ALT 2-1
MACTEC 2006

DRAFT

ENVIRONMENTAL ASSESSMENT

SANTEE COOPER
PEE DEE ELECTRICAL GENERATING STATION

Prepared for:

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October 31, 2006

EXECUTIVE SUMMARY

The South Carolina Public Service Authority (Santee Cooper) proposes to construct and operate two pulverized coal-fired steam generating units with associated facilities, a rail line extension and transmission corridor construction (Pee Dee Site) in Florence County, South Carolina (SC). The total net generating capacity of the facility will be 1,200 megawatt (MW). The facility is proposed to be located on a 2,709-acre tract on the Great Pee Dee River, in an area approximately 25 miles southeast of the City of Florence, near the Town of Pamplico.

This project was first considered by Santee Cooper in the early 1980s. In 1983 a comprehensive, 3-volume Environmental Assessment Report (1983 EA) was prepared by Gilbert/ Commonwealth under contract with Santee Cooper to assess environmental impacts associated with the project. This document, as well as additional supplemental reports, was submitted to the U.S. Department of the Army Corps of Engineers (USACE) and the South Carolina Department of Health and Environmental Control (SCDHEC) in conjunction with permit applications. Permits and regulatory certifications that were issued to Santee Cooper for this project include the following:

- A Finding of No Significant Impacts (FONSI; National Environmental Policy Act)
- USACE Section 10/404 permit (issued 1984, expired 1994)
- SCDHEC Section 401 Water Quality Certification (issued 1984)
- State Construction Permit (issued 1986, expired 1994)

The primary purpose of this environmental assessment report is to provide updated information for the reauthorization of this project. The focus of this report is on changes to the project and changes to the existing environment since 1983. The most significant project modifications include: 1) downsizing of the baseload generation from 2,200 MW to 1,200 MW; 2) technology and recycling improvements that will allow a significant reduction of solid waste disposal areas; 3) reconfiguring the site layout to avoid impacts to many of the larger, high value wetlands; 4) detailing a rail line extension to the project for raw materials delivery; and 5) construction of a new transmission corridor as part of the project. In general, potential adverse environmental impacts associated with the proposed project have been minimized as a result of these project modifications.

A No Action alternative was analyzed and rejected because power demand will exceed supply under that alternative. Six potential locations throughout lower South Carolina were evaluated and ranked on environmental and engineering criteria, with the Pee Dee Tract selected as the preferred location. For this assessment, three generating station layout alternatives were considered and Alternate Layout #3 was identified as the preferred alternative based on the fewest impacts to on-site wetlands and other environmental categories. Three transmission corridor alternatives were considered and Alternative Corridor #2 was identified as the preferred alternative for several reasons; including its use of the existing Friendfield-Lake City right-of-way (ROW), reliability issues, and it requires the least amount of clearing of forested acres. Four materials transportation alternatives were considered and the Southern Rail Line Alternative was identified as the preferred alternative because it was considered to be the most efficient mode of transport and to have the least environmental impacts.

Several environmental areas that were analyzed in the 1983 EA did not change significantly or would be impacted to a lesser level as a result of the facility modifications. These environmental areas include: landform and geology; land use; and cultural resources. This Environmental Assessment Report provides a general summary of the 1983 analysis and updated baseline information.

Other environmental areas have changed more significantly over time due to various factors such as industrial trends in Florence and Marion Counties and altered composition of vegetation, wildlife and aquatic resources. Detailed analyses of these topics are contained in this report, and are summarized below.

<u>Hydrology and Water Quality</u> - The water Consumption Rate from the proposed facility (net loss) of 24.5 cfs (29 cfs – 4.4 cfs) will comprise approximately 0.25% of mean river flow. Maximum consumption may increase to 43.4 cfs if a third pump is required during times of high river flow. Projections about how water withdrawal from the Great Pee Dee River might influence downstream saltwater intrusion indicate that specific conductance (an indicator of salt water) would have increased 26 μmhos during 1995-2002 at the most downstream gauge had the Pee Dee Station been in operation during that time period.

The facility should be able to meet the various expected effluent criteria and in-stream water quality standards during normal operations. Insofar as the Great Pee Dee River is impaired with respect to mercury in fish, and the facility will increase levels of mercury in the river, additional mercury reduction technologies may be required, particularly if a mercury Total Maximum Daily Load (TMDL) requirement is promulgated for the Pee Dee River basin. A model of expected mercury loading using river flow data from the nearest gauge and expected mercury concentration in effluent indicated that under most operating conditions river water mercury concentrations would increase by 0.005 µg/L or less. These estimates of mercury concentrations were based on actual measured data from a similar existing Santee Cooper facility (Cross Plant).

Temperature simulations completed for this report indicated that in-stream temperature standards will be met.

The QUAL2e DO model for expected National Pollutant Discharge Elimination System (NPDES) permit conditions at the site indicate that in-stream DO may decrease by less than 0.02 mg/L. The expected discharge water quality (based on effluent data from the Cross Plant) is not anticipated to further impact in-stream water quality.

Implementation of erosion control best management practices (BMPs) and a storm water pollution prevention plan (SW3P) are expected to minimize impacts to river sediments during construction. Adherence to stormwater management and discharge permit requirements during operation should minimize sediment quality impacts.

Wetlands - The Pee Dee Site has been determined to have an estimated 520.95 acres of jurisdictional (regulated Section 404) waters of the U.S. including wetlands. This includes 443.66 acres on the Pee Dee Tract, 58.79 acres on the proposed transmission corridor and 18.50 acres on the proposed rail corridor. In addition, approximately 26.9 acres of non-jurisdictional wetlands are located on the site; 26.87 acres on the Pee Dee Tract and .03 acres on the proposed Transmission Corridor. The project will result in unavoidable impacts to approximately 85.66 total acres of jurisdictional wetlands (13.70 acres filled; 71.83 acres cleared; 0.09 acres excavated; and 0.04 acres back-filled and bedded). This includes 17.59 acres on the Pee Dee Tract (including .44 acres filled for the intake structure), 58.68 acres on the transmission corridor and 9.39 acres on the rail corridor. In addition, the project will also result in impacts to approximately 8.09 acres of non-jurisdictional wetlands on the Pee Dee Tract (5.29 acres filled; 2.21 acres cleared; and 0.59 acres dredged). No impacts to non-jurisdictional wetlands on either the transmission corridor or the rail corridor are expected.

The current design layout for the generating station on the Pee Dee Tract has resulted in significant reductions in impacted jurisdictional wetlands (17.59 acres) when compared to the 1983 layout (58.95 acres).

A wetland mitigation plan will be developed and implemented. Compensatory mitigation to offset unavoidable impacts to wetlands and other aquatic resources can be accomplished through several options. The plan will include a focus on improving water quality and wildlife values. Mitigation for wetland impacts may take place on-site, off-site, in mitigation banks, or be funded by in-lieu fees. Mitigation may include creation, enhancement or restoration of wetlands and their functions; or through the preservation of on-site wetlands, preservation of wildlife corridors along connected wetlands and the Great Pee Dee River, and by providing upland buffers adjacent to wetlands.

<u>Vegetation</u> - The dominant vegetative communities on the site are pine forest and pine plantations, many of which were formerly used as crop lands but have been converted to silviculture. The development of the transmission and rail corridors, and the phased development of the facility, would ultimately result in the loss of approximately 1,420 acres of various plant community types, most of which consist of pine forest, pine plantation, mixed forest, and hardwood forest. The removal of this amount of the site's forested lands will have a minimal impact on Florence County timber resources, since this represents less than 0.5% of timber resources county-wide.

Two federal protected plant species known to occur within Florence and Marion counties are Canby's dropwort (*Oxypolis canbyi*) and American chaff-seed (*Schwalbea americana*). Results of the on-site surveys, literature review and communications with resource agency personnel indicate that neither of these species occur on the Pee Dee Site. Numerous state listed plant species were observed on-site during the surveys in 2006, and populations of one state-listed plant species is reported to occur in the vicinity of the proposed transmission line.

Wildlife - A review of the federal listed threatened and endangered species for Florence and Marion Counties was conducted to address the habitat conditions and the potential for occurrence of any federal protected animal species on-site. Three federal protected bird species known to occur within Florence and Marion counties include red-cockaded woodpecker (RCW), bald eagle and woodstork. Results of the on-site surveys, literature review and communications with resource agency personnel indicate that these species do not occur on the Pee Dee Site. During the baseline studies conducted for the 1983 EA, one pair of RCWs was identified within the Pee Dee Tract. However, several subsequent RCW studies (conducted in 1989, 1991 and 1994) indicate that the cavity trees previously inhabited by the RCWs have been abandoned and the RCWs no longer inhabit the site; despite management activities that were implemented to enhance the RCW habitats.

Aquatic Resources - A 2006 electrofishing survey in the Great Pee Dee River at the site resulted in the capture of 66 fish (CPUE = 28 fish/probe hour) with a species richness of 13. The most commonly captured species were: blue catfish, carpsucker, and longnose gar. Deformities, erosion, lesion, and tumor (DELT) abnormalities were observed in two fish for an incidence rate of 3%. Skin-on fillets were measured for Total mercury in Blue Catfish and Gizzard Shad, both resident species. Neither of these species have fish consumption advisories in the Great Pee Dee River, but the concentrations measured in this study indicate that they approach levels where "no consumption" advisories are usually established (250 μg/kg).

A site-specific entrainment rate of 17 fish/million gallons was estimated via filtration of >170,000 gallons of river water over a 24 hour period. Based upon projected water use estimates for the plant, it is expected that approximately 480 larval fish/day would be entrained by the plant during periods of maximum withdrawal.

Shortnose sturgeon is the only federal listed aquatic species known to occur in the vicinity of the Pee Dee site. Entrainment and impingement of the early life stages of sturgeon eggs will be minimized by the placement of the intake screens, small slot width of the wedgewire screens and associated low through-slot velocities, and expected distribution of eggs and larvae. In general, the effects of the discharge from the Pee Dee Station should be minimal based on the projected small size of the discharge plume that would allow for a zone of passage for migrating fish. Suitable substrates for shortnose sturgeon spawning were identified approximately two to four miles downstream of the proposed discharge structure, which is well removed from potential operational impacts.

Air Quality - The Pee Dee Station will be located in an area that is currently in attainment with National Ambient Air Quality Standards (NAAQS) for all regulated pollutants. The primary pollutants that would be emitted by the facility are particulate matter (PM), sulfur dioxide and nitrogen oxide (NO_x). Electrostatic precipitators (ESPs) will be used to control PM, and wet limestone scrubber systems will reduce sulfur dioxide emissions. Nitrogen oxides will be controlled using post-combustion technology. Air modeling shows that the operation of the units at the Pee Dee Station would not cause a violation of any of the NAAQS.

The Pee Dee Station will also have to comply with the federal Prevention of Significant Deterioration (PSD) Program. Florence County has sufficient Class I and Class II increment available for consumption for the Pee Dee Station for all three pollutants.

Land Use – The layout of the final site plan consists of a 1,245 acre 'footprint' within the Pee Dee Tract. The proposed transmission and rail corridors consist of approximately 144 and 31 acres impacted, respectively. The facility footprint is slightly larger than was evaluated in the 1983 EA. This will result in more acreage impacted for the construction of the generating station. However, 297 acres of this footprint are reserved for future ash ponds and solid waste landfills, which are not expected to be needed, and therefore constructed, for at least 20 years.

Cultural Resources – Eight sites potentially eligible for the National Register of Historic Places (NRHP) were identified on the Pee Dee Tract in the 1983 EA. In order to verify the location and condition of these sites, a Phase I Archaeological Survey is being conducted for the Pee Dee Tract, in general accordance with State Historic Preservation Office (SHPO) guidelines for Section 106 compliance. Upon completion of the Phase I Archaeological Survey, Santee Cooper will avoid and minimize impacts to NRHP-eligible resources on the subject property. Impacts that cannot be avoided will be mitigated according to SHPO requirements, including data recovery. NRHP-eligible or listed resources avoided by construction activities will be subject to active preservation by deed-restriction or other suitable methods to be determined by the SHPO, Santee Cooper and other consulting parties. Phase I Archaeological Surveys have been completed for the transmission and rail corridors, resulting in a determination that there will be no effect on significant archaeological resources.

Noise – Noise modeling, completed for the 1983 EA, associated with plant operations indicated that levels <65 decibels (dB) can be expected in all areas of the site, with the exception of residences located near the intersection of Ashley and Duli Roads (See Section 4.8), under the operating scenarios considered. Noise measurements taken in 2006 near the proposed location of the generating station indicate that the current eight-hour time weighted average sound level is 44.5 dB. The current Florence County noise ordinance makes exceptions for the conduct of manufacturing operations. The proposed Pee Dee Station should be exempt from further noise regulations under that ordinance.

Railway noise may be normally unacceptable at six residences in close proximity to the generating station and one church in close proximity to the proposed rail. Noise calculations indicate that noise levels at the church will be within the acceptable range if the use of whistles/horns can be eliminated at the rail crossing of SC Secondary Route 791 (S-791; Chinaberry Road) through the use of automatic crossing guards.

Solid Waste and Hazardous Materials – There are no known historic solid or hazardous waste issues that will require clean-up prior to construction. Operation of the facility will require the use and storage of significant amounts of raw materials and chemicals including; coal, fuel oil, limestone, pet coke, anhydrous ammonia, sulfuric acid, and sodium hypochlorite.

Production of electricity and the corresponding pollution controls will inherently generate waste material. The majority of the solid waste generated will be in the form of bottom ash, fly ash and Flue Gas Desulfurization (FGD) system waste. Following temporary on-site storage of these wastes, much of these materials will be sold as raw materials for various industries. Remaining material that cannot be sold may be disposed of on-site. There will be two types of waste disposal areas on the plant site. One will be for bottom ash in ash ponds and the other for fly ash and scrubber sludge in the solid waste disposal areas. The facility will be required to comply with federal and state laws pertaining to waste and hazardous materials storage and handling.

Traffic – Primary access to the proposed facility will be along South Carolina Secondary Route 57 (S-57, Old River Road). Turn lanes and traffic control measures may need to be added to S-57. Construction materials and plant components will be delivered to the site via existing roads and rail, which will include re-opening a decommissioned rail line. Coal trains one-mile in length (approximately 100 rail-cars), slowed to travel speeds of 4-6 miles per hour once they reach the site, will deliver coal once per day to the site. The area of greatest disruption to traffic flow from these trains will be at the junctions of US Route 378 (US 378), SC Route 41 (SC 41) and S-57 at Kingsburg. Local traffic will be affected by site-related traffic during the construction phase and also by train traffic during the operation phase.

Socioeconomics – Population increases in the project area are expected to be minimal from 2000 to 2030. The project will provide hundreds of new jobs during both the construction and operation phases with 80 - 90% expected to be local hires. It is estimated that as many as 1,500 workers will be required during peak construction. Population increase resulting from project personnel is expected to comprise $< 6\%$ of the projected population growth in the project area. It is expected that a permanent work force of approximately 200 people will be required once both units are operational. Since most workers are expected to be local hires, it is likely that local infrastructure will be able to meet increased demands imposed by new workers. The plant's emergency services plan will need to be coordinated with local emergency officials to address catastrophic events scenarios.

