process. The maximum concentration of ammonia in the ash pond effluent would be controlled by the rate of slip, effluent flow after the pond reaches a steady-state concentration, and mixing within the ash and stilling ponds. The addition of ammonia from the APH's soot blowing is another factor. It is assumed that 10% of the material will be removed from the APHs by the soot-blowers. Comparison of the preceding conditions with constant slip loading is shown in Table 3-11.

Table 3-11. Potential NH3-N Concentrations in Ash Pond and Outfall DSN002 from Wet Sluicing

	Total NH_3 load* (lb. NH_3/hr)	Concentration** of ammonia at outfall (mg NH_3-N/L)	
		Ash Pond‡	**DSN002**
SCR/ NO_XTech Hybrid^	26.67	2.64	0.065
High Dust SCR ^^	18.55	1.83	0.045

* Loading and concentration is for all nine units combined.

** Net values are shown, which are in addition to NH_3 present in intake water. Concentrations based upon the flow through the ash pond (32 mgd), and for DSN 002, combined with the CCW (1,315 mgd) using current wet sluicing equipment.

^ Assumes slip rate is constant at the highest anticipated level (2&5ppmv).

^^ Assumes slip rate is constant at the highest anticipated level (2ppmv).

‡ Concentrations are here for reference. There are commitments to re-route discharge to CCW.

NO_XTech/High Dust SCR Hybrid

A worst case scenario would be for all nine units to have a constant maximum expected slip of 2 ppmv slip for the SCR on units 1-4, 5 ppmv for NO_XTech on unit 5-9, plus the addition of ammonia from the APH's soot blowing. It is assumed that 10% of the all ammonia slip will be removed from the APH's by the soot-blowers then sluiced from the ESP's along with the other fly ash.

High Dust SCR

A worst case scenario would be for all nine units to have a constant maximum expected slip of 2 ppmv during operation plus the addition of ammonia from the APH's soot blowing. Again, it is assumed that 10% of the all ammonia slip will be removed from the APH's by the soot-blowers then sluiced from the ESP's along with the other fly ash.

Comparison of the potential ammonia concentrations in the ash pond and at DSN 002 is shown in Table 3-11.

DSN002

Effective March 1, 2001, there is a requirement to monitor chronic toxicity once per year in the renewed NPDES permit, effective March 1, 2001. Toxicity of ammonia present in the discharge would be a function of pH and temperature. For example, the maximum allowable ammonia concentration to protect from chronic (sub-lethal) effects to aquatic life in undiluted effluent is 5.29 mg N/L at pH 7.1 and temperature 15.6 °C (low end of DSN002 pH and temperature range measured at KIF from January 2000-March 2001) and 0.525 mg N/L at pH 8.1 and temperature 36.0 °C (high end of DSN002 pH and temperature range measured at KIF from January 2000-March 2001). Table 3-11 show that the ammonia concentrations projected for Outfall DSN002 under the worst case conditions are below the maximum allowable concentrations for protection of aquatic life.

Operational changes including limiting the maximum ammonia slip to less than 5 ppmv for NO_XTech, 2 ppmv high dust SCR, managing SCR catalyst, and managing APH washes and subsequent chemical treatment pond discharges, as discussed below, will be made as necessary to meet both effluent toxicity and numeric requirements. TVA's commitment for removing the potential re-circulation through the wastewater system, if the ash pond discharge is re-routed to the CCW discharge, would result in greater protection of water quality in the associated water bodies.

Mitigation Option Including Dry Stacking of Fly Ash

For completeness and an analyses of truly worst case scenario for discharges, this section incorporates infiltration caused by rainfall from the dry stacking area which is analyzed in the groundwater section of this assessment.

Ammonia in the dry fly ash has potential to enter the wastewater stream during a rainfall event as runoff and leachate from the dry fly ash stacking area. This runoff and leachate will be directed to a lined runoff collection pond (Figure 3-2). For the worst case fly ash analysis, it was assumed that a rainfall event generated runoff from the fly ash stacking area and the LCS described in the Groundwater section fully routed to the collection pond. The runoff collection pond would be routed to the CCW. It was assumed that the exposed surface area of the stack had just reached maximum working capacity (10 acres) before having interim cover applied. The concentration of ammonia in the fly ash was 325 mg ammonia per kg of fly ash (SCR/NO_XTech Hybrid) and 226 mg ammonia per kg of fly ash (high dust SCR), and all of the ammonia stored in the top 1 inch of the exposed area would be released as runoff through the ash pond. The infiltration assumptions are covered in the ground water section. The runoff collection pond will accumulate water from the entire 63 acre site, which includes the 10 acre exposed area, as well as all of the infiltration collected by the LCS (Figure 3-2). Little data is available to estimate the concentration of ammonia in fly ash or to estimate the amount of ammonia that will run off during a rain event. Much of this data will be plant specific. To limit ammonia loads from the dry fly ash stack, it would be important to restrict the amount of dry fly ash exposed to 10 acres or less. The greater the surface area of exposed dry fly ash, the more ammonia is available to runoff or leach during a rain event.

The worst case dry fly ash stacking area scenario analyzed for this EA is summarized below:

- For SCR/NO_XTech Hybrid, with a 2&5 ppmv respective slip, the ammonia load is estimated to be distributed as follows: approximately 6.67 pounds per hour to the air pre-heaters and approximately 26.67 pounds per hour to the dry fly ash.
- For high dust SCR, a 2 ppmv slip the ammonia load is estimated to be distributed as follows: approximately 4.64 pounds per hour to the APHs and approximately 18.55 pounds per hour to the dry fly ash.
- All units have been operating at constant maximum slip.
- A rainfall event generated maximum runoff from the dry fly ash stack which has just reached maximum capacity before being covered. 5% of the rainfall is leached out and collected by the LCS from the entire 63 acre area then directed to the CCW.

Table 3-12. gives the expected effluent concentrations of the CCW, using the worst-case scenario. The effluent concentrations that were calculated assume there are no losses of ammonia through chemical reaction, settling, or volatilization.

Table 3-12. Potential NH3-N Concentration at DSN002 from Dry Fly Ash Stacking

	Total NH_3 load* (lb. NH_3/hr)	Concentration** of ammonia at outfall (mg NH_3-N/L) **DSN002**
SCR/NO_XTech^	26.67	0.11
High Dust SCR^^	18.55	0.08

* Loading and concentration is for all nine units combined.
** Values are shown are based upon flow through the CCW (1,315 mgd).
^ Assumes slip rate is constant at the highest anticipated level (5ppmv).
^^ Assumes slip rate is constant at the highest anticipated level (2ppmv).

Chemical Treatment Pond

Ammonia that builds-up on the APHs will be washed at regular intervals into the chemical treatment pond where small amounts of ammonia potentially dissipate through volatilization. The factors which will determine how much of the ammonia could volatilize are the pH, temperature, mixing, and the partitioning between the water and air phases, as reflected in the Henry's Law coefficient.

The aqueous molecular ammonia is subject to losses from the aqueous phase to the air phase. This partitioning of the unionized ammonia between the water and air phases at equilibrium is quantified in the Henry's Law coefficient. This partitioning varies with pH and temperature with higher values favoring higher concentrations of ammonia in the air phase and lower values favoring ammonia in the water phase.