Conclusions – A review of monitoring data, field surveys and other recent environmental studies indicate the project will result in relatively minor, unavoidable environmental impacts. Total impacts remain similar in relation to what was permitted during a 1983 NEPA-review for a previous version of this project. A FONSI was issued as a result of the 1983 review.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF FIGURES

TABLE OF CONTENTS (continued)

LIST OF TABLES

TABLE OF CONTENTS (continued)

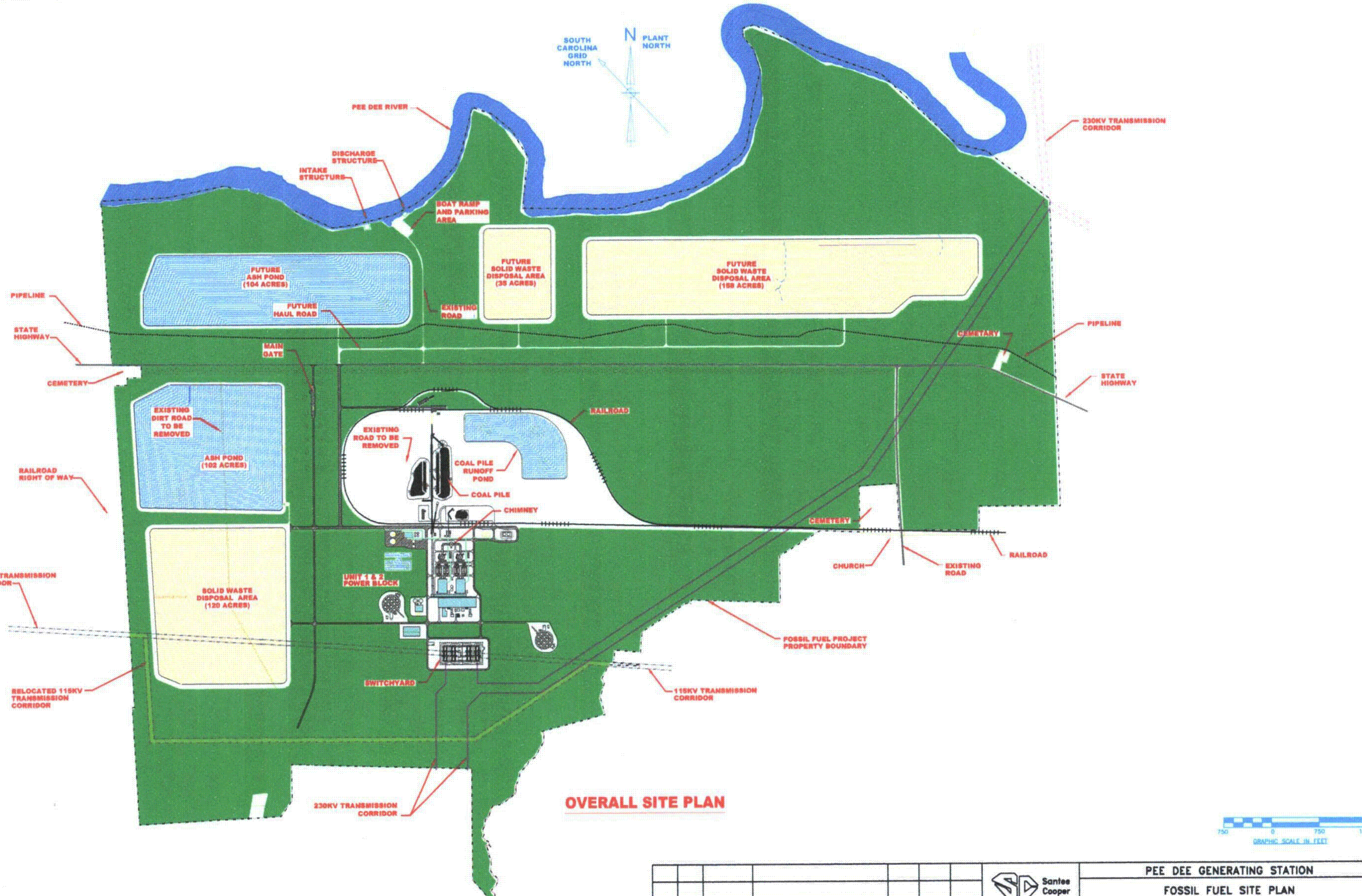
LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
ADT	Average Daily Traffic
APE	Area of Potential Effect
ATV	All Terrain Vehicle
BACT	Best Available Control Technology
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
BMPs	Best Management Practices
BMI	Benthic Macroinvertebrate
BNA	Base Neutral Acid
BOD	Biochemical (Biological) Oxygen Demand
Btu	British Thermal Units (not 1st time)
CFB	Fluidized Circulating Bed
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	Carbon monoxide
COC	Chain of Custody
COD	Chemical Oxygen Demand
CPPP	Coastal Plain Physiographic Province
CPUE	Catch per unit effort
Cr	Chromium
CRP	Conservation Reserve Program
CRS	Center for Resource Solutions
CSX	CSX Corporation, Inc.
Cu	Copper
dB	Decibels
dbh	Diameter at Breast Height
DBA	Adipic Acid
DELT	Deformities, Erosion, Lesions, and Tumors
DNL	Day-Night average sound levels
DO	Dissolved Oxygen
DRG	Digital Raster Graphic
DSM	Demand Side Management
EA	Environmental Assessment
EDR	Environmental Data Resources, Inc.
EIA	Energy Information Administration
EIB	Engineering Innovation Building
EIS	Environmental Impact Statement
ELF EMF	Extremely Low Frequency Electromagnetic Fields
EMF RAPID	Electric and Magnetic Fields Research and Public Information Dissemination Program

EO	Executive Order
EPT	Ephemeroptera, Plecoptera and Tricoptera
ESP	Electrostatic Precipitator
°F	Fahrenheit (not 1st time)
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FF	Fabric Filter
FGD	Flue Gas Desulfurization
FONSI	Finding of No Significant Impact
fps	feet per second
GE	General Electric
GEL	General Engineering Laboratories, Inc.
GIS	Geographic Information System
GPC	Georgia Power Company
GPS	Global Positioning System
gpm	gallons per minute
GWH	Gigawatt Hour
HC	Hydrocarbons
Hg	Mercury
HP	High Pressure
HRSG	Heat Recovery Steam Generator
HUD	U.S. Department of Housing and Urban Development
IGCC	Integrated Gasification Combined Cycle
IP	Intermediate Pressure
km	kilometer
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
LP	Low Pressure
µg/kg	micrograms per kilogram
mg/L	milligrams per liter
MMBtu	Million British Thermal Units
Mn	Manganese
MOU	Memorandum of Understanding
MW	megawatt
N	Nitrogen
NAAQS	National Ambient Air Quality Standards
NCASI	National Council for Air and Stream Improvement
NEPA	National Environmental Policy Act
NESA	North Eastern Strategic Alliance
ng	Nanogram
NGVD	National Geodetic Vertical Datum
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_x	Nitrogen Oxide
NOAA	National Oceanic and Atmospheric Administration

NPDES	National Pollutant Discharge Elimination System
NRC	National Recreation Commission
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standard
NWI	National Wetlands Inventory
O&M	Operations & Maintenance
P	Phosphorous
PC	Pulverized Coal
PCB	Polychlorinated Biphenyl
PEC	Probable Effect Concentration
pi	point of intersection
PM	Particulate Matter
ppm	parts per million
PSD	Prevention of Significant Deterioration
psig	per square inch gauge
RCW	Red-Cockaded Woodpecker
RGLs	Regulatory Guidance Letters
RM	River Mile
ROW	Right-of-Way
RRCC	Robust Redhorse Conservation Committee
SC	South Carolina
SCDAH	South Carolina Department of Archives and History
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCDOT	South Carolina Department of Transportation
SCE&G	South Carolina Electric and Gas
SCECAP	South Carolina Estuarine and Coastal Assessment Program
SCIAA	South Carolina Institute of Archaeology and Anthropology
SCR	Selective Catalytic Reduction
SCS	Soil Conservation Service
SCSBCB	South Carolina State Budget and Control Board
SCWMRD	South Carolina Wildlife and Marine Resources Department
SEPA	Southeastern Power Administration
SERC	Southeastern Electric Reliability Council
SHPO	State Historic Preservation Office
SNCR	Selective Non-Cataylitic Reduction
SO_2	Sulfer Dioxide
SQG	Sediment Quality Guideline
STIP	Statewide Transportation Improvement Program
SW3P	Storm Water Pollution Prevention Plan
TEA	The Energy Authority
TEC	Threshold Effect Concentration
TMDL	Total Maximum Daily Load
tph	tons per hour
TSS	Total Suspended Solids

TT-4	Traffic Tally 4
TWA	Time Weighted Average
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOE	U.S. Department of Energy
USDOI	U.S. Department of Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VACAR	Virginia-Carolinas Electric Reliability Subregion
VHP	Very High Pressure
VOC	Volatile Organic Carbon
WHO	World Health Organization
WMA	Wildlife Management Area



OVERALL SITE PLAN

ZONE	REV.	DATE	DESCRIPTION	DRAF.	ENGR.	SUPV.
	1	1/2/07	REVISED SITE PLAN	WFH		

Santee Cooper
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

PEE DEE GENERATING STATION

FOSSIL FUEL SITE PLAN

ENGINEERING AND CONSTRUCTION SERVICES — PROJ. NO.: 109675

DES. ENGR.: JEF | DRAWN BY: WFH | SCALE:1"=750'

DATE: 7/6/2006 | DRAWING NO.: FOSSIL FUEL SITE | SHEET 1 OF 1

1.0 INTRODUCTION

1.1 Location of Project Site

The South Carolina Public Service Authority, herein referred to as Santee Cooper, plans to construct and operate a new two-unit coal-fired electrical generating station in Florence County, South Carolina, at a site located along the Great Pee Dee River near the Town of Pamplico. The site, 2,409 acres, was purchased in 1981. An additional 300 acres were purchased in 1983/84 bringing the total site acreage to 2,709 acres, not including the transmission and rail corridors.

The site is located in Florence County, South Carolina, approximately 90 miles east of the City of Columbia, 40 miles northwest of Myrtle Beach, and 25 miles southeast of the City of Florence (Figures 1-1, 1-2 and 1-3). South Carolina Secondary Route 57 (S-57, Old River Road) is oriented through the site from northwest to southeast. The Great Pee Dee River forms the site's northeastern boundary. The Town of Pamplico, not shown in the aerial view, is the closest town to the site, located approximately five miles to the northwest. The Pee Dee site includes a transmission corridor (discussed in Section 1.3.4) that extends westward from the site approximately 11.94 miles to the existing Friendfield-Lake City transmission right-of-way (ROW) and a rail corridor (discussed in Section 1.3.5) that extends approximately 4.34 miles from the site, in a southeasterly direction, to an operational railway in Poston.

1.2 Project Status

Santee Cooper commissioned Gilbert/ Commonwealth, of Reading, Pennsylvania, to conduct an environmental assessment (EA) of the project for a U.S. Department of the Army Corps of Engineers (USACE) permit application to construct intake and discharge structures for the proposed electrical generating station. The EA was completed in 1983 and submitted to the USACE in January 1984, as part of the permit application. After review and public notice, the USACE issued a Section 10/404 Permit (No. 84-3Z-005) to Santee Cooper with an effective date of August 24, 1984 and an expiration date of June 30, 1994. The Section 401 Water Quality Certification was issued by the South Carolina Department of Health and Environmental Control