Currently, the APHs are steam blown. There are two APHs per unit. There is one lance per heater at the exit side of gas path which blows up on a swinging arm. The wash frequency is twice per week; with duration of 45 to 90 minutes (Campbell 2001). Soot-blowing waste goes directly to the ESP's. The worst case loading of ammonia to the wastewater will be limited to two APH units washed simultaneously during an outage. It is unknown how effective the soot-blowers will be at removing ammonia build-up. For this analysis it is assumed that 10% of the ammonia build-up on the APHs will be removed by soot-blowing and collected by the ESP's which currently is wet sluiced with the fly ash or dry stacked if the option is initiated.

The worst case scenario analyzed assumes four APHs (two units) are washed every 18 months simultaneously. The potential chemical treatment pond loading scenarios are summarized in Table 3-13. To help manage ammonia nitrogen to the ash pond, the chemical treatment pond will be re-directed away from the ash pond into the CCW.

Table 3-13. Potential NH_3-N concentrations in the chemical treatment pond from APH wash.

Constant slip rate	Total loading^ (lb. NH_3/wash)	Concentration of wash water * (mg NH_3-N/L)	Chemical pond concentration based on available volume** (mg NH_3-N/L)
SCR/ NO_XTech	18,662	460	189
High Dust SCR	12,960	313	128

^ Assumes an 18 month build-up of two units w/10% removal from soot blowers
* Assumes 1 million gallons of water used for each APH.
** Chemical pond volume = 9.75 million gallons (Albright 2002).

Table 3-14 shows the potential concentration the chemical treatment pond could receive. The pH of a typical APH wash is low due to the metal content. For the worst case, ammonia concentrations in the wash water could reach 460 mg NH_3-N/L and the chemical treatment pond itself could see concentrations of 189 mg NH_3-N/L. Ammonia concentrations this high might cause air quality issues if the pond pH is allowed to rise to a pH of above 9 which would allow some ammonia to dissipate through volatilization. KIF does not normally increase the chemical treatment pond pH to precipitate metals. It is expected that the pH should be near neutral or lower during a wash. Therefore, ammonia should not accumulate above the pond before being discharged through outfall 002 at which time concentrations will be at levels of no concern for air quality, as shown in Table 3-14.

Table 3-14. Example of Number of Days for Discharging Air Preheater Wash Water into CCW and Resulting Concentrations.

* 18 Month Wash Cycle - Assumes build-up on APH is constant; for SCR, at the end of the catalyst life. Values are in addition to concentrations in Tables 11 & 12.

# Days of Chemical Pond Discharge	CCW Concentration mg NH_3-N/l *	
	SCR/NO_XTech	High Dust SCR
1	1.40	0.95
5	0.28	0.19
10	0.14	0.095

Whole Effluent Toxicity

Discharge from Outfall 002 is regulated under NPDES Permit No. TN0005452. There is insufficient mixing in the receiving stream to demonstrate that there is no reasonable potential for Outfall 002 to cause toxicity to aquatic life; however, since no effluent related toxicity occurred during the last five year permit cycle, the frequency of toxicity monitoring was reduced from semi-annual to annual under the renewed permit. The permit currently contains a whole effluent toxicity (WET) limit of 1.0 toxicity unit for chronic (1.0 TUc) toxicity. The chronic limit is based on a 7-day or 3-brood exposure of the fathead minnow and the daphnid, respectively. This permit limit is based on a 25 percent inhibition concentration (IC25) test endpoint, which means that exposure to undiluted effluent resulting in reductions in fish survival and growth or daphnid survival and reproduction by 25 percent or more would constitute a permit violation.

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 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 (EPA-822-R-99-014, December 1999). The acute CMC is the one-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 thirty-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.

To protect aquatic life from ammonia toxicity at the discharge point for Outfall 002, effluent ammonia concentrations that should not be exceeded at possible pH and temperature combinations are provided in Table 3-15. Ammonia water quality criteria would not be exceeded based on discharge concentrations projected in Table 3-12 and recent pH and temperature data. In addition, results from site specific ammonia toxicity studies (Table 3-16) conducted with daphnids and fathead minnows using ammonia spiked KIF condenser cooling water under high (summer) and low (winter) hardness conditions, adjusted to three target pH levels, indicated that the discharge concentrations in Table 3-11 should not result in toxicity which would jeopardize compliance with WET limits. As described in the previous section, operational treatment measures would be utilized to meet permitted toxicity limits for this discharge, although no negative effects from the ammonia addition are predicted

Table 3-15. Maximum Allowable Ammonia Concentrations in Outfall 002 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=7.0	pH=7.5	pH=8.0	pH=8.5
15[†]° C					5.73	4.23	2.36	1.06
20° C					4.15	3.07	1.71	0.77
25° C	36.09	19.89	8.41	3.20	3.01	2.22	1.24	0.55
30° C					2.18	1.61	0.90	0.40

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

Table 3-16. KIF Ammonia Spike Study - Toxicity Endpoint Summary (expressed as mg/L N).

Endpoint	Baseline[1] KIF #1[3] (summer)	Baseline[1] KIF #2[3] (winter)	pH 7.5 (mg NH_3-N as N) KIF #1 (summer)	pH 7.5 (mg NH_3-N as N) KIF #2 (winter)	pH 8.0 (mg NH_3-N as N) KIF #1 (summer)	pH 8.0 (mg NH_3-N as N) KIF #2 (winter)	pH 8.5[2] (mg NH_3-N as N) KIF #1 (summer)	pH 8.5[2] (mg NH_3-N as N) KIF #2 (winter)
Fathead 96-h LC50	>100%	>100%/ >100%	15.5	14.9	10.5	7.4	4.5	4.4/ 3.2
Daphnid 96-h LC50	>100%	>100%/ >100%	39.9	38.4	32.0	21.4	4.8	5.1/ 8.0
CMC	N/A		19.9		8.4		3.2	
Fathead IC25	>100%	>100%/ >100%	7.7	8.8	5.4	2.8	1.8	1.6/ 0.88
Daphnid IC25	>100%	>100%/ >100%	18.4	29.5	11.6	16.2	4.0	0.50[4]/ 5.8
CCC	N/A		2.22		1.24		0.554	

1 Results expressed as percent sample.

2 Downward pH drift during 24-h exposure periods was greater than in previous pH adjusted tests. The expected ammonia/pH toxicity relationship was demonstrated (i.e., more toxicity at higher pH), but it is possible endpoints are somewhat higher (less conservative) than they would have been if the high pH had been better maintained. For this reason, the pH 8.5 low hardness (winter) tests were repeated since it was believed that combination of test characteristics was representative of the worst case scenario. Results are shown as Initial tests/Repeated tests.

3 KIF #1 -summer hardness conditions (mean test value = 114 mg $CaCO_3$/L); samples collected 6/14/01. KIF #2 -represents winter hardness conditions (mean test values = 45/40 mg/ $CaCO_3$/L); simulated effluent sample prepared from upstream Emory River water and ash pond water collected 8/9/01 and 12/10/01.

4 This endpoint is overly conservative due to anomalous dose response at two lower concentrations. Reproduction at 3.23 mg N/L was only reduced from control by 18 percent, suggesting the actual IC_{25} should be > 3.23 mg N/L.

Surface Water Quality

Resource Description

KIF is located in eastern Tennessee, approximately 1.5 miles due north of the town of Kingston, Tennessee. KIF is situated on a peninsula formed by the Clinch and Emory Rivers at Clinch River Mile 2.6 and is in the headwaters of Watts Bar Reservoir near the confluence of the Clinch and Emory Rivers. Watts Bar Dam is approximately 40.5 river miles below KIF (37.9 miles on the Tennessee River and 2.6 miles on the Clinch River) at TRM 529.9. River reaches on the Clinch and Emory in the vicinity of KIF are of a riverine nature. Flow past KIF on the Clinch River averages 5226 cfs over the year with the summer mean being 4306 cfs and the winter mean 6221 cfs. Flow past KIF on the Emory River averages 1478 cfs over the year with the summer mean being 504 cfs and the winter mean 2675 cfs (Thornton 2001).

Clinch and Emory Rivers / Watts Bar

KIF is located at approximately CRM 2.6 near the mouth of the Emory River. Much Clinch River flow is controlled by Melton Hill Dam upstream of KIF at CRM 23.2. Being in the headwaters of Watts Bar Reservoir, flow at KIF is also controlled by Watts Bar

Dam. Momentary flows at the site may vary considerably from daily average flows, depending upon turbine operations for peak power demands at Watts Bar and Melton Hill Dams. The 3-day 20-year (3Q20) low flow from Melton Hill Reservoir on the Clinch River is 0.0 cfs. The 3Q20 flow from Poplar Creek and East Fork Poplar Creek (tributaries to the Clinch below Melton Hill, but above KIF) total 19.07 cfs. The 3Q20 flow on the Emory River at KIF is 0.04 cfs. Under normal operating conditions, short-term flow reversals can develop in the reservoir. However, the duration of flow reversal rarely lasts more than half a day (Thornton 2001).

The watershed health indicator for the Watts Bar Lake watershed and the Lower Clinch River watershed are both rated by the state of Tennessee as having More Serious Water Quality Problems and Low Vulnerability (EPA 2001a). More Serious Water Quality Problems indicates a watershed with aquatic conditions well below state water quality goals that have serious problems exposed by other indicators. Low Vulnerability indicates watersheds where data suggest pollutants or other stressors are low, and, therefore there exists a lower potential for future declines in aquatic health. Actions to prevent declines in aquatic conditions in these watersheds are appropriate but at a lower priority than in watersheds with higher vulnerability. The "more serious water quality problems" in the Watts Bar Lake and Lower Clinch River watersheds are due to concerns over 1) not meeting designated uses, 2) fish and wildlife consumption advisories, and 3) contaminated sediments. Because of these concerns, the 28.2 mile section of the Clinch River from its mouth to Hickory Creek has been placed on the State's 303d list of "impaired" waters. A fishing advisory is in effect due to the presence of PCBs. Chlordane and metals, specifically mercury, are of concern also (EPA 2001b).

Construction Impacts

The area to be disturbed by construction activities is approximately 8 acres. No impacts to surface water would be expected from construction and installation of the SCRs or NO_XTech, associated ammonia storage areas, and related systems with use of proper construction BMPs. Also, construction and installation activities will not disturb reservoir sediments, so any possible pre-existing sediment contamination will not be suspended. KIF is already an industrial facility with some existing BMPs in place. Additional BMPs to prevent erosion and runoff to surface waters will be implemented as needed.

Operational Impacts

No direct negative (toxic) impacts on water quality of Watts Bar Reservoir from ammoniated discharges would be anticipated with implementation of either of the commitments for management of discharges resulting from ammoniated fly ash (see **Summary of Environmental Commitments**). Additionally, since ash pond and other discharges would be required to meet NPDES limits. Also, operational activities will not disturb reservoir sediments, so any possible pre-existing sediment contamination will not be suspended.

If the removal of ash pond discharge to the CCW discharge is implemented as a mitigation option, TVA's commitment (see **Summary of Environmental Commitments**) to remove the potential for re-circulation of ammoniated wastewater through the plant intake will help to improve the discharge water quality in the portion of Watts Bar Reservoir receiving the ash pond discharge. Still, there could be some very minor increase in phytoplankton productivity from the introduction of ammonia in Watts Bar Reservoir if nitrogen is currently a limiting nutrient. However, the amount of nutrient loading resulting from operation of NO_XTech and/or SCRs at KIF would be inconsequential compared to loading from all other sources in the watersheds (i.e. runoff from spring-time fertilization, farmlands, etc.).

Groundwater Resources

Description

The plant site resides within the Valley and Ridge physiographic province, a region characterized by narrow, subparallel ridges and valleys trending northeast-southwest. Bedrock units of the Rome Formation, Conasauga Group, and the Knox Group subcrop beneath the site in broad, northeast-trending bands. These units generally dip to the southeast at angles ranging from a few degrees to vertical. Shales of the Rome Formation form Pine Ridge along the western margin of the plant site. The Conasauga Group underlies most of the reservation, and consists largely of shale with interbedded limestone and conglomerate. Dolomites and limestones of the Knox Group lie beneath the extreme eastern portion of the reservation. These formations locally exhibit low water-producing capacity. A mantle of predominantly alluvial soils ranging up to 100 feet in thickness lies above bedrock. The alluvium typically consists of clay, silt, and sand with occasional gravel. Residual clays derived from weathering of the underlying rock are also present in some areas. Shallow fill soils and ash are common in the developed areas of the reservation.

Groundwater is derived from infiltration of precipitation and from lateral inflow along the western boundary of the reservation. As shown in the Figure 3-1, groundwater movement generally follows topography with flow in an easterly direction from Pine Ridge toward the Emory River and Watts Bar Lake. An exception to this trend occurs on the northern margin of the ash disposal area where groundwater movement is northerly toward Swan Pond Creek. Groundwater originating on, or flowing beneath, the site ultimately discharges to the reservoir without traversing off-site property.

A survey of local groundwater use within an approximate two-mile radius of the KIF ash pond was conducted in March 1995 (Boggs 1995). A total of 22 residential wells and one spring were identified within the survey area (Figure 3-2). Depths of the residential wells are unknown; however, it is likely that most are completed in the Conasauga at relatively shallow depths (i.e., less than 300 ft). The only spring identified in the area (Figure 3-2) provides untreated water for 10 to 12 residences along Swan Pond Road and for several residents of the Kingston Heights subdivision. The spring emanates from the Copper Ridge Formation. Other residents within the survey region are served by four local water utilities which operate intakes on Watts Bar Lake or the Emory River.

Construction Impacts

High-Dust SCR System

Plant construction activities potentially affecting groundwater resources would be limited to excavations associated with the (1) SCR reactors, (2) ammonia transfer lines in the plant area, and (3) the new ash pond discharge line if (if chosen as a mitigation option). Excavations associated with SCR structures and subsurface lines in the plant area would not exceed about 5 feet in depth, and would not be expected to encounter significant groundwater. Groundwater control, if needed, would be limited to short-term dewatering from excavations.