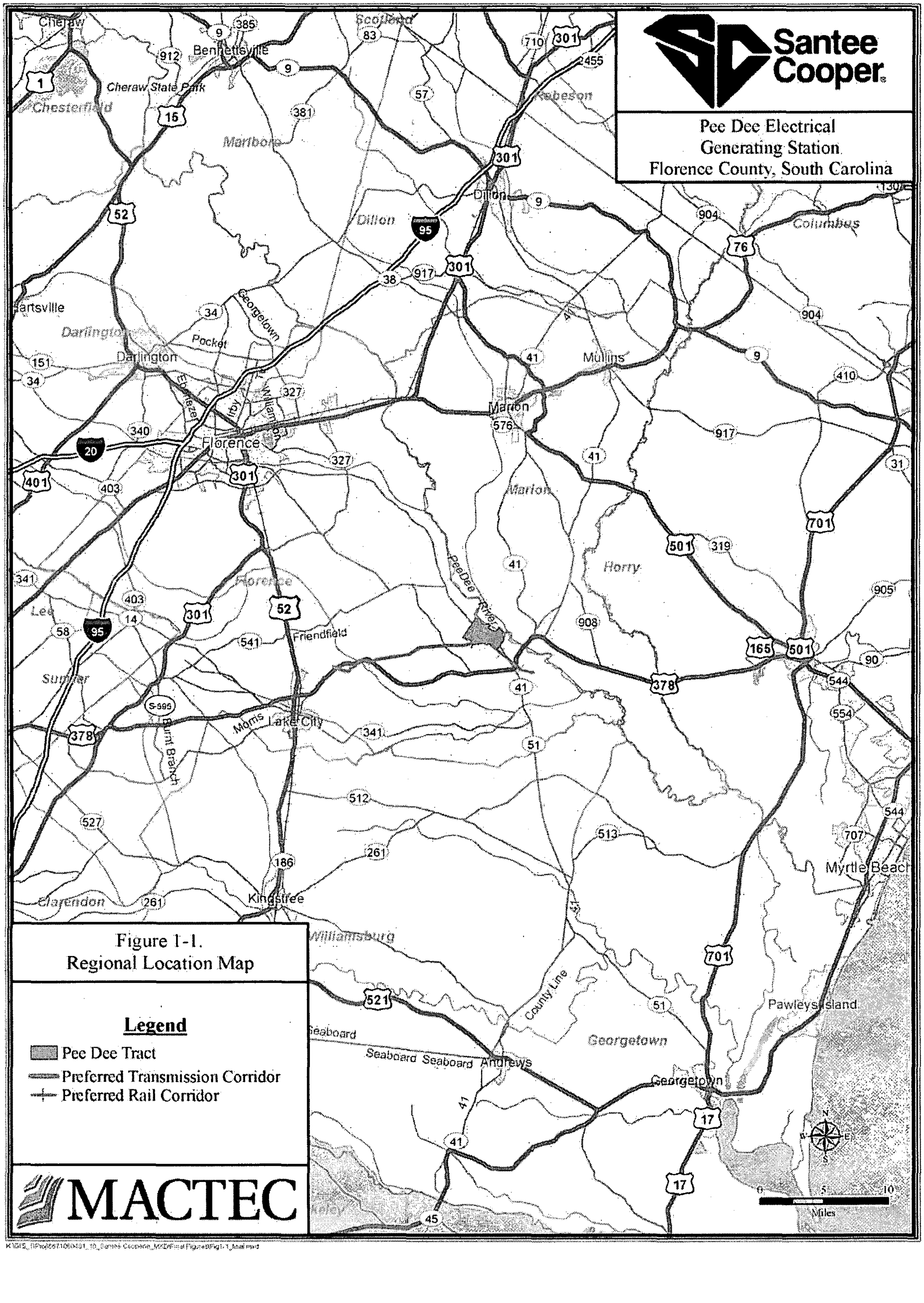


Figure 1-1.
Regional Location Map

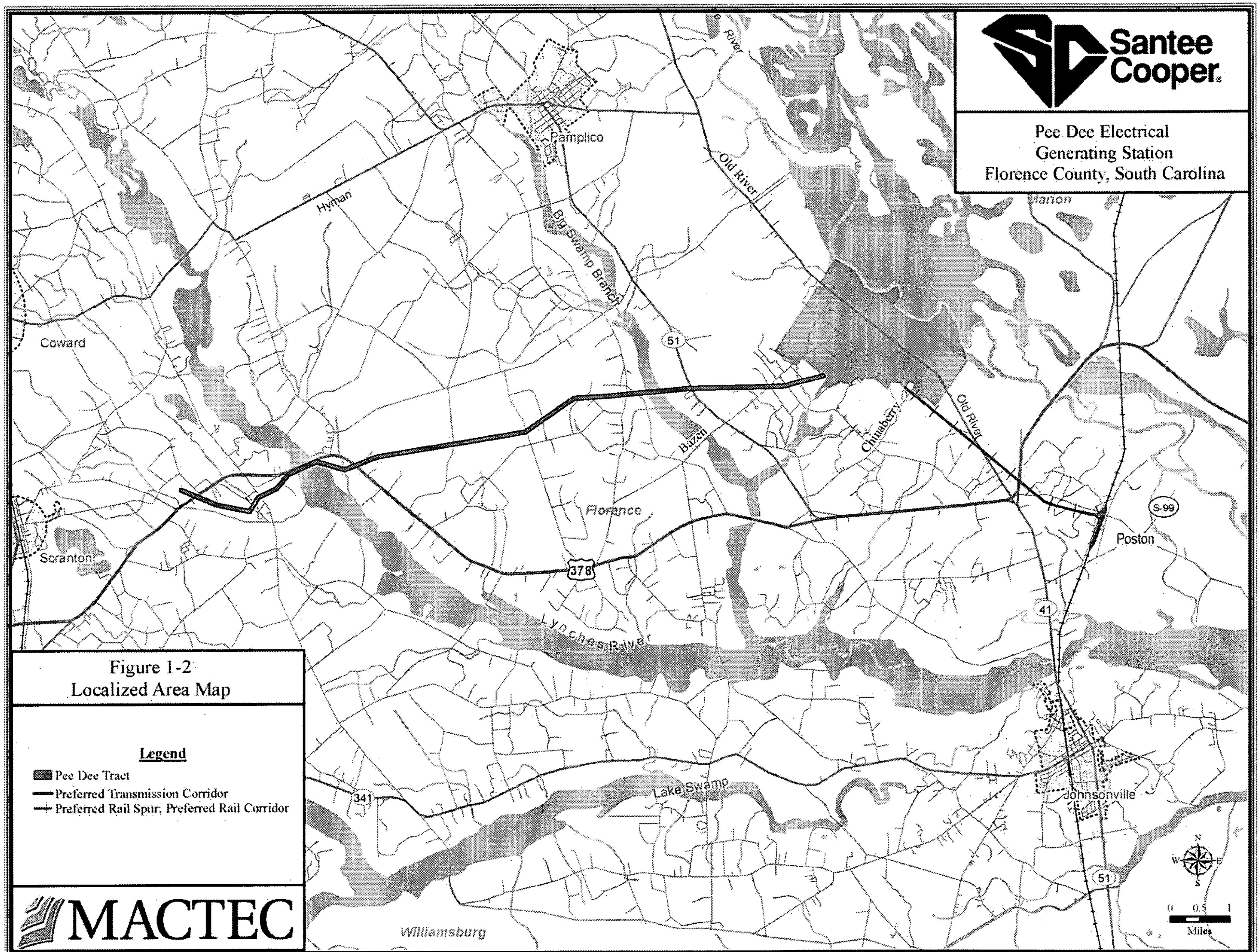


Figure 1-2
Localized Area Map

Figure 1-3
Pee Dee Site
1994 Aerial Photograph

(SCDHEC) on March 6, 1984. The State of South Carolina (State Budget and Control Board) also issued a construction permit (P/N 84-3Z-005) with an effective date of July 23, 1986 and an expiration date of July 23, 1989. A Permit Modification was issued by the State Budget and Control Board with an effective date of July 10, 1989 and an expiration date of June 30, 1994, to provide a State Construction Permit with the same time frame as the USACE Section 10/404 Permit. Copies of the Section 10/404 Permit, the Section 401 Water Quality Certification, and the State Construction Permit are contained in Appendix B.

The electrical load projections forecast in the 1983 EA called for four units, two at 500 megawatts (MW) each and two at 600 MW each to be constructed at the Pee Dee site.[1] The original Pee Dee site schedule anticipated that the 500 MW units would come on-line in 1995 and 1999, with the larger units following in 2003 and 2007. At Santee Cooper's other coal-fired facility, Cross Generating Station, Units 2 and 1 were planned to come on-line in 1984 and 1991, respectively. Cross Unit 2 began commercial operation in 1984 as planned, but due to many factors, primarily of which was load growth, Unit 1 at Cross was delayed until May 1995. Similarly, construction at the Pee Dee site was delayed. Up-dated load projections and planned capacity additions envisioned at this time are discussed in detail in Section 2 of this report.

1.2.1 Site Management

Santee Cooper has had the entire site in the Wildlife Management Area Program since 1984. As such, Santee Cooper has managed the site in cooperation with the South Carolina Department of Natural Resources (SCDNR) for wildlife conservation and management. Agricultural and silviculture operations and management have also continued since 1984. In addition, Santee Cooper has actively managed and worked to improve the red-cockaded woodpecker (RCW) habitat. However, studies conducted in 1989, 1991, and 1994 report no evidence of RCW activity on-site or within 0.5 mile of the site vicinity.

Agricultural activities at the site have decreased during the last 15 years. The acreage desired and leased by area farmers has steadily decreased through the 1980's; down to 125 acres leased

[1] MW numbers are net ratings. Gross ratings minus station electrical requirements yield the net ratings.

on the site for agricultural activities in 2006. As agriculture activity decreased, Santee Cooper increased the silviculture acreage by planting loblolly pine in previously cultivated agricultural fields. A total of 680 acres of agricultural fields have been planted in pine. Also, in cooperation with SCDNR, Santee Cooper established food plots for wildlife, with over 25 acres planted for wildlife in 2005. Timber harvests have been conducted at various areas within the site, which resulted in 30 acres reforested during the last 5 years.

1.2.2 Permit Status

1.2.2.1 Federal Section 10/404 Permit, Section 401 Certification and the State Construction Permit

In July 1982, the USACE published interim final rules for nationwide permits (47 Federal Register, page 31794). This publication included a permit for "outfall structures and associated intake structures" where discharges of effluent from the outfall are authorized by a NPDES permit. At that time, Santee Cooper was in the process of preparing the EA for the Pee Dee Station. It appeared that Santee Cooper could utilize this nationwide permit for the Pee Dee Station and since it was the only federal permit required, the National Environmental Policy Act (NEPA) would not be triggered (see Section 1.2.3.5) and there would be no need for the EA.

Santee Cooper was greatly concerned about utilizing the nationwide permit for a project of this magnitude and submitted detailed comments in response to the July 1982 Federal Register publication. Their principal concern was that there may be instances in which an individual permit would better serve the public interest and be a wiser choice for the applicant. When an entity is engaged in large-scale construction, there is a clear benefit to obtaining certainty. That certainty can only be obtained after there is a complete opportunity for public scrutiny of the project and an opportunity for public comment. The issuance of an individual permit, with its attendant procedural requirements for public notice, comment and appeal, provides an entity that is engaged in a large-scale project with a final resolution of what issues may be deemed controversial. Santee Cooper's primary comment was that the USACE should explicitly include a provision for an applicant to request an individual permit.

The USACE responded to comments in Regulatory Guidance Letter No. 83-1, dated January 17, 1983, by stating that if an entity proposing to conduct an activity covered by a general permit specifically requests that the activity be regulated on an individual permit basis in lieu of the general permit, the District Engineer will accept and process the application for an individual permit if the reasons cited by the applicant are adequate to support the request.

Subsequently, Santee Cooper requested an individual permit and the USACE agreed to accept their application. The USACE Public Notice for the project dated January 23, 1984, noted that the applicant elected not to avail itself of the nationwide permit and instead, pursue an individual permit. This was also noted in the District Engineer's Statement of Findings dated June 1, 1984 (Appendix B).

Both the USACE Section 10/404 Permit and the State Construction Permit expired on June 30, 1994. Santee Cooper initiated informal discussions with the USACE in early 1994 with regard to a permit extension. A formal request for an extension dated June 9, 1994, was submitted to the USACE with a copy and a request to SCDHEC for a corresponding extension of the State Permit (Appendix B). In addition, the 1994 RCW Report was submitted by letter dated August 22, 1994 in support of Santee Cooper's request that Condition (f) (RCW Management) be deleted from the Permit(s) (Appendix C). Copies of the report were forwarded to both the United States Fish and Wildlife Service (USFWS) and to the SCDNR.

The Section 401 Water Quality Certification (Appendix B) issued by SCDHEC on March 6, 1984 included no expiration date. The public notice associated with the present application for reauthorization of federal and state construction permits will include a request for a new Section 401 Water Quality Certification.

1.2.2.2 Wetlands

Santee Cooper facilitated an on-site meeting with the Charleston District USACE on October 9, 1981 at the Pee Dee Tract, in order to delineate jurisdictional wetlands. A map was prepared indicating the areas that were determined to be jurisdictional wetlands and the USACE verified the delineation by letter dated November 3, 1981 (Appendix D). Topographic mapping was later prepared and parties agreed that jurisdictional wetlands would include all the land below 33 feet National Geodetic Vertical Datum (NGVD). The USACE verified this updated delineation by letter dated December 7, 1983 (Appendix D). It should be noted that headwaters and isolated wetlands were not regulated as jurisdictional waters until several years later. In addition, neither the 1981 nor the 1983 verification letters indicated any expiration dates.

Questions have arisen through the years regarding the amount of time jurisdictional wetland verifications are valid when specific time limits were not imposed. In an effort to provide a consistent national approach to reevaluating wetland delineations, the USACE issued guidance, in the form of Regulatory Guidance Letters (RGLs). Specifically, RGL Nos. 90-6 and 94-1 were issued to address this issue.

Paragraph 4 of RGL 90-6 states that written wetland jurisdictional delineations made before the effective date of this guidance, without a specific time limit imposed, will remain valid for a period of two years from the effective date of this RGL, which was August 14, 1990. Thus the Pee Dee delineation would be valid through August 14, 1992. However, paragraph 5 of RGL 90-6 states that the District Engineer can extend wetland verifications for an additional five years from the expiration date in paragraph 4 (August 14, 1992), which would allow for the Pee Dee delineation to be valid through August 14, 1997. This is due to the fact that the Section 10/404 permit was issued prior to the effective date of the RGL, and the fact that substantial resources have been expended. At the end of the five-year period, a new delineation would be required.

A new delineation, which included isolated wetlands, was performed in 1996 and was verified by the USACE by letter dated March 10, 1997 (Appendix D). An updated wetland delineation and USACE field verification, conducted in 2006, is included in Sections 3.3 and 4.3 of this report.

Wetland delineations were also conducted along the transmission and rail corridors in July and August, 2006. The USACE has been contacted to request a wetlands determination for these areas (Appendix D).

1.2.2.3 Federal Protected Species

The 1983 EA revealed the presence of two (2) organisms included in the Federal and State Endangered Species lists. These were the shortnose sturgeon (*Acipenser brevirostrum*) and the red-cockaded woodpecker (*Picoides borealis*). The sturgeon was identified as occurring in the waters of the Great Pee Dee River near the site and Santee Cooper found the woodpecker on the property. Upon these findings, Santee Cooper initiated informal consultation with both the State and Federal Wildlife agencies. During the application period, the USACE conducted formal consultation with the National Marine Fisheries Service (NMFS) (concerning the shortnose sturgeon) and with the USFWS (concerning the red-cocked woodpecker). Biological Assessments were prepared in 1983 concerning project impacts on these species. These assessments concluded that the proposed project was not likely to affect the continued existence of, or result in the destruction or adverse modification of any critical habitat of the shortnose sturgeon or the red-cocked woodpecker.

Under the terms of the original permit, Santee Cooper agreed to manage specific areas where red-cockaded woodpeckers (RCW) were found. Management activities included removal of hardwoods and debris within 33 feet (10 meters) of the cavity trees, prescribed burnings, and thinning. Despite Santee Cooper's efforts, follow-up studies conducted in 1989, 1991, and 1994 (Appendix C) report no evidence of RCW activity in any of these areas. Copies of these reports were forwarded to both the USFWS and to the SCDNR.

The intake structure was specifically re-designed to minimize potential impacts to the shortnose sturgeon. Updated information regarding the RCW and the shortnose sturgeon is provided in Sections 3.3 and 4.3 of this report.

1.2.2.4 Cultural Resources

Santee Cooper performed an intensive archeological reconnaissance of the Pee Dee Tract as part of the 1983 EA. A total of 103 cultural resource sites were located and evaluated in terms of their ability to satisfy the criteria for significance set forth in 36 Code of Federal Regulations (CFR) 800.10, concerning the eligibility of the resources for inclusion in the National Register of

Historic Places (NRHP). These included thirty-nine prehistoric sites, thirty-three historic archeological sites, nine home-sites, sixteen tobacco barns, and seven pack houses. The conduct of the fieldwork and preparation of the report was designed to follow the recording standards set forth at 36 CFR 63 and the information requirements set forth at 36 CFR 66.

Copies of the final report, entitled "Pee Dee Electrical Generating Station – Cultural Resources Survey", were provided to the State Archeologist and the South Carolina Department of Archives and History/State Historic Preservation Officer (SCDA&H/SHPO). No comments were received from the State Archeologist. After review of the report, a meeting was held on April 19, 1984, at the offices of the SCDA&H/SHPO in Columbia, South Carolina. SCDA&H/SHPO staff, USACE representatives, and Santee Cooper representatives, including the archeological consultant, attended the meeting.

As a result of the meeting, it was concluded that the study of historic and prehistoric sites contained sufficient documentation regarding the presence and status of archeological sites. It was generally agreed that there were eight sites on the property which are potentially eligible for inclusion in the NRHP. Of these, seven were located outside the impact zone of plant construction and operation per the 1983 project design (layout). The eighth site, designated 38FL152, was located in the vicinity of a proposed solid waste disposal area per the 1983 layout.

Santee Cooper was advised by the USACE that if impacts could be avoided, then under the terms of their regulations, Site 38FL152, as well as the other seven sites, would be considered to be outside the project construction and operation impact zone known as the "permit area". Santee Cooper elected to pursue this course of action and the permit required total avoidance of all eight sites.

In 2006 Santee Cooper re-submitted the cultural resources studies from the 1983 EA report to the SHPO, with a recommendation that these eight potential NRHP sites be preserved in place. After reviewing the survey report (Commonwealth Associates, 1984), the SHPO provided the following comments, by letter dated July 31, 2006: 1) The report is an excellent reconnaissance report and provides a good context, a clear picture of the nature of the cultural resources in the project area, and good evidence for the National Register eligibility of some sites. 2) However, the report does not satisfy current standards for the identification and evaluation steps of the Section 106 process and "the fieldwork...must be considered unreliable for reporting site conditions and integrity" (Marcil, 2006).

In order to verify the location and condition of these sites, a Phase I Archaeological Survey is being completed for the Pee Dee Tract, in general accordance with State Historic Preservation Office (SHPO) guidelines for Section 106 compliance. Upon completion of the Phase I Archaeological Survey, Santee Cooper will avoid and minimize impacts to NRHP-eligible resources on the subject property. Impacts that cannot be avoided will be mitigated according to SHPO requirements, including data recovery. NRHP-eligible or listed resources avoided by construction activities will be subject to active preservation by deed-restriction or other suitable method to be determined by the SHPO, Santee Cooper and other consulting parties. Phase I Archaeological Surveys have been completed for the transmission and rail corridors, resulting in a determination that there will be no effect on significant archaeological resources. Updated information on cultural resources compliance is provided in Sections 3.6 and 4.6 of this report.

1.2.2.5 Other Permits and Requirements

The following sections address other requirements and permits that require public notice.

<u>National Environmental Policy Act (NEPA)</u>

The National Environmental Policy Act of 1969, commonly referred to as "NEPA", declares a national environmental policy and promotes consideration of environmental concerns by federal agencies. NEPA requires federal agencies to prepare documentation detailing the environmental impact of, and alternatives to, proposals for major federal actions significantly affecting the quality of the environment. Federal action includes a federal agency's decision on whether to grant a permit for proposed facilities.

The decision of whether to prepare an Environmental Impact Statement (EIS) for any given proposed project lies within the discretion of the various federal agencies. For major projects, an agency can either prepare an EIS or a "FONSI", a "finding of no significant impact". NEPA regulations define a FONSI as a document prepared by a federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the environment and for which an EIS therefore will not be prepared. The regulations further provide that a FONSI must include an environmental assessment or a summary of one.