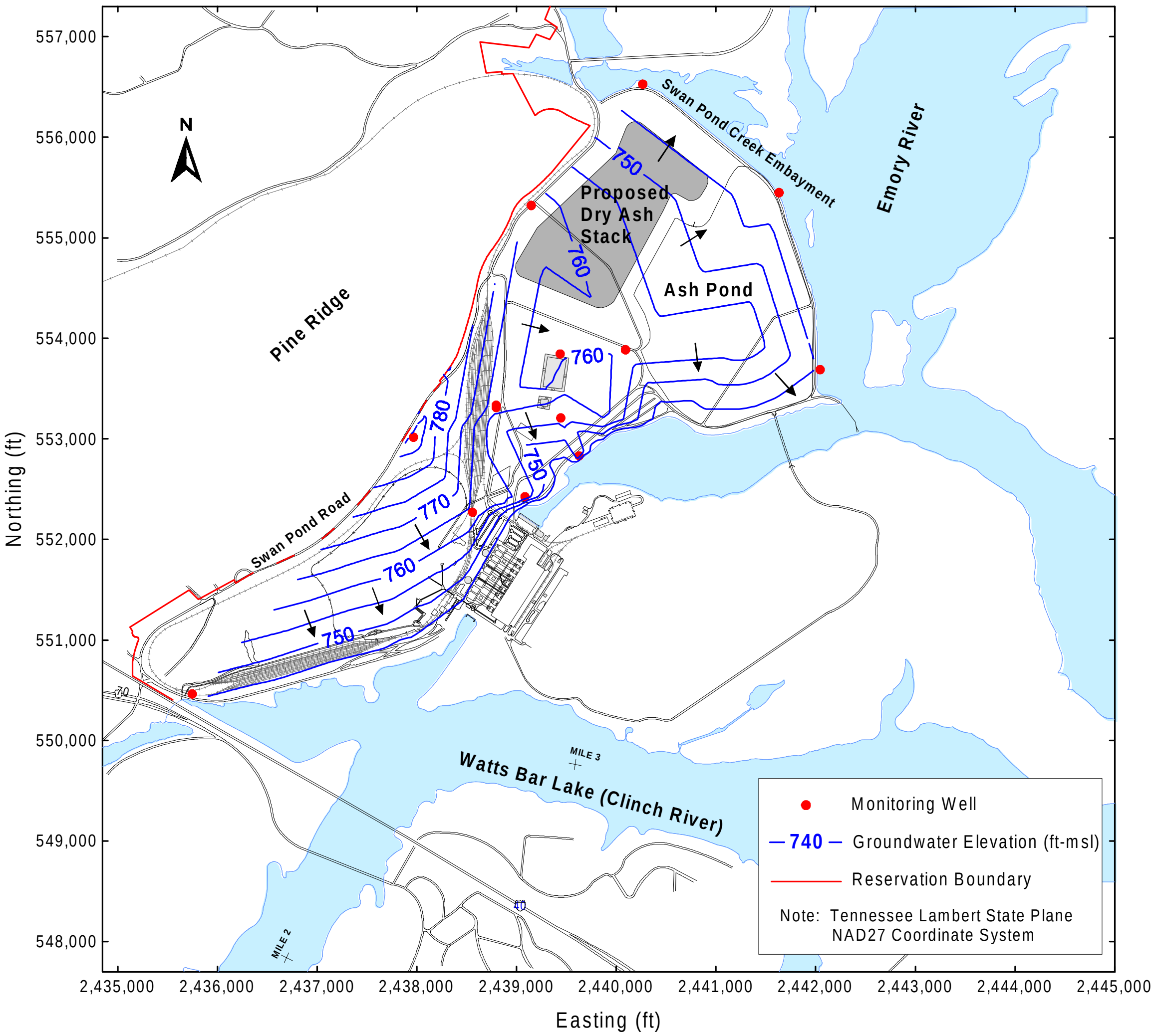

Figure 3-1. Groundwater Potentiometric Surface Based on December 1994 Water Level Measurements.

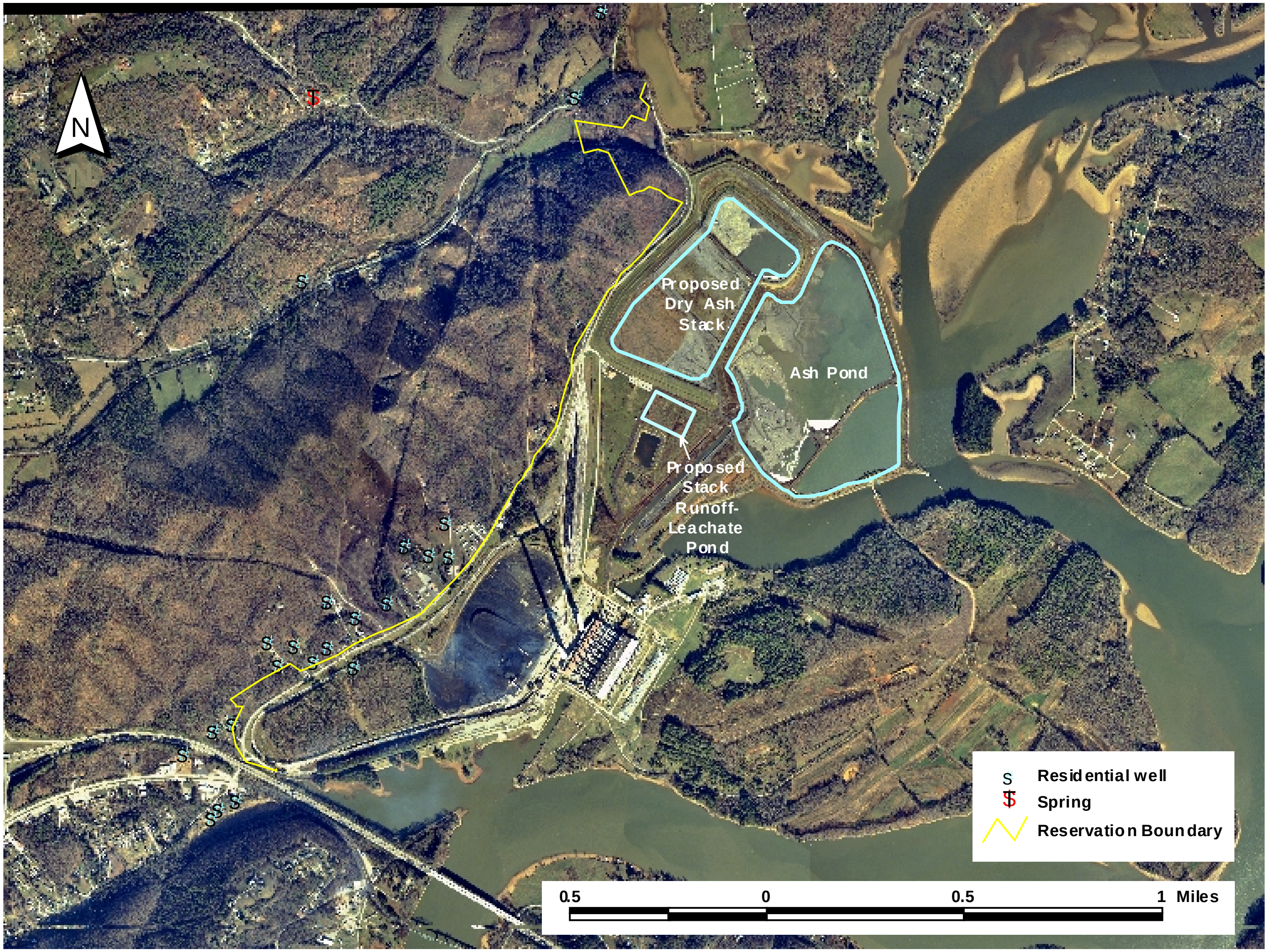

Figure 3-2. Photo Showing Private Wells and Spring in Vicinity of Kingston Fossil Plant

The overall impact of construction of the *SCR System* on groundwater resources would be negligible.