As stated earlier, Santee Cooper commissioned a national consulting firm, Gilbert/Commonwealth, of Reading, Pennsylvania, to conduct an EA of the project in 1981. The three volume report, published in late 1983, with several supplemental reports, was submitted to the agencies in January 1984 with the federal/state permit application for construction of the intake and discharge structures. A joint federal/state public notice was issued on January 23, 1984.

No comments were received opposing the project. After review of the 1983 EA and comments received, the USACE issued a FONSI dated June 1, 1984. The FONSI stated that the District Engineer concluded the environmental effects of the proposed project are not significant and the preparation of an Environmental Impact Statement is not warranted. The District Engineer's Statement of Findings, also dated June 1, 1984, concluded that, on balance, the total public interest would best be served by the issuance of a USACE permit for the proposed work. A Section 404(b)(1) compliance determination was also issued, as was a Section 401 Water Quality Certification. See Appendix B for copies of the documents.

The major purpose of this report is to provide updated information to allow the USACE to reach a decision under the NEPA regulations and allow the USACE and the State of South Carolina to reissue the USACE Section 10/404 Permit, the Section 401 Water Quality Certification, and the State Construction Permit.

<u>Air Quality/Prevention of Significant Deterioration (PSD)</u>

Air quality impacts were an important aspect of site selection. Preliminary modeling was done during the 1980 Site Selection Study that resulted in the purchase of the Pee Dee site. This modeling indicated that locating the proposed facility (1,200-MW) at the Pee Dee site would not violate air quality standards. In 1981, a preliminary air quality study was conducted by R.W.

Beck and Associates to determine if a 2200 MW plant could be constructed at the Pee Dee site. This study concluded that the site would support 2200 MWs of coal-fired generation without violating air quality requirements.

The 1983 EA addressed air quality impacts for both the construction phase and the operational phase in great detail. Computer models were utilized to predict air quality impacts. The analysis demonstrated that the addition of the proposed facility would not result in a violation of the National Ambient Air Quality Standards (NAAQS) and that PSD regulations would be met (see sections 2.1.5, 3.1.5, and Appendix C of the 1983 EA).

In the late 1980's, Santee Cooper's load forecast indicated a potential need for additional peaking capability. The Pee Dee site was the proposed location (see Section 1.3, Alternatives Analysis). A construction permit application was submitted to SCDHEC, Air Quality Control, in early 1991 for a 250 MW combustion turbine peaking facility at the Pee Dee site. Included in the PSD application was a Best Available Control Technology (BACT) review, air dispersion modeling, and soils and visibility impacts analysis. Alternate arrangements were made in 1993 to purchase peaking power. Thus, the permit application was withdrawn by letter dated October 20, 1993.

A PSD construction permit application was submitted to SCDHEC in May 2006 for two coal fired units. This application includes up-to-date computer analyses demonstrating that the proposed facility will meet ambient air quality standards. Proposed air quality control equipment is designed to meet the requirements in effect at that time of application submittal. A public notice inviting comments will be issued for the air permit application once a draft permit is completed by SCDHEC. Additional information regarding air quality is provided in Sections 3.4 and 4.4 of this report.

National Pollutant Discharge Elimination System

Wastewater discharges require National Pollutant Discharge Elimination System (NPDES) permits. These permits establish limitations and monitoring requirements for wastewater discharges to federal and state waters. Discharge limitations will be based on EPA's effluent guidelines for Steam Electric Generating Plants and State Water Quality Standards. The effluent guidelines specify technology-based standards for "new sources". A public notice inviting comments will be issued for the NPDES permit(s) application(s).

The 1983 EA provided EPA's standards and a description of waste discharge characteristics expected from the various discharges, after treatment, along with existing hydrology and water quality information. This information is updated in Sections 3.2 and 4.2 of this report. Due to the long-range nature of this project, application(s) for NPDES permit(s) will not be submitted until construction time nears. Water pollution control equipment and facilities will be designed to meet the requirements in effect at time and the discharges will comply with the requirements of the NPDES permit.

<u>Federal Aviation Administration (FAA) - Tall Stack Notification</u>

On January 16, 1984, Santee Cooper submitted a "Notice of Proposed Construction or Alteration," FAA Form 7460-1, for the construction of two stacks rising 650 feet above ground to the Southern Regional Office of the Federal Aviation Administration (FAA) in Atlanta, Georgia. On March 23, 1984, the FAA issued a "Determination of No Hazard to Air Navigation". FAA notified Santee Cooper that an aeronautical study, reference number 84-ASO-167-OE, of the proposed construction had been completed. The study found that the construction would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities.

A condition of the permitted activity required that Santee Cooper notify the agency at least 48 hours before the start of construction and again within five days after the construction reached its greatest height. The FAA also required the structures be obstruction marked and lighted in accordance with the standards of the FAA Obstruction Marking and Lighting Advisory Circular 70/7460-1F, Chapters 3, 4, 5 & 9.

The determination remained subject to review through April 22, 1984, and was to become effective May 2, 1984, unless a petition for review was filed within the allotted time frame. The determination was issued with an expiration date of November 2, 1985, unless extended, revised, or terminated. FAA requested a "Project Status Report" and Santee Cooper responded on July 21, 1986, indicating the construction date was undetermined at that time. Santee Cooper will again notify the FAA of its intent to construct the stacks at the time the application for the Department of the Army Permit is submitted for the plant facilities.

Other Permits

Other permits required include construction permits for potable water and wastewater systems, stormwater and erosion control, and solid waste disposal authorizations or permits. These permits will be applied for during the detailed design phase prior to their actual construction. All applicable regulations will be adhered to.

1.3 Alternatives Analysis

1.3.1 Energy Alternatives

Alternatives to construction of the Pee Dee Electrical Generating Station include no action, demand-side management options and other supply-side energy options. The following sections review these alternatives.

1.3.1.1 No Action Alternative

The present and growing dependence of the people in the Santee Cooper service area on electricity for economic and physical well being means that failure to meet the load could have serious consequences in terms of physical and economic damage. There would be occasions when the needed energy could not be obtained, resulting in a deterioration in voltage and service quality (brown-out) and/or rotating black-outs where Santee Cooper would cut off some substations completely during periods of power shortage. During a black-out, some customers would be totally deprived of electricity.

The "No Action" alternative would have many secondary adverse impacts for the State of South Carolina. These would include making the portion of the state served by Santee Cooper unattractive, indeed unacceptable, to most businesses considering relocating to this area. Some existing businesses would have to consider leaving this portion of the state. As a regulated electric facility, Santee Cooper has the obligation to provide service to all in its service area that apply for service now and in the future. Santee Cooper would therefore be remiss in its obligations if it were to adopt a "No Action" alternative.

1.3.1.2 Demand-Side Alternatives

Demand-side management ("DSM") programs are evaluated on a regular basis for their effect on energy and demand. Santee Cooper offers these DSM programs where it is cost effective and continues to search for ways to promote energy conservation. As an example, Santee Cooper has issued a public statement demonstrating its commitment to the National Action Plan for Energy Efficiency (NAPEE). Participants of the Action Plan, facilitated by the U.S. Environmental Protection Agency (USEPA) and U.S. Department of Energy (USDOE), include leading gas and electric utilities, state agencies, energy consumers, energy service providers, and environmental / energy efficiency organizations. The goal of the NAPEE is to create a sustainable, aggressive national commitment to energy efficiency through gas and electric utilities, utility regulators, and partner organizations (USEPAc, 2006).

In addition to endorsing the NAPEE recommendations, Santee Cooper has taken specific steps to demonstrate its commitment to a comprehensive conservation program. Santee Cooper has distributed compact fluorescent lights (CFLs) to new residential and commercial customers to encourage energy efficiency and market energy saving products. Conservation messages are being used in all internal and external communications, executive speeches and giveaways at landfill dedication events and new DSM programs will include promoting Leadership in Energy and Environmental Design (LEED) certified construction, developing a duct sealing program, developing a new energy efficient home program, and providing certified Energy Star ratings for Energy Star homes and for federal tax credit.

Additionally, Santee Cooper has developed rates that have encouraged over 400 MWs of peak load control by industrial customers. The company understands the necessity of resource conservation, and the importance of load control. However, as Santee Cooper continues to evaluate and adjust the load forecast and resource plans to meet future customer demand in a reliable and cost effective manner, the need for future generation resources is still apparent. The following is a summary of Santee Cooper's existing Demand Side Management programs. Although these programs have a combined savings of approximately 15 MW, this represents less than 0.3% of total annual energy demand required by Santee Cooper customers.

1. Good Cents New and Improved Home Program

The Good Cents Program was developed to provide residential customers an incentive to build new homes to higher levels of energy efficiency and improve existing homes by upgrading heating and air conditioning equipment and the thermal envelope to high energy efficiency standards. All homes are evaluated to determine if they meet the standards set for the program. Inspections are completed during construction for new homes and at the completion of construction for new and improved homes.

Program participation in 2004 resulted in an estimated demand savings of 13,803 kilowatts (kW) and estimated energy savings of 19,719,000 kilowatt hours (kWh). Total expenditures for the Good Cents Program incurred through Santee Cooper in 2004 were $5,804,116. (Demand savings are based on summer peak demand reduction of 1.05 MW).

2. H_2O Advantage Water Heating Program

H_2O Advantage is a storage water heating program designed to shift the demand related to water heating off-peak. This is accomplished with the installation of an electronic timer or radio controlled switch on an 80 gallon water heater. This program began in 1990 and was offered for the last time in 2000. The contract spans 10 years so this program will no longer be impacting the system after 2010.

Program participation in 2004 resulted in an estimated demand savings of 1,390 kW. Total expenditures for the H_2O Advantage Program incurred through Santee Cooper in 2004 for existing participants were $2,090,130.

3. Commercial Good Cents

Commercial Good Cents is offered to commercial customers building new facilities that improve the efficiency in the building thermal envelope, heating and cooling equipment, and lighting. Commercial customers that meet program standards are given an up-front rebate to encourage participation in the program.

Program participation in 2004 resulted in an estimated demand savings of 177 kW and estimated energy savings of 284,858 kWh. Total expenditures for the Commercial Good Cents Program incurred through Santee Cooper in 2004 were $52,758.

4. Thermal Storage Cooling Program

The Thermal Storage Cooling Program shifts energy used by commercial customers for air conditioning from peak to off-peak hours by utilizing thermal energy stored in a medium such as ice or water. Rebates are offered to customers who install this type of equipment. There is currently only one active participant in this program.

5. Interruptible / Economy Power Pricing Rates

Santee Cooper has developed and offers time-of-use, non-firm, and off-peak rates to its direct-served commercial and industrial customers to encourage them to reduce their peak demand.

An "economy power" rate is available to industrial customers, which is based on an hourly incremental energy rate. This is a real time pricing rate; the price for energy changes each hour. Customers must schedule their usage each hour. Service under this Rider is curtailable in emergency situations by Santee Cooper. Pricing alternatives are available under this rate where the energy price is fixed during certain hours.

There are also supplemental curtailable and interruptible rates available to industrial customers which allow for curtailment under certain circumstances.

1.3.1.3 Supply-Side Alternatives

Purchase Power from Others

In August 2005, Santee Cooper solicited requests for proposals to obtain long-term capacity and energy from potential electric utilities. In general, Santee Cooper requested proposals for up to 600 MW of capacity and energy for the period January 1, 2013 through December 31, 2042. On October 31, 2005, Santee Cooper received two responses expressing a potential interest but such expressions offered no prices. Several other vendors indicated that they had no plans for excess capacity for sale during that timeframe. Accordingly, based on the lack of definitive responses for its request for proposals for long-term power supply, Santee Cooper is proceeding with its generation planning process on the basis of "self-build" options. However, Santee Cooper continues to explore alternatives that may result in lower cost power supply.

Renewable Green Power

Santee Cooper entered the Green Power arena in 2001 with the start-up of the Horry County Landfill generating site. Santee Cooper was the first electric utility in South Carolina to offer electricity made from renewable resources. Green power is electricity generated from renewable resources. These resources are replenished naturally and minimize environmental impact. Santee Cooper continually looks for ways to protect the environment through alternative sources while at the same time diversifying the corporate fuel mix. A major effort has been made to assess the renewable resources which are available in South Carolina for development into utility-scale power. This study continues to re-evaluate the economics and processes available for renewable electricity generation to determine when investment is warranted.

In December of 2005, Santee Cooper announced it was fulfilling its commitment to reinvest Green Power funds back into renewable resources by embarking on its next phase of Green Power. Solar, wind, biomass and small landfill energy will be added to the company's green power mix of renewables, making Santee Cooper the only utility in South Carolina with a full component of renewable resources.

Since its inception in 2001, more than $1 million has been collected through the company's Green Power program. All revenue from every block of Green Power sold is or will be reinvested in future development of renewable resources or facilities. Santee Cooper is one of only a few utilities in the country that reinvests 100 percent of its Green Power revenue into additional renewable generation.

Santee Cooper has achieved national Green Pricing Accreditation for its Green Power Program. The Center for Resource Solutions (CRS), based in California, announced that Santee Cooper's Green Power meets the national and South Carolina accreditation standards for environmental and consumer protection. Accredited utility programs undergo an annual independent verification process to document that they have delivered the green power promised to their customers.

These renewable resources will be developed in a five-year, statewide and multi-tiered program:

- Continuation of landfills across South Carolina
- Solar projects at state universities and in various South Carolina regions
- Potential wind demo projects
- Potential biomass project at the Jefferies Station

<u>Landfill Gas Generation</u>

Methane gas is considered to be a renewable energy source because it is created through natural decomposition of organic materials. In September 2001, Santee Cooper became the first electric utility in the state to generate and offer Green Power to its customers from the 3.3-megawatt (MW) Horry County Landfill Generating Station near Conway. The company opened its second Green Power facility, an $8.5 million, 5.4-megawatt station, in April 2005. Located at Allied Waste's 210-acre Lee County Landfill, it makes electricity from three 1.8-MW engines that use methane gas as fuel. In February, 2006, Santee Cooper's third Green Power facility began commercial operation at the Richland County Landfill near Elgin, South Carolina. Through a process at the 124-acre landfill, methane gas produced by decomposing waste fuels a 5.5-megawatt gas-turbine generator at the $8.5 million facility. An additional Green Power station is currently under construction by Santee Cooper, estimated to begin commercial operation in

2006, in Anderson County, bringing Santee Cooper's total potential Green Power generation to 19.7 megawatts. Santee Cooper is actively seeking to develop seven additional landfills in the state. These additional landfill sites, combined with the four sites that will be operating by the end of 2006, would have a potential Green Power generation of nearly 50 MW by 2012.

Solar

Santee Cooper is spearheading South Carolina's first solar Green Power site. Santee Cooper, in cooperation with Coastal Carolina University located in Conway, South Carolina, will install photovoltaic modules on four open air structures, each measuring 27 feet by 22 feet, to be used as bus stops and for other campus and community events. The solar components of the project will cost approximately $130,000 and will produce 16 kilowatts (kw) of electricity that will be placed on Santee Cooper's electrical grid. The project is expected to be completed in September 2006.

On March 14, 2006, Santee Cooper partnered with Clemson University to implement solar energy technology at the Flour-Daniel Engineering Innovation Building (EIB) and in addition, the use of on campus state-of-the-art-energy efficiency technology. This partnership is part of the implementation of Santee Cooper's next phase of a multi-tiered renewable resource generation plan, which includes the use of solar energy.

The project includes a 15 kW photovoltaic solar array that will supply electricity to the campus grid. The energy efficiency component includes the installation of new variable frequency drives to be installed on 15 air handlers that will substantially reduce electric energy usage in several low average occupancy areas that include auditoriums, atriums, and gymnasiums. The systems will be demand actuated, meaning that sensors will detect when the areas are occupied and adjust the settings accordingly. All systems will be on Direct Digital Control to implement the complex.