NO_X*Tech-SCR Hybrid System*

Construction activities potentially affecting groundwater resources would be limited to excavations associated with (1) the new ash pond discharge line; (2) natural gas lines and ammonia transfer lines in the plant area; and (3) the six-inch natural gas supply line from the KIF plant to the ETNG trunk line in Harriman, Tennessee. For the SCR portion of the hybrid installation, the construction activities for SCRs or Units 1 through 4 would be the same as those described for the high dust SCR system. Excavations for underground lines would not exceed about 5 feet in depth, and would not be expected to encounter significant groundwater. Groundwater control, if needed, would be limited to short-term dewatering from excavations. The overall impact of construction of the NO_XTech-SCR hybrid system on groundwater resources would be negligible.

Construction of the six-inch natural gas supply line along both alternative routes would generally involve shallow trenching. Materials used in constructing the pipeline would be free of chemicals that might contaminate groundwater. The average trenching depth would be 4 feet with maximum depth not expected to exceed 6 feet. Groundwater control, if needed, would be limited to short-term trench dewatering. Directional (horizontal) drilling techniques would used for pipeline crossings beneath the Emory River and Swan Creek embayment. Groundwater withdrawals during drilling would be temporary and would not be expected to lower groundwater levels in area due to the off-setting effect of induced recharge from local surface water.

No Action Alternative

There would be no groundwater resource impacts associated with this alternative.

<u>Operational Impacts</u>

In general, the potential sources of groundwater contamination during plant operations include (1) infiltration of surface releases of ammonia within the storage tank retention basin following accidental spills or tank failure, and (2) infiltration of leachate containing ammonia generated by ammoniated–ash deposited in the ash pond or in a dry ash stack.

Accidental Release of Ammonia from Storage Facility

The worst case scenario assumes the catastrophic failure of one of the ammonia tanks (useable volume 26,250 gallons), the discharge of 8,100 gallons of emergency deluge water, together with the accumulation of 110,000 gallons of water from the 10-year 24-hour rainfall event (Smith, 2001). Thus, for the worst case scenario, it is estimated that a total of 144,350 gallons of concentrated ammonia solution will be captured in the tank retention basin. The base footprint of the tank retention basin is trapezoidal. The working conservative cross-sectional area of the base is 4,350 square feet. The total volume of ammonia solution described above would provide an initial depth of 4.44 feet (1.35 meters) in the retention basin.

This basin would be located adjacent to the tank storage area such that it would collect any emergency ammonia solution releases from the tank area. For the management of this volume of liquid, two scenarios are under consideration: (1) the retention basin is lined with a compacted low permeability clay or a synthetic liner, and (2) the basin is comprised of a wall or berm surrounding the floor/bottom consisting of existing in situ soil materials. For either of the two scenarios, outdoor containment such as proposed, would be drained of excess precipitation periodically as necessary to retain storage capacity. This is particularly important as precipitation from the entire ammonia tank storage area will be directed to the retention basin. If this rainwater is thought to be contaminated it would be tested prior to drainage/disposal and managed appropriately.

For the scenario with the lined basin, the released solution would be contained totally within the basin, except for the likely vaporization of ammonia. Well compacted clay liners would typically exhibit hydraulic conductivities ranging from 0.5 to 1×10^{-7} cm/s --- essentially impermeable, as would be the synthetic liner. The liquid accumulated in the basin would be pumped out and hauled off for commercial disposal, or transferred to a storage pond onsite for further management.

Based on the assumed volume of anhydrous ammonia released and the volumes of water as specified above, the ammonia solution in the retention basin would be about 8.8 molar in ammonia/ammonium and would have a pH of about 12. At this pH the solution falls below the threshold (pH 12.5) that would qualify it as a hazardous waste (US EPA, 1999a). Nevertheless, the concentrated ammonia solution is very caustic. Also, ammonia vapor would volatilize quite readily from such a high pH solution. Thus, careful neutralization of the ammonia solution accumulating in the retention basin from an accidental release to reduce the pH to less than 8 is recommended as an interim management measure. At pH 8, the volatilization of ammonia would be negligible.

For the alternative scenario, the degree of containment of the worst case ammonia solution is dependent on the permeability of the soils comprising the floor of the retention basin. As mentioned previously, an even distribution of the 110,000 gallons of ammonia solution over the entire 4,350 square feet containment area would produce an average depth of fluid of 4.44 feet (1.35 meter). The infiltration of this ammonia solution into the soil of the retention basin was estimated based on the Green-Ampt model (Green and Ampt 1911) for infiltration through partially saturated soils (Boggs 2001). It assumes a sharp (step function) wetting front without diffusion or dispersion of the ammonia solution.

Five borings recently completed in the vicinity of the proposed ammonia tank retention basin indicate that the site is underlain by 10 to 14 feet of unconsolidated silty, sandy clay residuum and weathered shale (Law 2001). Thin-bedded shale and limestone bedrock of the Conasauga Group lie below the soil overburden.

The Green-Ampt infiltration model was used to estimate the rate of downward movement of the ammonia wetting front through 4 feet of residual soil between the design elevation for the bottom of the retention basin (elevation 760 ft MSL) and the water table (elevation 756 ft MSL) based on observations from two of the five borings. The infiltration analysis utilized site-specific saturated hydraulic conductivity and moisture content data derived from soil samples collected from recent borings. Moisture-retention and relative hydraulic conductivity data reported by Mualem (1976) for a soil (Yolo light clay) having characteristics similar to the local in situ soil were used for the analysis, in the absence of site-specific information.

Soil parameters values used in the infiltration analysis include a vertical hydraulic conductivity of 4.3×10^{-4} m/d (5.0×10^{-7} cm/s), a total porosity of 0.50, initial volumetric moisture content of 0.31, and pressure head at the wetting front of -0.25 meters. Results are given in terms of estimated time for the ammonia front to reach selected depths below the basin floor (Boggs 2001).

Excerpts of these results are presented in Table 3-17. For shallow infiltration of the worst case release, it was estimated that it would take about 3, 12, and 43 days for the ammonia front to penetrate 0.5, 1.0 and 2.0 feet, respectively, below the basin floor. Notably, it would take about 150 days for the front to reach a depth of 4 feet, the estimated high groundwater level for the basin location.

Also, for this soil, when the wetting front reaches the groundwater table the accumulated worst case ammonia solution should be 1.12 feet deep or 83 percent of the initial ammonia solution in the basin, in the absence of corrections for evaporative losses. No retardation factor was invoked for the movement of the ammonium because the high ammonium concentrations involved would easily saturate any available soil cation exchange capacity.

Table 3-17. Infiltration of the Worst Case Ammonia Solution into the Ammonia Tank Retention Basin Soil Based <u>in part</u> on Estimates for a Similar Reference Soil (Yolo Clay).