Santee Cooper also entered a partnership with The University of South Carolina to implement solar energy technology at the Blatt Physical Education Center, located at 1300 Wheat Street in Columbia. A 25 kW photovoltaic solar array, which will also serve as a shade screen, will be mounted above an elevated walkway overlooking the intramural playing fields at the Center. The system will be connected to the USC electric grid. An interactive and educational kiosk beneath the panels will describe the system and its operation, and system information will also be available via an internet website. Santee Cooper is providing $250,000 to USC through a grant for the project, which is expected to be complete in September 2006.

Wind Demo Projects

Santee Cooper has partnered with the South Carolina Energy Office and the US Department of Energy to produce wind maps for the state, and extending 20 miles offshore. This wind mapping is the first step in identifying viable projects for utilizing wind to generate electricity. Potential demonstration projects for 20-50 kW of electric generation have been identified, and are staged for future construction using the GreenPower funds. The changing political and technical developments with offshore wind generation are also being monitored for potential application in South Carolina.

Potential Biomass Project

In 2005, a detailed engineering study was conducted to determine the feasibility of burning woodchips at Jefferies Generating Station in existing units. If implemented, an estimated 75,000 tons of wood chips would be burned annually in Jefferies Units 3 & 4. This equates to about 10 to 12 MW of biomass renewable energy. The two Jefferies units, rated at 150 GMW each, are capable of burning wood chips and actually did combust wood chips in 1989 to 1991 after Hurricane Hugo depressed the wood chip prices.

The 2005 study included preliminary engineering designs along with a cost benefit analysis. At this time, the project is put on-hold because the required long term timber collection contracts were not able to be obtained.

Summary of Green Power Production

Green power currently provides only a small fraction of the total electricity production for Santee Cooper. New projects are in the planning stages, but will not change the fact that this sector will continue to be a relatively small proportion of total production into the foreseeable future (Table 1-1).

Table 1-1: Green Power Production Summary

Source	Current Energy Production Megawatts (MW)
Landfill Gas	19.70
Solar	0.06
Wind	0.00
Burning Woodchips	0.00

1.3.1.4 Solid Fossil Fuel Options

The following is a review of the solid fossil fuel options which were considered by Santee Cooper prior to selecting the coal-fired supercritical unit for the Pee Dee site. The first option, Supercritical, was selected as the best technology for the Pee Dee site.

Supercritical

Supercritical units use higher initial turbine pressures coupled with high temperature to produce higher efficiencies than subcritical units. Numerous supercritical units have been constructed worldwide. These units normally use extra stages of feedwater heating and sometimes employ double reheat. Pressures and temperatures are not as extreme as ultracritical; consequently metallurgy requirements are based on proven materials. The boilers are a once thru design which requires extremely pure makeup water and a condensate polisher for reliable operation. Efficiencies are higher than subcritical units. This class of unit is a proven reliable source of energy for electric generation.

The typical steam cycle used for this case is based on a 3500 pounds per square inch gauge (psig) /1050°F/1100°F single reheat configuration. The high pressure (HP) turbine uses steam at 3515 psia and 1050°F. Cold reheat steam exhausted at 622 psia and 587°F is reheated to 1050°F before entering the intermediate pressure (IP) turbine section. The turbine generator is a single machine comprised of tandem HP, IP, and low pressure (LP) turbines driving one 3,600 rpm hydrogen-cooled generator. The turbine exhausts to a dual-pressure condenser operating at 1.5 and 2.0 inches Hga, low- and high-pressure shells, respectively, at the nominal 100 percent load design point. The feedwater train consists of seven closed feedwater heaters (four low pressure and three high pressure), and one open feedwater heater (deaerator).

The overall net plant efficiency is 39 percent (i.e., net heat rate 8700-9200 Btu/kWh). These units have the advantage of lower operating cost by virtue of their higher efficiency and lower fuel use and consequently lower emissions. Disadvantages would include lack of experience with operating and maintaining these units and their slightly higher capital costs. These disadvantages are expected to be within the scope of operating and maintenance personnel.

This class unit was selected as the best technology from a reliability, operational, and environmental perspective due to the advantages offered by such units. Long term generation plans typically consider these units as proven and reliable sources for generation.

Ultracritical

Ultracritical units use extremely high pressures coupled with high temperature exotic metals to produce very high efficiencies. A few ultracritical units have been constructed, mainly in Japan. The units typically use double reheat configurations and have 8-10 stages of feedwater heating.

The typical steam cycle used is based on a 4500 psig/1100°F/1100°F/1100°F double reheat configuration. The very-high-pressure (VHP) turbine uses steam at 4515 psia and 1100°F. The first cold reheat exhausts at 1357 psia and 753°F and is reheated to 1100°F before entering the HP turbine section. The second cold reheat flow exhausts at 378 psia and 757°F, and is reheated to 1100°F before entering the IP turbine. The turbine generator is a single machine comprised of tandem VHP, HP, IP, and LP turbines driving one 3600 rpm hydrogen-cooled generator. The turbine exhausts to a single-pressure condenser operating at 2.0 inches Hga, at the nominal 100 percent load design point. The feedwater train consists of nine closed feedwater heaters (five low-pressure and four high pressure), and one open feedwater heater (deaerator). Extractions for feedwater heating, deaerating, and the boiler feed pump are taken from the HP, IP, and LP turbine cylinders, and from the cold reheat piping. The overall net plant efficiency is 41 percent. (i.e., net heat rate 8700-9200 Btu/kWh).

These units have the advantage of lower operating cost by virtue of their higher efficiency and lower fuel use and consequently lower emissions. Disadvantages would include an extreme lack of experience with the fabrication and maintenance of metal alloys used in these units and their higher capital costs. It is expected there are operations and maintenance issues which are not identified which could increase the lifetime costs of operating such units. Also, most vendors producing these units are based overseas, and support could be an issue. The selection of this class unit was rejected due to the lack of experience with commercial operations of this type.

Subcritical

Subcritical units use normal utility pressures and temperatures for electric generation. Currently all Santee Cooper units are subcritical. Numerous subcritical units have been constructed worldwide. These units employ feedwater heating and reheat. Pressures and temperatures are below critical; consequently systems and metallurgy used are based on proven materials. Reliability and availability are proven; however, efficiencies are lower on these units.

The typical plant, similar to Cross units, uses a 2400 psig/1000°F/1000°F single reheat steam power cycle. The HP turbine uses steam at 2415 psia and 1000°F. The cold reheat steam at 604 psia and 635°F is reheated to 1000°F before entering the IP turbine section. Tandem HP, IP, and LP turbines drive one 3600 rpm hydrogen-cooled generator. The LP turbines consist of two condensing turbine sections. They employ a dual-pressure condenser operating at 2.0 and 2.4 inches Hga at the nominal 100 percent load design point. The feedwater train consists of six closed feedwater heaters (four LP and two HP), and one open feedwater heater (deaerator). Extractions for feedwater heating, deaerating, and the boiler feed pump are taken from all of the turbine cylinders. The overall expected plant efficiency is 37.6 percent. (i.e., net heat rate 9,500-10,200 Btu/kWh).

These units have the advantage of lowest installed cost due to the use of proven technology and some off the shelf components. Availability is generally very good due to minimal stresses on unit components. Additionally, there is a large pool of experienced labor for construction and operation of such units. Disadvantages include lower efficiency and increased fuel cost and emissions.

This class unit was seriously considered due to the low costs. However, the efficiency improvements with the supercritical units result in lower emissions for equivalent generation thus the supercritical was deemed a better option.

Integrated Gasification Combined Cycle (IGCC) / Gas Turbine

IGCC units use a commercial gasifier in conjunction with combustion turbines in combined cycle configuration to produce electricity. The gasifier can use atmospheric air or can employ an air separation plant to supply pure oxygen. The gas produced is used to fuel the combustion turbine/heat recovery steam generator. Any hydrocarbon fuel stock can be used in this process, but coal would be preferred due to economics. IGCC units are also capable of separating carbon dioxide, a greenhouse gas, from the exhaust stream so the carbon dioxide may be sequestered or otherwise not released to the environment. The following is a typical process for IGCC. Note that this configuration requires pure oxygen, therefore includes an air separation plant.

The typical plant would utilize a combined cycle for combustion of the low-Btu gas from the gasifier to generate electric power. A Brayton cycle using air and combustion products as working fluid is used in conjunction with a subcritical steam Rankine cycle. The two cycles are coupled by generation of steam in the heat recovery steam generator (HRSG), by feedwater heating in the HRSG, and by heat recovery from the IGCC process (gas cooler). The pressurized transport reactor gasifier utilizes a combination of air and steam to gasify the coal and produce a low-Btu hot fuel gas. The fuel gas produced in the transport gasifier leaves at 1690°F and enters a hot gas cooler. A significant fraction of the sensible heat in the gas is retained by cooling the gas to only 1100°F. High-pressure saturated steam is generated in the hot gas cooler and is superheated in the HRSG, which also performs reheating duty, steam generation (IP and LP pressure levels), and economizer duty (heats feedwater and condensate).

The gas flows through a series of hot gas cleanup processes including a chloride guard, transport reactor desulfurization polisher, and final particulate filter. A fraction of the clean hot gas is cooled and recycled to back purge the particulate filter. A separate fines combustor provides complete carbon conversion, handling the particulates captured by the barrier filter. The gas turbine operates in an open cycle mode. The inlet air is compressed in a single spool compressor;

a small portion of the compressed air is conveyed off-board the machine, after-cooled, boosted to a higher pressure in a separate compressor, and supplied to the gasification process. The hot combustion gases are conveyed to the inlet of the turbine section of the machine, where they expand through the turbine to produce power to drive the compressor and electric generator. The turbine exhaust gases are conveyed through a HRSG to recover thermal energy, and then exhaust to the plant stack.

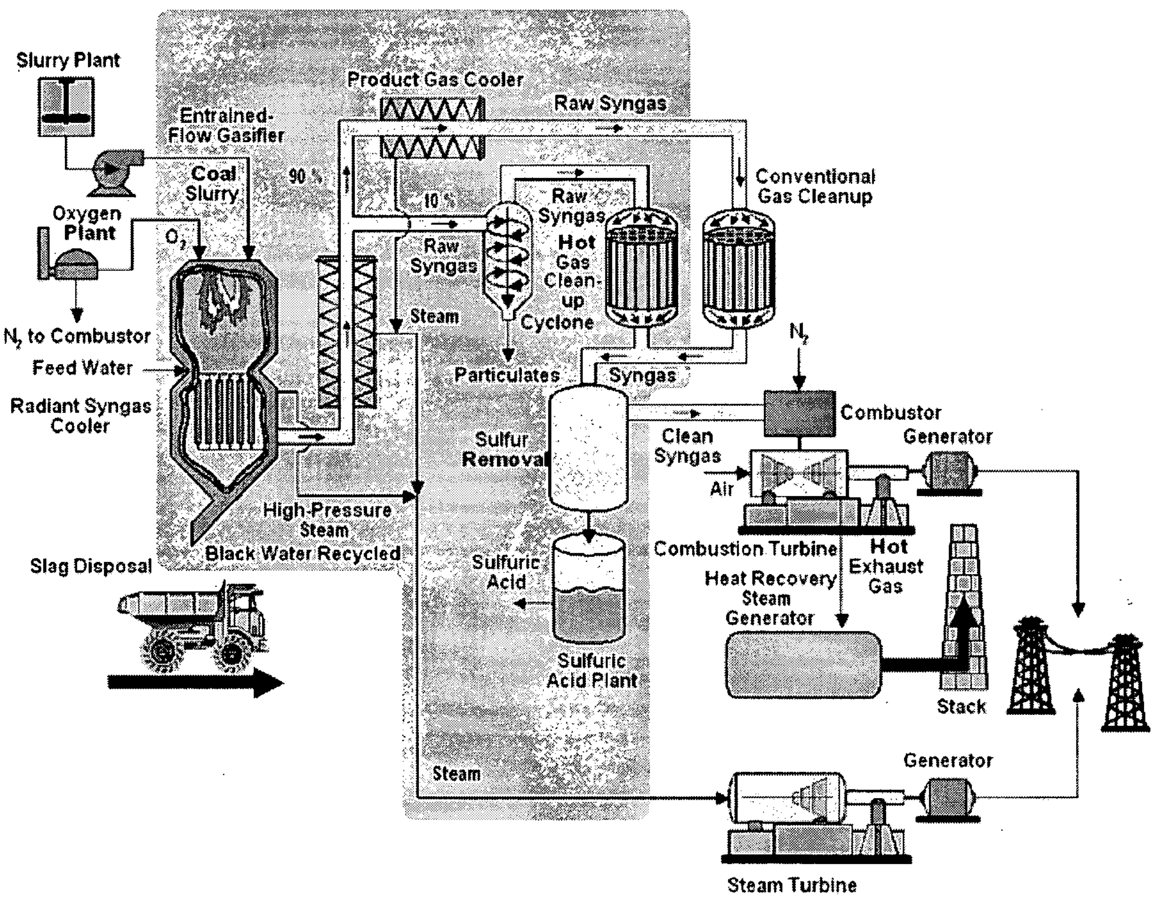


Figure 1-4: IGCC Unit
Source: Santee Cooper

One aspect in which this application differs from the original gas turbine design configuration concerns the increase in mass and volumetric flow rates of fuel gas. This results from the low-Btu gasification process used, which requires significant increases in fuel flow rates in order to deliver the required combustion heat input. The gas turbine would be fitted with new combustors designed to fire the low-Btu gas. The increase in mass and volume flow rates also requires that the turbine nozzle areas increase by approximately 4 percent to pass the higher flow. The increase in nozzle area is considered to be within the capabilities of the basic design of the machine. The gas turbine used in this application thus requires modifications in several respects, and is considered a derivative of the GE "H" machine, and not an actual production model. The overall plant efficiency is up to 49 percent. (i.e., net heat rate 7000-9500 Btu/kWh).

This configuration has limited experience in the United States. There are two sites which use elements of the processes described above, and neither are close to a similar size as the planned Pee Dee site thus there is no reliable source for a large scale unit of this type. These sites have had to solve technical issues to allow the units to operate reliably. Additionally, there are numerous technical issues still under investigation. This type unit requires further development to achieve the reliability levels expected from a subcritical or supercritical coal fired utility unit. Additionally, due to numerous chemical processes, this site would require a higher level of technical expertise to manage the processes.

During research, technical and reliability issues associated with gasifier refractory and heat exchangers, combustion turbine combustors and turbine blades, gas cleanup system, and waste disposal were noted. Additionally, reliability is lower than fossil units and capital and O&M are less certain due to lack of experience with this type of unit. The majority of South Carolina, including the location of the Pee Dee site, is not capable of sequestering carbon dioxide in nearby geologic formations. Due to numerous technical issues associated with units of this type, lack of experience with these units, and the wide range of installed costs, this option was rejected for the Pee Dee site.

<u>Fluidized Bed Boiler</u>

Fluidized bed units use a circulating bed medium, typically limestone, to burn fuel and absorb pollutants. This configuration reduces processing costs and pollution control equipment capital cost. Fuel is burned within a bubbling bed of limestone or other absorptive media at relatively low combustion temperatures (1500-1700 °F). Nitrogen oxide formation is minimal compared to normal coal combustion methods. The limestone media is re-circulated and eventually bled off for disposal. Additional controls would consist of a cyclone separator, a polishing dry sorbent injection system, a selective non-catalytic reduction (SNCR) system and a bag house for emissions control.

The largest fluidized circulating bed (CFB) boilers in service are located at the Jacksonville Electric Authority Northside station. These 300 megawatt units operate in the subcritical mode and are otherwise similar to current units in the Santee Cooper fleet. Numerous fluidized bed units have been constructed worldwide, although they are normally smaller installations. Like other sub-critical units, pressures and temperatures below critical consequently systems and metallurgy used are based on proven materials. Efficiencies are lower on these units.