		Retention Basin Soil	
Depth of Wetting Front		Time Elapsed	
(meters)	(feet)	(days)	(weeks)
0	0	0	0
0.15	0.5	3.0	0.43
0.30	1.0	12	1.7
0.61[a]	2.0[a]	43	6.1
0.91	3.0	90	13
1.22[b]	4.0[b]	150	21

[a] Cumulative infiltration = 9% of initial ammonia solution depth in basin.
[b] Depth to groundwater.

The nature of anhydrous ammonia and the regulatory background has a direct bearing on the use of the infiltration data. The Code of Federal Regulations 40CFR117 (US EPA 1999b) and 40CFR302 (US EPA 1999c) gives the reportable quantity (RQ) for anhydrous ammonia as 100 pounds for releases to the environment. An unlined basin constructed on the existing ground would be the environment and would have to be cleaned up very expeditiously.

The infiltration data also indicate the changes in the depths for cleanup above and below the basin bottom with increasing time. Thus, within about 3 days the front has infiltrated to about 0.5 feet and in 43 days to about a 2-foot depth (Table 3-17) and the majority (~91 percent - see table foot note) of the ammonia solution remains in the retention basin, facilitating removal for alternative management. Of course, removal of the infiltration head by removal of the pool of free liquid would have the added benefit of reducing the rate of infiltration of the solution into the bottom of the basin. Notably, while it would take about 150 days for the solution front to reach groundwater, corrective action would be taken long before such a large quantity of concentrated ammonia solution penetrates to any significant depth in the unprotected soil environment.

Relatedly, recompacted soil composites from the proposed retention basin area showed hydraulic conductivities of 1.9×10^{-7} and 2.8×10^{-7} cm/s at 88.5 and 93.9 percent compaction, respectively (Law Engineering, 2001). Because of the variability of the observed undisturbed hydraulic conductivities in the basin area, it is recommended that composites of the soils in the area will be remolded to similar (~ 90) percentages of compaction to provide a 1-foot liner. This would provide the appropriate uniformly low permeability across the entire basin area and so protect the higher hydraulic conductivity subareas observed within.

<u>Impacts of Ammoniated Ash Disposal</u>

Sluiced Ash Disposal Option

Under this wastewater management and mitigation option, ammoniated ash produced from the NO_XTech-SCR hybrid or high-dust SCR *systems* would be sluiced to the existing ash pond for disposal. Assuming complete leaching of ammonia from the ash, the resulting NH_3-N concentration in the sluice water is estimated to be approximately 1.83 mg/L for the SCR system and 2.64 mg/L for NO_XTech-SCR hybrid system. Once in the ash pond, the majority of ammoniated sluice water would be routed to the CCW, while the remaining water would infiltrate into the underlying alluvium. Under prevailing groundwater gradients, ammonia-affected sluice water entering the shallow groundwater system below the ash pond would ultimately discharge into the Emory River as see page (Figure 3-1) without traversing adjoining private property. Consequently, there would be no impacts to existing or future groundwater users in the site vicinity. Ash pond water entering the Emory River via groundwater meets acute aquatic life criteria for ammonia and chronic criteria for some expected stream pH and temperature conditions (see Table 3-15).

Dry Ash Disposal– Without Leachate Collection System (LCS)

Dry ammoniated ash produced by either the *NO_XTech-SCR hybrid system* or the *high-dust SCR system* would be stacked directly on top of existing ash deposits in the area now occupied by ash dredge cells (Figure 3-2). The total area designated for dry stacking is approximately 63 acres. No more than 10 acres of dry ash would be exposed at any time during the stacking period. The ash stack would ultimately be capped with one foot of clay having hydraulic conductivity of 10^{-7} cm/s or less, followed by one foot of vegetated topsoil.

Based on field observations of the hydrologic water budget of a dry ash disposal area at TVA's Bull Run Fossil Plant located near Clinton, Tennessee (Young 1989), as much as 5% of total precipitation contacting ammoniated ash deposited in the dry stack facility would be expected to form leachate and infiltrate into the underlying soil. The remaining leachate would runoff, evaporate, and/or remain stored in the ash. Groundwater flow patterns indicate that ammonia-affected leachate entering the groundwater system below the dry stack would discharge into Swan Pond Creek embayment without traversing adjacent private property (see Figures 3-1 and 3-2). Therefore no impacts to existing or future groundwater users in the site vicinity would be expected.

Potential aquatic impacts resulting from ammoniated ash leachate seepage into Swan Pond Creek embayment were evaluated for worst-case assumptions regarding ammonia loading and stream flow. An average rate of ash leachate generation of 7440 L/day was estimated for the 10-acre maximum exposed dry stacking area based on total annual precipitation of 52.9 inches/year and 5% net infiltration rate through the base of the dry stack. Assuming complete leaching of ammonia from the ash by infiltrating precipitation, the NH_3-N concentration of the leachate would be approximately 1054 mg/L for ash produced by the NO_XTech-SCR hybrid process and 733 mg/L for *SCR* ash. The ammonia loading to Swan Pond Creek would be approximately 7.84 kg/day for NO_XTech-SCR hybrid ash and 5.45 kg/day for *SCR* ash. To obtain the ammonia concentration in Swan Pond Creek, complete mixing of predicted ammonia loadings with the estimated 7-day, 10-year low stream flow of 1.051×10^6 L/day is assumed (Thornton 2002). The resulting NH_3-N concentration in Swan Pond Creek would be approximately 7.5 mg/L for NO_XTech-SCR hybrid ash and 5.2 mg/L for *SCR* ash. The predicted NH_3-N concentrations for both NO_XTech-SCR hybrid and *SCR* ash exceed CCC aquatic life criteria under most expected stream pH and temperature conditions (see Table X of **Wastewater**). Therefore, simple dry stacking of ammoniated ash produced by either technology might result in aquatic impacts under certain stream conditions. Therefore, as described below, TVA would install a leachate collection system if dry ash disposal is chosen as a wastewater management and mitigation option.

Dry Ash Disposal Option – With Leachate Collection System

Under this option dry ammoniated ash would be deposited in an engineered facility having a clay bottom liner and an ash leachate collection system. The facility would encompass the 63 acre area now occupied by ash dredge cells (Figure 3-2). Stack development would proceed in 21-acre parcels with each parcel having its own LCS. As the final design elevation of each parcel is achieved, the stack would be capped with one foot of clay having hydraulic conductivity of 10^{-7} cm/s or less, followed by one foot of vegetated topsoil. Ash leachate captured by the LCS would be routed, along with surface runoff from the dry stack, to a lined retention pond bordering the southwestern side of the dry stack (Figure 3-2). Effluent from the retention pond would subsequently be metered into the CCW intake to achieve the desired ammonia dilution (see **Wastewater**).

Groundwater resource impacts of this option would be insignificant. The bottom liner and LCS would essentially eliminate downward migration of ammoniated-ash leachate from the dry stack into the underlying groundwater system. This, in turn, would prevent ammonia-related impacts to Swan Pond Creek embayment resulting from potential influx of local groundwater. Similarly, the runoff-leachate retention pond would be lined either with a geomembrane or compacted clay, thereby eliminating the potential for ammonia contamination of the underlying groundwater.

No Action Alternative

There would be no groundwater resource impacts associated with this alternative.

Socioeconomics

<u>Resource Description</u>

The KIF is located in Roane County, Tennessee, near the city of Kingston and a short distance from the city of Harriman. The population of the city of Kingston is 5,264 and that of Harriman, 6,744. The other cities in the county are Midtown, located a short distance west of the plant site, with a population of 1,306, and Rockwood, located somewhat farther to the west, with a population of 5,774.

The labor market area is defined to include the adjacent Tennessee counties, which includes Knox County (Knoxville). Knox County, as well as the smaller counties, would be a likely source of employment for construction activity. Hamilton County (Chattanooga) is also close enough, although not in the labor market, that it might supply some construction workers.

Population

According to the 2000 Census, Roane County has a population of 51,910, an increase of 9.9 percent compared to the 1990 population of 47,227. This was a slower rate of growth than the state of Tennessee, which increased by 16.7 percent, and the nation, which increased by 13.2 percent. The labor market area also grew slowly than the state, increasing by 14.8 percent to a 2000 population of 699,418, somewhat faster than the national growth rate.

The minority population in Roane County is small, constituting about 5.2 percent of the total in 2000. The largest minority population is black, constituting about 2.7 percent of the total population. Less than 0.5 percent of the population is white Hispanic origin. About 1.2 percent of the population identified themselves as being of two or more races. Both the state and the nation have much larger minority populations, 20.8 percent and 30.9 percent respectively.

Income and Employment

Per capita personal income in Roane County in 1999 was $21,728, about 85 percent of the state average of $25,548 and 76 percent of the national average of $28,546. The level was higher in the labor market area as a whole, $24,724 or almost 97 percent of the state average and almost 87 percent of the national average. There was considerable variability, however, among the counties in the labor market area, ranging from $15,153 in Morgan County to $27,376 in Knox County.

The largest source of earnings in Roane County is services, which accounts for over 48 percent of total earnings and almost 37 percent of employment in the county. Most of this is undoubtedly associated with federal government operations at Oak Ridge National Laboratory, which is located near the eastern edge of the county close to Oak Ridge. Government is also an important source of earnings (almost 17 percent), as is transportation and public utilities (14 percent). On the other hand, manufacturing contributes only a little more than 8 percent.
With a civilian labor force of 23,450 in 2000, Roane County had an unemployment rate of 4.3 percent, somewhat higher than the labor market area (3.1), the state (3.9), and the nation (4.0). Roane County is more dependent on services and government for its jobs, and less dependent on manufacturing and trade than is the labor market area or the state. About 10 percent of jobs in Roane County are in manufacturing, while almost 14 percent in the labor market area and over 15 percent in the state are in manufacturing. On the other hand, Roane County has about 37 percent in services, compared to 30 percent in the labor market area and 28 percent statewide; the county has about 17 percent in government, compared to 13 percent in the labor market area and 12 percent statewide.

Potential Impacts

Employment

If the SCR system is chosen, the construction period will last about two years. Installation of the SCRs for Units 1 through 4 would begin in June 2002 and be completed no later than November 2003. Construction of the SCRs for Units 5 through 9 would begin October 2002 and be completed no later than April 2004. Operation of the SCRs would begin in May 2004. Under this alternative, there would be a peak of about 600 construction workers at the site for a period of a few weeks during this two-year period, a maximum increase of about 2.4 percent in the number of jobs in Roane County. This would be a small positive economic impact on the local economy.

Installation of the NO_XTech system would require much less construction and modification than installation of SCRs. Only about 200 construction workers would be required at the peak levels of employment, about 0.8 percent of the number of jobs in Roane County, resulting in a positive impact on the local economy smaller than with the SCR alternative.

Under Alternative B (hybrid installation of SCRs and NO_XTech), a natural gas supply line would be constructed between the plant and the East Tennessee Natural Gas Company supply line in Harriman. The construction period would be brief and would require only a small number of workers, and therefore would have no important impact on the local economy.

Under the no action alternative, there would be no impact to employment from construction since no construction would occur.

There would be no important impact to operations employment under any of the alternatives.

I*ncome*

The increase in employment during construction, along with any local purchases of supplies, would provide a small increase in income in the county. This impact would be greater if the SCR system alternative is chosen, but would be small in either case. Under the no action alternative, there would be no impact.

There would be no important impact to income from plant operations under any of the alternatives.

Population

Based on experience at previous TVA construction projects and on the site's proximity to a fairly large labor force, it is estimated that at least 50 percent of the construction workers would already live in the general area, close enough that they would commute rather than move, depending on worker needs elsewhere in and out of the Valley. The remaining workers would move to the general vicinity of the plant.

Assuming that 50 percent of the workers would move into the area, the maximum impact on population at any one time would be about 300 workers for the SCR alternative or 100 workers for the alternative including NO_XTech, plus whatever family they brought with them. As noted above, employment peaks would be of very short duration, so the number of family members who would move with the workers probably would be lower than for longer-term construction jobs. It is likely that the maximum population impact at any one time would be no more than about 600 persons for the SCR alternative, only a little more than one percent of the population of Roane County. For the alternative including NO_XTech , the maximum impact likely would be no more than about 200 persons, less than 0.4 percent of the county population. However, not all of these workers would locate in Roane County. The distribution of this population among counties and within counties would depend largely on the availability of housing or of sites for trailers. Locations near the site or near shopping and other amenities would generally be favored.

Under the no action alternative, there would be no population impact.

There would be no population impact from plant operations under any of the alternatives.

Community Services

Under either action alternative, the impact on community services, such as police, fire, and medical, would be small during construction because of the small size of the impact on population and because of the short duration of the maximum impact during construction.

There would be no important impacts on community services due to operations, except in the unlikely event of an ammonia release, in which case stress could be placed on the medical and emergency services of the area.

Under the no action alternative, there would be no impacts associated with either construction or operations.

Environmental Justice

The proposed actions at the plant site would physically be a minor addition to an expansive heavy industrial facility having a significant property buffer area. Therefore, there is low potential during construction for important impacts on any of the residents of the surrounding area. The minority population of Roane County, where the plant is located, is about 5.2 percent of the total (Table 3-18), compared to 20.8 percent statewide and 30.9 percent nationally. The plant site itself is located near the southeastern corner of census tract 307 and just across the Clinch River from the northwest corner of census tract 302.02. Both of these census tracts have very low minority populations, 4.7 percent in tract 307 and 5.8 percent in tract 302.02, according to the 2000 Census of Population. Because of the low potential for important construction impacts and also because of the relatively small minority population in the area, no disproportionate impacts to disadvantaged populations are expected.

The new gas pipeline necessary for Alternative B would go generally northward from the plant site, cross the Emory River, and connect with the existing ETNG pipeline in Harriman. Under either of the alternative routes, the area which the pipeline would cross is very sparsely populated between the plant site and Emory River. North of the river, it would be generally in unpopulated areas, although not far away from some populated areas. The total population of all the Census Blocks that the pipeline would pass through under either alternative is 527, according to the 2000 Census. Of these, only about 1.9 percent are minority. Impacts from pipeline construction would be minor and brief. Due to the small minority population and the magnitude of likely impacts, no disproportionate impacts to disadvantaged populations are anticipated.