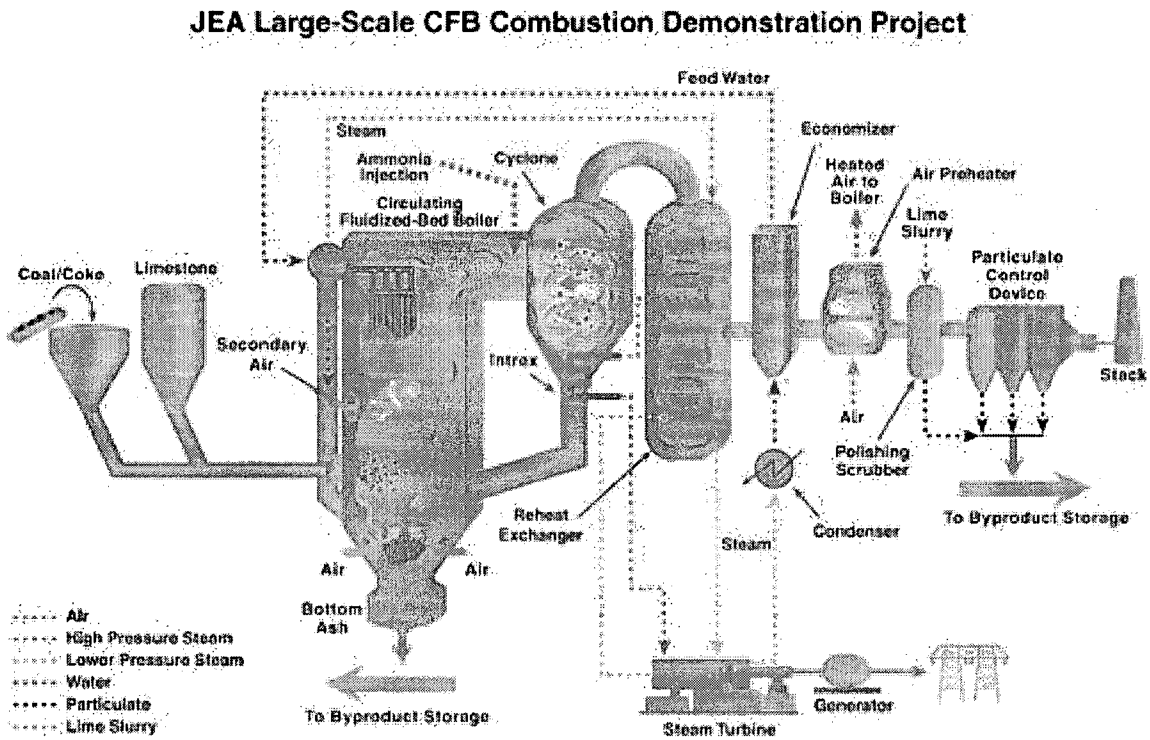


Figure 1-5: CFB Boiler Unit
Source: Santee Cooper

The proposed plant would use a 2400 psig/1000°F/1000°F single reheat steam power cycle. The HP turbine uses steam at 2415 psia and 1000°F. The cold reheat steam at 604 psia and 635°F is reheated to 1000°F before entering the intermediate-pressure (IP) turbine section. The unit would be configured based on manufacturer's recommendations for available boiler steam flow.

The overall plant efficiency would be around 33 percent. (i.e., net heat rate 9,500-11,000 Btu/kWh).

These units have the advantage of lower installed cost due to the use of proven technology and some off the shelf components. Additionally, there is a large pool of experienced labor for construction and operation of such units. These units have a large degree of fuel flexibility and can readily burn many undesirable fuels and biomass. Operating cost would be lower due to fuel flexibility and the use of lower grade fuels, biomass, and waste materials. Disadvantages would be lower efficiency and resulting increased emissions, however these issues could be minimized by additional controls. The selection of this technology was rejected because maximum unit size limits consideration for a large scale site.

Hybrid Cycle

Hybrid units use a coal gasifier and a fluidized bed combustor arranged in a "topping cycle" for an ideal combination of lower-cost capital equipment, high-performance fuel use, and improved environmental performance. The combination may be particularly suited for smaller power stations - those in the 200-300 megawatt range - which are likely to become more attractive as power companies develop strategies to deal with the growing uncertainties involved in forecasting future power demands.

The Department Of Energy Fossil Energy program has refocused its combustion research program to new types of "hybrid" technologies - typically coal-based systems that combine coal combustion and coal gasification into a highly efficient, environmentally clean power-generating technology.

In a "hybrid" system, coal is partially gasified in a pressurized gasifier. This produces a fuel gas that can be combusted in a gas turbine - the "top" of the cycle, hence the name. Left behind in the gasifier is a combustible char that can be burned in a fluidized bed combustor or advanced high-temperature furnace to produce steam to drive a steam-turbine power cycle and to heat combustion air for the gas turbine. Heat from the gas turbine exhaust also can be recovered to produce steam for the steam turbine in a HRSG.

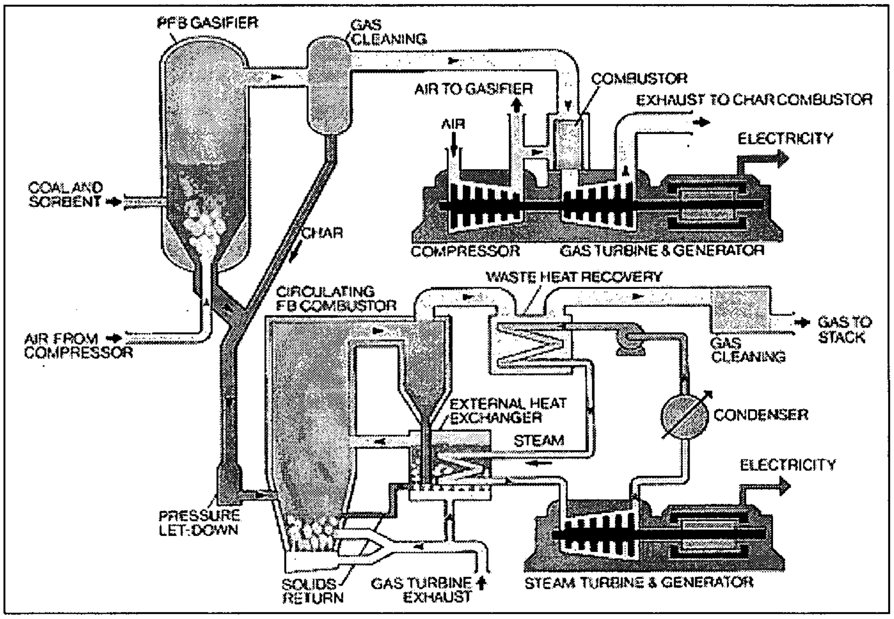


Figure 1-6: Hybrid Cycle Unit
Source: Santee Cooper

Per DOE, this system of gasifiers, combustors, gas and steam turbines results in a high overall fuel-to-electricity efficiency, estimated to exceed 55 percent in many advanced concepts (the average efficiency of today's coal-burning power plant typically is around 33-35%). There is no actual data on installed cost or efficiency available.

This class unit was not being considered due to limited experience and numerous technical issues associated with units of this type. This is a concept which has not been fully qualified as commercially viable.

As with IGCC, there are many technical and reliability issues associated with gasifier refractory and heat exchangers, combustion turbine combustors and turbine blades, gas cleanup system, and waste disposal. Additionally, reliability is lower than fossil units and capital and O&M are less certain due to lack of experience with this type of unit. This configuration is promising but needs further development.

1.3.2 Site Alternatives

Choosing a location for the Pee Dee site was based on a site selection study performed for Santee Cooper by Envirosphere in 1980[2]. The following is a summary of that study.

1.3.2.1 Screening of Potential Sites

The first task of the study consisted of identifying areas in the state that had a minimum of 2,000 acres and access to a waterbody with a 7-day 10-year flow of approximately 1,200 cfs or greater. The initial screening of the state resulted in identifying 11 areas as having sufficient land and water available for the proposed development.

Map studies, site reconnaissance, and contact with State and Federal agencies eliminated 5 sites, leaving 6 sites for further evaluation:

- Site 1: Cohen's Bluff, located on the Savannah River in Allendale County.
- Site 3: Lone Star, located at the confluence of the Santee River with Lake Marion in Calhoun County.
- Site 6: Bucksport, located on Bull Creek, between the Pee Dee and Waccamaw Rivers in Horry County.
- Site 7: Poston, located on the Great Pee Dee River in Florence County.
- Site 9: The Neck, located on the Great Pee Dee River in Florence County.
- Site 10: Society Hill, located on the Great Pee Dee River in Darlington

1.3.2.2 Environmental Site Evaluation and Ranking

An environmental site evaluation and ranking was performed to further evaluate the six sites in terms of their environmental and economic features, and to rank them in terms of their suitability for supporting up to four, 500 MW coal-fired units. The site discriminator factors used in this study were divided among seven disciplines: terrestrial ecology, aquatic ecology, land use planning, air quality, geotechnical, water quality/hydrology and waste management. The site discriminators applied under each discipline are listed in Table 1-2.

[2] It should be noted that Santee Cooper is limited to sites located within South Carolina as required by Santee Cooper's enabling legislation.

Table 1-2: Differentiating Factors for Evaluating Siting Alternatives

I.	TERRESTRIAL ECOLOGY 1. Endangered/Threatened Species 2. Unique Habitats 3. Surrounding Areas 4. Prime Farmland 5. Deer Habitat 6. Habitat Diversity
II.	AQUATIC ECOLOGY 1. Recreation/Commercial Factors (Value) 2. Habitat/Community/Species Diversity (Sensitivity) 3. Ecological Disruption/Eutrophication (Health) 4. Size and Water Available (Assimilative Capacity) 5. Rare and Endangered Species (Fatal Plan) 6. Nursery or Spawning Area (Special or Unique Habitat)
III.	LAND USE PLANNING 1. Aesthetics Value 2. Employment 3. Historic/Archaeology 4. Land Use Compatibility 5. Property Value On Site 6. Public Services and Housing 7. Recreation 8. Tax 9. Transportation
IV.	AIR QUALITY 1. Background Air Quality Levels (SO_2, NO_X, TSP) 2. PSD Class I Impacts (SO_2, TSP) 3. Ambient Levels: (SO_2, NO_X, TSP) Background + Plant Impact 4. Non-attainment Area Impacts (TSP) 5. Cooling Tower Fogging Potential (Average Relative Humidity, Proximity to Major Roads)
V.	GEOTECHNICAL 1. Seismic (g-level) 2. Seismic (Liquefaction potential) 3. Foundation Stability of Subsurface Sediments 4. Subsurface Carbonates (possible Solution Cavities) 5. Dewatering Problems (groundwater)
VI.	WATER QUALITY / HYDROLOGY 1. Water Availability 2. Thermal Assimilative Capacity, Receiving Water Body 3. Makeup Water Quality 4. Receiving Body Water Quality Standards
VII.	WASTE MANAGEMENT 1. Relative Soil Impermeability 2. Relative Nearness of Ground Water 3. Probability of Absence of Impacts on Existing Water Uses 4. Probability of Licensing Site Without Some Lining 5. Protection of Disposal Area From 100 Year Flood

Source: Santee Cooper

Scientists in each disciplinary group applied each factor to every site individually. Ratings for each factor were assigned a value of 1 to 5. A rating of 5 indicated that a site was very well suited for development in terms of that factor; a rating of 1 indicated that the site was poorly suited for development in terms of that factor. The individual factor scores for each discipline were averaged and are presented in Table 1-3. This table shows that sites 7, 9 and 10 were preferable to sites 1, 3 and 6, based upon the unweighted scores.

Table 1-3: Average Evaluation Scores based on Individual Discipline Experts

Discipline \ Site	1	3	6	7	9	10
Met/Air Quality	3.3	2.8	2.2	2.5	3.0	3.3
Coal Storage/Waste Mgmt.	2.2	2.4	1.0	3.0	2.4	2.8
Land Use Planning/S.E.	2.8	2.7	2.7	3.3	3.1	2.8
Terrestrial Ecology	3.3	2.7	3.7	4.0	3.3	4.0
Aquatic Ecology	4.2	2.5	2.7	4.2	4.2	4.2
Hydrology/Water Quality	4.5	3.5	3.5	4.0	4.0	4.0
Ecology/Seismology	2.0	2.6	2.2	3.4	3.2	3.4
TOTAL SCORES	22.3	19.2	18.0	24.4	23.2	24.5
PRELIMINARY RANK	4	5	6	2	3	1

Source: Santee Cooper

Meetings were held to test the accuracy of the individual evaluations and to increase the objectivity of the ranking process. Meeting participants consisted of environmental, engineering and geotechnical experts. The meetings were conducted in two phases, the first of which consisted of each discipline expert explaining his/her evaluation of the six sites based upon the site discriminator factors. The other experts on the panel were free to ask questions so that they could independently score each site according to the same factors.

During the second phase, a consensus was reached on which factors were more important in terms of power station siting considerations. A range of 1 to 10 was decided upon, with 1 indicating that a factor was least important and 10 indicating that it was very important. The importance factor for each site discriminator factor was multiplied by the rating factor developed earlier. Next, a confidence penalty was subtracted according to how confident the experts were of their data. A penalty of 1 indicated they were very confident and a 5 indicated the least confidence in the data. The result was a number of evaluation points for each discriminator factor for each site.

The process resulted in a comparison of the scores reached for each site as shown in Table 1-4. From an environmental viewpoint, Site 7 scored the highest, with 398 points; Site 10 was second, with 395 points; and Site 9 was third, with 386 points.

Table 1-4: Summary of Site Scores based on Multi-Discipline Weighted Factors

Discipline \ Site	1	3	6	7	9	10
Air Quality	70	58	14	70	70	70
Waste Management	24	20	3	22	22	23
Land Use Planning	64	52	51	80	77	68
Terrestrial Ecology	34	19	25	39	29	37
Aquatic Ecology	46	17	13	45	45	45
Hydrology	37	26	25	29	29	29
Water Quality	41	20	29	33	33	33
Geotechnical	48	66	31	80	81	90
SITE TOTAL	364	278	211	398	386	395
SITE RANKING	4	5	6	1	3	2

Source: Santee Cooper

1.3.2.3 Economic Site Evaluations

An economic site evaluation was included as part of the site selection study performed in 1980. This economic evaluation was a consideration of site differential costs based on generic cost information and quantities estimated from conceptual plant layouts developed in the screening of potential sites. Items common to all sites were not included in the evaluation. For items such as foundations and land differential costs where it was impossible to differentiate among the sites because of a lack of data at that time, qualitative evaluations were made.

To provide a basis for the cost evaluation of the candidate sites, the major site features were determined. Assumptions concerning major site features were used as a basis for the cost evaluations. The following major site features were determined for each site:

- Waste Storage
- Earthwork
- Makeup Water Pipelines
- Intake Structures
- Foundation Considerations
- Circulating Water System
- Blowdown Pipeline
- Transmission Line Losses

Based upon site differential costs for development of the six candidate sites, Site 7 (Pee Dee tract) was the most economical location to develop, with Site 9 being the second most economical.

1.3.2.4 Recommendation, Site Purchase and Investment

Based on the 1980 Site Selection Study, Site 7 (Pee Dee tract) was recommended as being the overall most economically and environmentally acceptable site. Pursuant to this recommendation, the 2,409 acre Pee Dee tract was purchased in 1981. During preparation of the 1983 EA, it became apparent that the optimum location of the power block and ancillary structures would be close to the southern boundary of the tract. Therefore, 300 additional acres were purchased in 1983/1984 along the southwestern boundary to serve as a buffer. The total purchase costs exceeded $7.7 million. Between 1981 and 1998 an additional $2.8 million was invested in studies and preliminary planning, including the 1983 EA, bringing the total investment for the Pee Dee project to over $10.5 million prior to the most recent round of studies and reports.

1.3.3 Site Layout Alternatives

Alternative layouts were evaluated thoroughly during the preparation of the 1983 EA. In total, five alternative layouts were considered before a layout was selected for inclusion in Santee Cooper's 1983 permit application to the Army Corps of Engineers (USACE).