In general, operational impacts would be minor and not noticeable to residents of the surrounding area. However, there is a small probability of ammonia releases, as discussed above. In the unlikely event of such releases, demographic data for areas around the site indicate that for the worst-case scenario, the potentially impacted population is slightly more minority than the county average and much less minority than the state average. The low-income population constitutes a slightly larger share than the county and state averages. For the alternative scenarios (out to 0.2 or 0.3 miles), there is no residential population to be impacted; impacts would be limited to workers on the site. No disproportionate impacts to disadvantaged populations would be likely.

Table 3-18. Plant Vicinity Demographics for Minority and Low-income Populations.

Distance from site	**Total Population, 2000**	**Minority Population (Nonwhite and White Hispanic) (%)**	**Low-income Population, 1990 (% below poverty level)**
.48km (0.3 miles)	0	0	0
11.1km (6.9 miles)	26,000	5.7	17.9
Roane County	51,910	5.2	16.0
Tennessee	5,689,283	20.8	15.7

Transportation

<u>Resource Description</u>

KIF is primarily served by highway and rail modes of transportation. Portions of the existing transportation network in the vicinity of the plant are shown in Figure 3-3. The plant is located in Kingston, Tennessee in Roane County. Vehicle access to the plant is via Interstate 40, State Highway 58, U.S. Highway 70 (S.R. 1) and U.S. Highway 27 (S.R. 29). KIF is located off of Swan Pond Road which loops around from where it intersects U.S. Highway 27 (S.R. 1) at the north end to where it intersects U.S. Highway 70 (S.R. 1) on the south end. The nearest interstate highway is I-40 and the nearest interstate access (Midway exit) has recently been upgraded to a full interchange by the addition of two new ramps. The following table (Table 3-19) shows the Average Daily Traffic (ADT) counts in the site vicinity (Reference *1999 Average Daily Traffic* report prepared by the Tennessee Department of Transportation).

Figure 3-3. Transportation Network in the vicinity of Kingston Fossil Plant.

Table 3-19. Average Daily Traffic (ADT) Counts in the Site Vicinity.

	ADT (veh/day)
Interstate 40	32,480
U. S. Highway 70	11,440
State Highway 58	8,850
U. S. Highway 27	20,810
Swan Pond Road	2,870
Swan Pond Circle (north)	1,670
Swan Pond Circle (south)	510
Webster Road	1,250

KIF has rail access from the Emory Gap Yard (NS) in Harriman which access the TVA-owned railroad tracks that terminate at the KIF rail yard. TVA currently utilizes this track for coal delivery. Coal delivery averages about 100 cars per day, seven days per week.

KIF does have a temporary barge unloading area located between Clinch River Mile 3 and 4 on the southeast side of the plant. The dock is capable of receiving large components to be unloaded by crane. The SCR alternative will utilize the temporary barge unloading area for delivery of large SCR components.

Potential Impacts

By building either alternative NO_X reduction system at KIF, there will be minor impacts to the state and county roads due to the additional generation of traffic during both the construction and operational periods. The construction period for both options will span a period of approximately 2 years. During the construction period, the most intense work will occur during construction outages. The maximum on-site construction workforce for the SCR alternative will be approximately 600 employees. Assuming an average ridership of 1.6 persons per vehicle, and a trip in and out each day, about 750 vehicles will be added to the road network due to daily commuters during this period for the SCR alternative. The maximum on-site construction workforce for the alternative including NO_XTech will be approximately 200 employees. Assuming an average ridership of 1.6 persons per vehicle, and a trip in and out each day, about 250 vehicles will be added to the road network due to daily commuters during this period for the NO_XTech alternative. There will also be additional truck traffic added to the road network throughout the day in the form of construction material deliveries to the site. Some additional delay may be experienced at the intersection of Plant Road and Swan Pond Road at shift changes. Those primarily experiencing the delay will be the construction commuters. Such a problem can be easily tolerated for the duration of the construction period. The employment levels will 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 outages. In the long term, operation of the NO_X reduction system would not generate any noticeable additional traffic for the roads in the local area. There is good road access to the KIF site and the roads in this area are fully capable of absorbing this additional traffic with no drop in the existing level of service currently provided to the road users. The potential traffic impact for both the construction and operational phase of the NO_X reduction system is insignificant.

Natural Gas Pipeline Route
A few roads and one Kingston spur railroad would be crossed by the proposed pipeline route. Swan Pond Circle will be crossed twice in different locations. Kingston Plant Road and Fiske Road in Harriman will also be crossed. All of these asphalt-surfaced roadways are fairly low volume roads. (See Figure 3-3) The Swan Pond Circle south crossing will be included as part of the directional drill with the Swan Pond embayment crossing. The Swan Pond Circle north crossing, Fiske Road, Kingston Plant Entrance Road, and the railroad spur will be bored; whereas, the interior Kingston Plant Road will be crossed by the trenching method.

The directional drill at the south Swan Pond Circle crossing involves an entire length of pipeline welded together and pulled through a drilled hole under the Swan Pond embayment from the bank to the other side of the road.

Boring under the pavement involves excavation of an entry and an exit pit. Then, a hydraulic ram would be used at the entry pit to form a straight bore hole beneath the road to the exit pit. After completion of the bore, the entry-exit pits would be backfilled and restored to their respective original contours. Thus, there will not be any lane closures during construction and no noticeable impact on the county roads.

Kingston Plant Road within the reservation will be crossed by the open cut trench method. The pipeline is installed by excavating, installing the pipe, and backfilling and compacting the trench. The road is then resurfaced to the original conditions. During construction, we will commit to maintain one lane of traffic to allow entry and exit into KIF.

All the crossings will be marked with a warning sign post on either side of the road. When working near publicly traveled roadways, we will follow guidelines in accordance with the *Manual on Uniform Traffic Control Devices*. In addition, all traffic requirements made by Roane County and/or the Tennessee Department of Transportation would be met. All disturbed surfacing will be replaced in kind and vegetation will be re-established. TVA will use BMPs to ensure surface water quality.

Direct access to the construction area would be primarily within the pipeline right of way. Existing roads will be utilized to the extent practical to access to the pipeline. There will be some temporary and permanent access easements acquired for areas where necessary. Minor tree and brush cutting and some additional crushed stone may be required for access and sediment control; however, no ground disturbance or major grading activities will be required.

A natural gas metering station will be constructed at the point of intersection with ETNG adjacent to an existing metering station. The station will encompass an area of approximately 35 feet by 70 feet. An access easement will be purchased over an existing Mid-Coast access road ROW easement.
The additional traffic that would be traveling on the roadways due to this construction would be negligible. Pipeline construction crews are made up of only a few people and are transitory in the nature of their work and pose no significant impact to the transportation network. Likewise, material deliveries by truck are also negligible. Minor

delays will occur during construction of the crossings; however, this work is temporary and can be tolerated for a short period of time.

Ammonia Rail Unloading Facilities/Operation

The ammonia unloading facility will be sited at KIF just west of the abandoned ash disposal area. A short spur and turnout would be added to the existing track west of the proposed unloading facility.

After construction is completed, operation of the SCR will require ammonia deliveries of approximately 1-2 rail cars per week; whereas, operation of the NO_X Technology alternative will require approximately 2-3 rail cars per week. These deliveries would not affect the capacity or level of service currently provided by the existing rail network. The rail transportation network has sufficient excess capacity to handle the increased rail traffic. The rail network into KIF can handle the ammonia unloading operations once the short rail spur is constructed.