Although the proposed Pee Dee Station was permitted in 1984, construction of the Station has been delayed. The site layout has progressed through numerous iterations in an effort to minimize the environmental impacts and increase functionality. Additional layout and technology alternatives have been developed to update the preliminary plant design and minimize impacts on wetlands. Three new alternatives are presented below, along with the 1983 Layout.

1.3.3.1 1983 EA Layout

The initial layout for the Pee Dee Station placed the power block (boilers, turbines, and generators) on the bluff adjacent to the river, about mid-way of the length of the property, on the river-side of the site. This location was selected due to the proximity of the river (shortest pipe runs), access from the highway, distance to residences and high, adjacent land for waste storage areas. However, as the assessment proceeded, a great deal of data was gathered that was synthesized into development of alternative layouts. This data included geotechnical, cultural resources, wildlife, aquatic biota, endangered species, road and rail access, traffic counts, recreation, etc.

Foundation considerations are extremely important in locating coal-fired units. The huge generators and turbines require separate and substantial foundations due to the weights and centrifugal forces involved. The boiler structures, with heights extending to the equivalent of 24 stories, and the precipitators are very large structures that require extensive foundations. The stacks, expected to be 650 feet high, also require significant foundations to distribute the weight and wind loads. The stack at Cross Station, which is 600 feet high, rests upon a 175 feet wide octagonal concrete slab that is 15 feet thick and supported by 176 concrete caissons that are 4 feet in diameter and extend a minimum of 30 feet into the subsurface.

Gilbert/Commonwealth, in conjunction with Law Engineering, Inc., (now known as MACTEC Engineering and Consulting Inc.) executed a subsurface exploration and groundwater-monitoring program in 1982 to define the subsurface geology at the Pee Dee site (Section 3.1). Based on this information, it was determined that significant savings in foundation costs could be realized by locating the power block in the southwest area of the tract. This location would also require less new railroad line and eliminate the need to re-route Old River Road and the existing gas line.

A major factor in the selection of the Pee Dee tract was the quantity of river water flow available for cooling. The initial plan for the Pee Dee tract called for the first unit to utilize once-through cooling. Once-through cooling provides tremendous cost savings compared to cooling towers that utilize closed-cycle cooling. As part of the 1983 EA, Gilbert/Commonwealth was directed to perform a detailed evaluation of alternative cooling systems.

The evaluation of alternative cooling systems resulted in a decision not to use once-through cooling for the pulverized coal-fired (PC) steam generating units as originally planned, thus lessening the need to be directly adjacent to the river. Eliminating once-through cooling for the PC units greatly reduced potential impacts to the aquatic environment. Closed cycle cooling for one PC unit would require approximately 7,000 gallons per minute (gpm) of river water. This is in contrast to 300,000 gpm of river water required for open cycle cooling. Entrainment losses of up to 53.6 percent of the clupeid larvae at low river flows were estimated for open cycle cooling compared to 4.8 percent for closed cycle cooling. Impingement impacts for an open cycle system would also be substantially greater versus a closed cycle system due to the greater intake screen area. The thermal mixing zone is also greatly reduced with closed cycle cooling.

Another major environmental factor involved in the 1983 layout determination was discovery of endangered species (Section 3.3). The presence of the shortnose sturgeon weighed heavily in the decision not to use once-through cooling, and also in the intake structure design and placement. These decisions were made to minimize potential impacts to the sturgeon. The 1983 layout alternative was also designed to avoid potential red-cockaded woodpecker habitat.

Based on the 2006 wetland delineation it was determined that the original 1983 layout would have included a total impact to wetlands of 58.95 acres of jurisdictional waters and 15.11 acres of non-jurisdictional waters (Figure 1-7). The alternatives discussed below were designed primarily to decrease impacts to on-site wetlands, primarily via relocating the landfills and ash ponds.

1.3.3.2 Site Layout Alternative 1

Alternative 1 (Figure 1-8) concentrates the Power Block in the southwest portion of the site. Much of the construction would occur on land that is currently in pine plantation. A large amount of the forests and wetlands occurring in the central portion of the tract would be preserved. A fifty (50) acre area for future industrial activity would be sited in the southeastern portion of the tract. Alternative 1 would impact approximately 29.37 acres of jurisdictional wetlands.

1.3.3.3 Site Layout Alternative 2

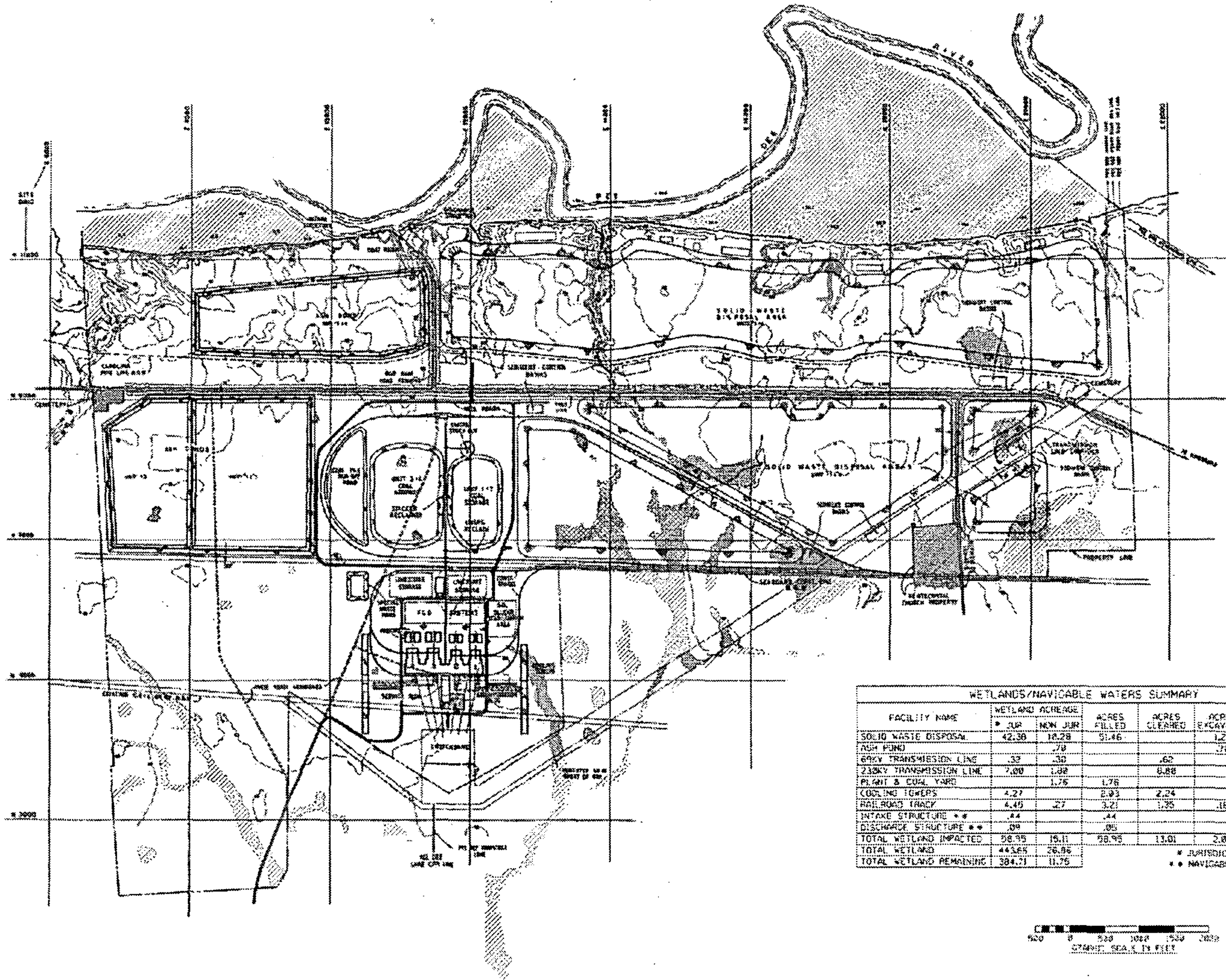
An alternative site plan (Figure 1-9), referred to as Alternative 2, differs from Alternative 1 in that: more of the stream corridor in the western portion of the tract is preserved by relocating one of the solid waste landfills to the river bluff; and the area reserved for the 50-acre industrial activity is relocated slightly to the west, thereby avoiding some wetlands. It is estimated that Alternative 2 would impact approximately 21.62 acres of jurisdictional wetlands.

1.3.3.4 Site Layout Alternative 3

A final alternative site plan (Figure 1-10), referred to as Alternative 3, preserves the changes between Alternatives 1 and 2, but differs from Alternative 2 in that the future solid waste landfill located at the top of the river bluff is divided into two smaller landfills. This split preserves a stream/wetland corridor which connects a substantial on-site wetland with the Great Pee Dee River. Alternative 3 is estimated to impact approximately 17.59 acres of jurisdictional wetlands.

1.3.4 Transmission Corridor Alternatives Analysis

This alternatives analysis presents the alternatives considered to address the electrical transmission component of the proposed Pee Dee Station project. The transmission corridor will be a 230 kV H-frame pole or single pole design that will connect from the proposed switchyard on the Pee Dee Station site to the existing Lake City Switching Station and to the existing 230 kV Marion-Hemingway transmission line on site. This section describes the purpose and need for the transmission line, the No Action Alternative, and the three alternative corridors that were considered for the transmission of electricity from the site.



FACILITY NAME	WETLAND ACREAGE		ACRES FILLED	ACRES CLEARED	ACRES EXCAVATED	ACRES BACKFILLED & BEDDED
	* JUR	NON JUR				
SOLID WASTE DISPOSAL	42.38	10.28	51.46		1.20	
ASH POND		.78			.78	
69KV TRANSMISSION LINE	.32	.30		.62		
230KV TRANSMISSION LINE	7.00	1.82		8.88		
PLANT & COAL YARD		1.76	1.76			
COOLING TOWERS	4.27		2.03	2.24		
RAILROAD TRACK	4.45	.27	3.21	1.35	.16	
INTAKE STRUCTURE * *	.44		.44			
DISCHARGE STRUCTURE * *	.09		.05			.04
TOTAL WETLAND IMPACTED	58.95	15.11	58.95	13.01	2.06	.04
TOTAL WETLAND	443.65	26.86				
TOTAL WETLAND REMAINING	384.71	11.75				

WETLANDS/NAVIGABLE WATERS SUMMARY

* JURISDICTIONAL
* * NAVIGABLE WATERS IMPACT

Santee Cooper

Pee Dee Electrical Generating Station
Florence County, South Carolina

Figure 1-7.
General Arrangement of Pee Dee Generating Station (1983 Layout)

LEGEND

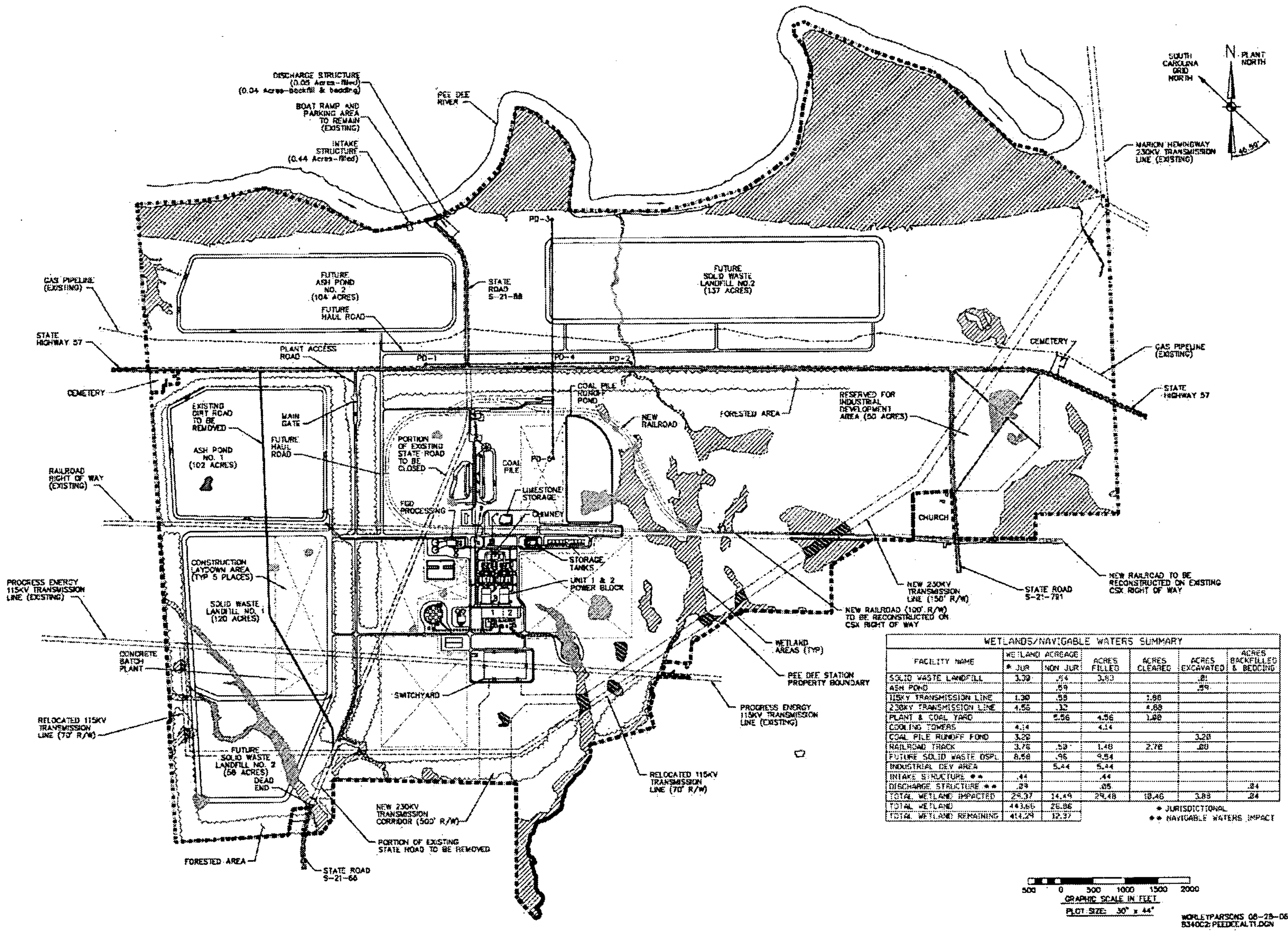
WETLAND

IMPACTED WETLAND

MACTEC

Santee Cooper

Pee Dee Electrical Generating Station
Florence County, South Carolina



WETLANDS/NAVIGABLE WATERS SUMMARY

FACILITY NAME	WETLAND ACREAGE		ACRES FILLED	ACRES CLEARED	ACRES EXCAVATED	ACRES BACKFILLED & BEDDING
	* JUR	NON JUR				
SOLID WASTE LANDFILL	3.39	.44	3.83		.81	
ASH POND		.59			.59	
115KV TRANSMISSION LINE	1.30	.58		1.88		
230KV TRANSMISSION LINE	4.56	.12		4.68		
PLANT & COAL YARD		5.56	4.56	1.00		
COOLING TOWERS	4.14		4.14			
COAL PILE RUNOFF POND	3.28				3.28	
RAILROAD TRACK	3.76	.50	1.48	2.78	.00	
FUTURE SOLID WASTE DSPL	8.58	.96	9.54			
INDUSTRIAL DEV AREA		5.44	5.44			
INTAKE STRUCTURE **	.44		.44			
DISCHARGE STRUCTURE **	.29		.05			.24
TOTAL WETLAND IMPACTED	29.37	14.49	29.48	10.46	3.88	.24
TOTAL WETLAND	443.66	26.86				
TOTAL WETLAND REMAINING	414.29	12.37				

* JURISDICTIONAL
** NAVIGABLE WATERS IMPACT

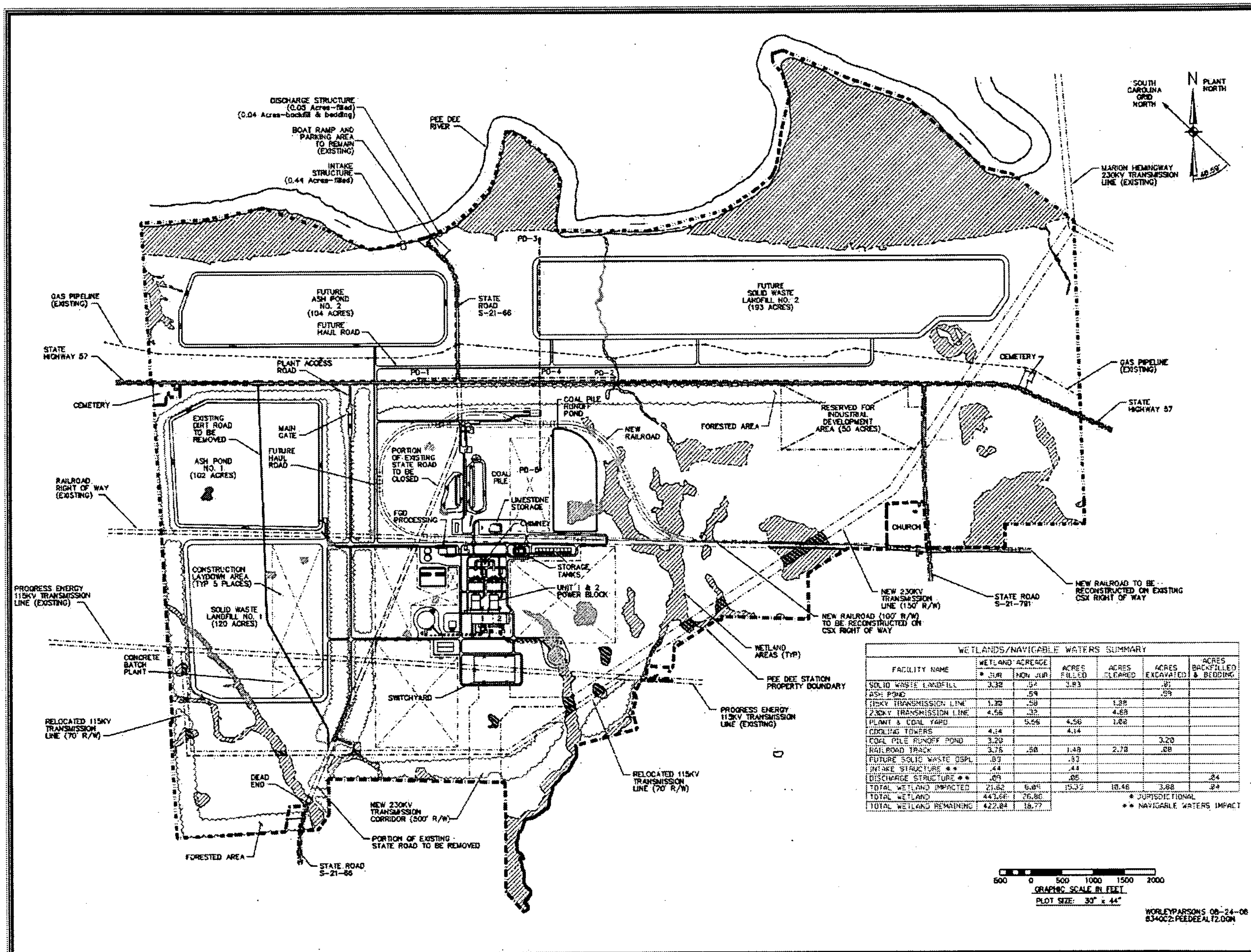
Figure 1-8.
General Arrangement of
Pee Dee Generating Station
(Alternate 1)

LEGEND

- WETLAND
- FILLED-WETLAND
- CLEARED-WETLAND
- EXCAVATED-WETLAND

MACTEC

Pee Dee Electrical Generating Station
Florence County, South Carolina



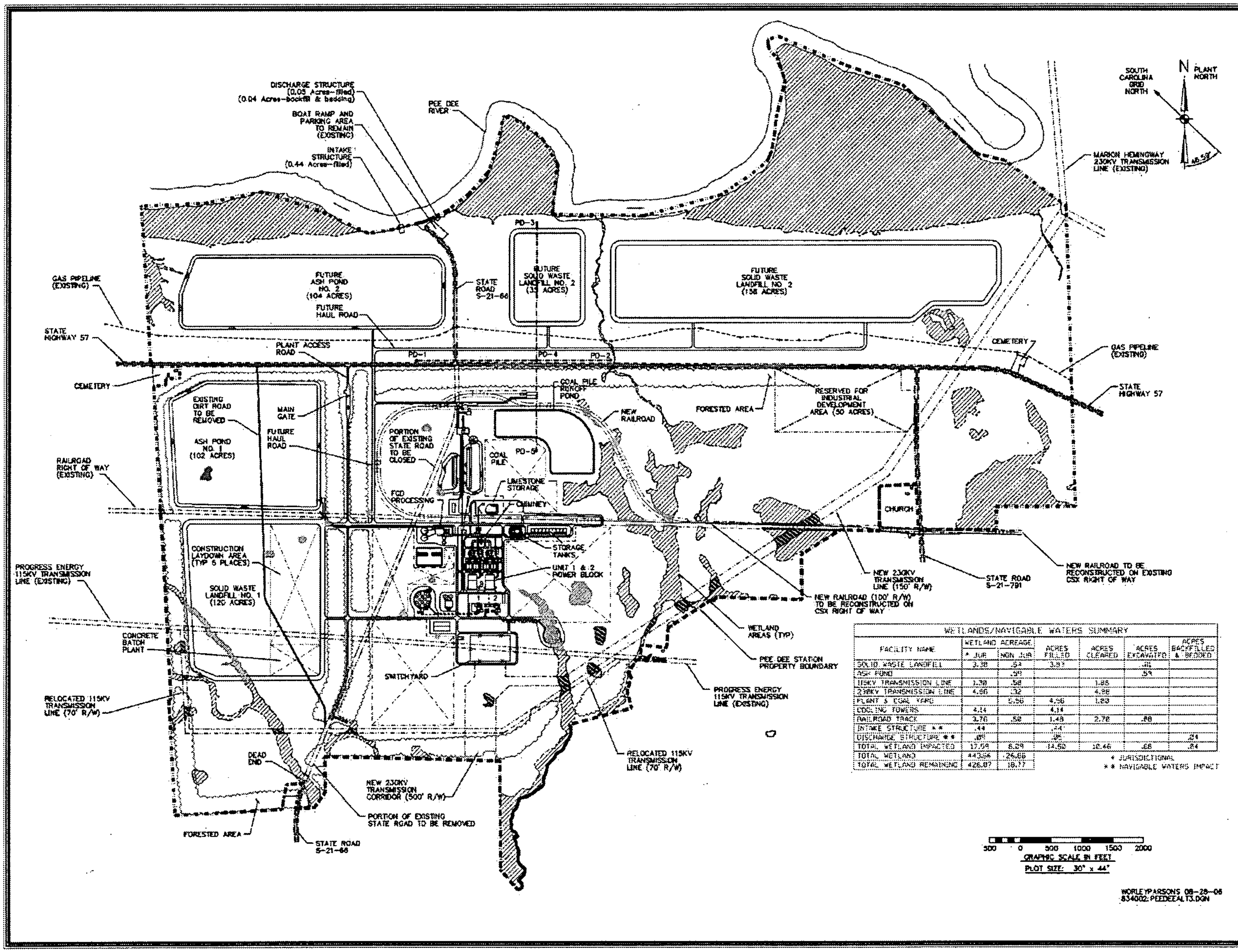
WETLANDS/NAVIGABLE WATERS SUMMARY						
FACILITY NAME	WETLAND ACREAGE * JUR	WETLAND ACREAGE NON JUR	ACRES FILLED	ACRES CLEARED	ACRES EXCAVATED	ACRES BACKFILLED & BEDDING
SOLID WASTE LANDFILL	3.32	.54	3.83		.81	
ASH POND		.59			.59	
115KV TRANSMISSION LINE	1.30	.58		1.28		
230KV TRANSMISSION LINE	4.56	.32		4.68		
PLANT & COAL YARD		5.56	4.56	1.82		
COOLING TOWERS	4.14		4.14			
COAL PILE RUNOFF POND	3.20				3.20	
RAILROAD TRACK	3.76	.50	1.48	2.78	.28	
FUTURE SOLID WASTE DSPL	.83		.83			
INTAKE STRUCTURE **	.44		.44			
DISCHARGE STRUCTURE **	.09		.05			.04
TOTAL WETLAND IMPACTED	21.62	8.09	15.32	10.46	3.88	.04
TOTAL WETLAND	443.66	26.86				
TOTAL WETLAND REMAINING	422.04	18.77				

* JURISDICTIONAL
** NAVIGABLE WATERS IMPACT

Figure 1-9.
General Arrangement of
Pee Dee Generating Station
(Alternate 2)

LEGEND

- WETLAND
- FILLED-WETLAND
- CLEARED-WETLAND
- EXCAVATED-WETLAND



WETLANDS/NAVIGABLE WATERS SUMMARY

FACILITY NAME	WETLAND ACREAGE * JUR	WETLAND ACREAGE NON JUR	ACRES FILLED	ACRES CLEARED	ACRES EXCAVATED	ACRES BACKFILLED & BEDDED
SOLID WASTE LANDFILL	3.38	.54	3.83		.01	
ASH POND		.59			.59	
115KV TRANSMISSION LINE	1.30	.58		1.88		
230KV TRANSMISSION LINE	4.56	.32		4.88		
PLANT & COAL YARD		5.56	4.56	1.20		
COOLING TOWERS	4.14		4.14			
RAILROAD TRACK	3.76	.52	1.48	2.78	.88	
INTAKE STRUCTURE **	.44		.44			
DISCHARGE STRUCTURE **	.09		.05			.04
TOTAL WETLAND IMPACTED	17.59	6.29	14.52	10.46	.88	.04
TOTAL WETLAND	443.66	26.66				
TOTAL WETLAND REMAINING	426.07	18.77				

* JURISDICTIONAL
** NAVIGABLE WATERS IMPACT

Santee Cooper

Pee Dee Electrical Generating Station
Florence County, South Carolina

Figure 1-10.
General Arrangement of Pee Dee Generating Station (Alternate 3)

LEGEND

- WETLAND
- FILLED-WETLAND
- CLEARED-WETLAND
- EXCAVATED-WETLAND

MACTEC

1.3.4.1 Purpose and Need

Background

Santee Cooper, as South Carolina's state owned electric company, has an obligation to provide reliable electricity to its customers. Santee Cooper does so by transmission and distribution of power generated at its power plants through the transmission grid, a system of connected wires with voltages of 230 kV, 115 kV, 69 kV, and 34 kV. The higher the voltage, the more power is delivered. A transmission line with a voltage of 230 kV delivers power to a 230-115 kV substation, where the 230 kV power is "stepped" down to 115 kV power. There are several 115 kV lines which leave the substation and go to smaller distribution substations. A distribution substation "steps" the voltage down to a much lower level. Leaving a distribution substation are numerous power lines and additional step-down transformers, providing power to homes, businesses, and schools.

Some industries require a higher voltage to power their processes. When this occurs, Santee Cooper provides a transmission line to an industry-owned substation.

A 230 kV transmission line is more costly to build than a 115 kV transmission line; however, the 230 kV transmission line is capable of delivering twice as much power as a 115 kV transmission line, constructed with the same size conductor. For this reason, Santee Cooper builds 230 kV transmission lines to move a large amount of power. Smaller, more economical transmission lines are then built to distribute power to customers. Santee Cooper's philosophy is a "looped" designed transmission system. This means a substation receives power from at least two different transmission lines, which improves reliability. If one transmission line fails, power is still available from other transmission lines.

Providing Power to the Grand Strand Area

The Grand Strand area is located in Horry and Georgetown counties of South Carolina. Santee Cooper provides electricity to the Grand Strand area through its transmission and distribution system. The Grand Strand area is one of Santee Cooper's largest consumers of electricity, consuming approximately 1100 MW of electricity. By 2016, Santee Cooper expects consumption in this area to grow to 1600 MW (one MW of electricity will power about 200 homes). The Pee Dee-Lake City transmission line will help Santee Cooper meet the growing needs of the Grand Strand area and improve the overall system reliability by providing an additional path from our power generating stations to customers in the Grand Strand area.

The Pee Dee site currently has two transmission lines located on it. One is owned by Progress Energy and one is owned by Santee Cooper. The Progress Energy transmission line is 115 kV. The power leaving the Pee Dee plant will be 230 kV. A 230 kV transmission line cannot be connected to a 115 kV transmission line. The Santee Cooper-owned Marion-Hemingway transmission line located on the site is a 230 kV transmission line. Power from the Pee Dee plant will be distributed using both the Marion-Hemingway and the Pee Dee-Lake City transmission lines.

The Pee Dee-Lake City 230 kV line is necessary to create a second 230 kV path between Santee Cooper system facilities located west and south of the Kingstree 230 kV Switching Station and the Grand Strand area. The current Lake City Switching Station will be upgraded to a substation in order to handle the additional line. This upgrade will occur on the existing developed footprint of the Switching Station and will not require additional clearing or other impacts. The Pee Dee-Lake City 230 kV line will also provide operational flexibility and increased reliability to the Lake City 230-69 kV Substation by providing a second 230 kV source into this substation. The existing Friendfield-Lake City 69 kV line was constructed to one side of the cleared ROW to allow for possible future construction of a 230 kV transmission line in this same ROW. Therefore, it is expected that minimal clearing or ROW disturbances would be necessary for installing the proposed 230 kV line along this existing cleared corridor.

The Pee Dee Electrical Generating Station will be a major source of electricity for the growing needs of the state. For the station to reliably operate at full capacity there must be a complete and reliable means of transmission of power from the plant. The Pee Dee-Lake City transmission line will assist in fulfilling this need.

1.3.4.2 No Action Alternative

The No Action strategy fails to meet the objectives and to address the needs outlined in the project Purpose and Need. If No Action is taken, a second 230 kV path to the power grid would not be available for the Pee Dee facility to transmit the electricity generated to areas in need of this additional power. During times of peak demand, brown-outs and/or black-outs in these areas may occur. However, the No Action strategy was retained as a basis for comparison against the other transmission corridor alternatives.

1.3.4.3 Comparison of Alternatives

<u>Corridor Evaluation</u>

Santee Cooper considered numerous corridors to meet the project objective. Since most of these initial corridors had relatively similar impacts, Santee Cooper settled on three corridors that represent the range of options to effectively address the project purpose (Figure 1-11). A 100-ft wide corridor along the three alternatives was compared using eight evaluation criteria described below:

1) **Length** – The selected corridor should be as direct as possible to provide reliable and cost effective transmission of electricity. The total length of the corridor should be considered, with particular attention focused on the length of the new corridor required to reach the existing Friendfield-Lake City transmission ROW. The 69 kV Friendfield-Lake City transmission ROW currently allows room for a 230 kV line within the ROW with minimal additional clearing.

2) **Stream Crossings** – The corridor should minimize crossings of the major streams and rivers and their associated wetlands. Perennial streams are defined as lasting or continuing throughout the entire year; and intermittent streams are defined as showing water only part of the time (Dictionary.com)

3) **Wetlands** – The corridor should minimize the acreage of wetlands that will need to be cleared and impacted.

4) **Agricultural Land Use** – Cropland and pastures are already considered to be cleared areas, so the environmental impacts and financial costs of clearing will be less for a corridor with more of this type of land use.

5) **Cultural Resources** – The corridor should minimize impacts to cultural resources.

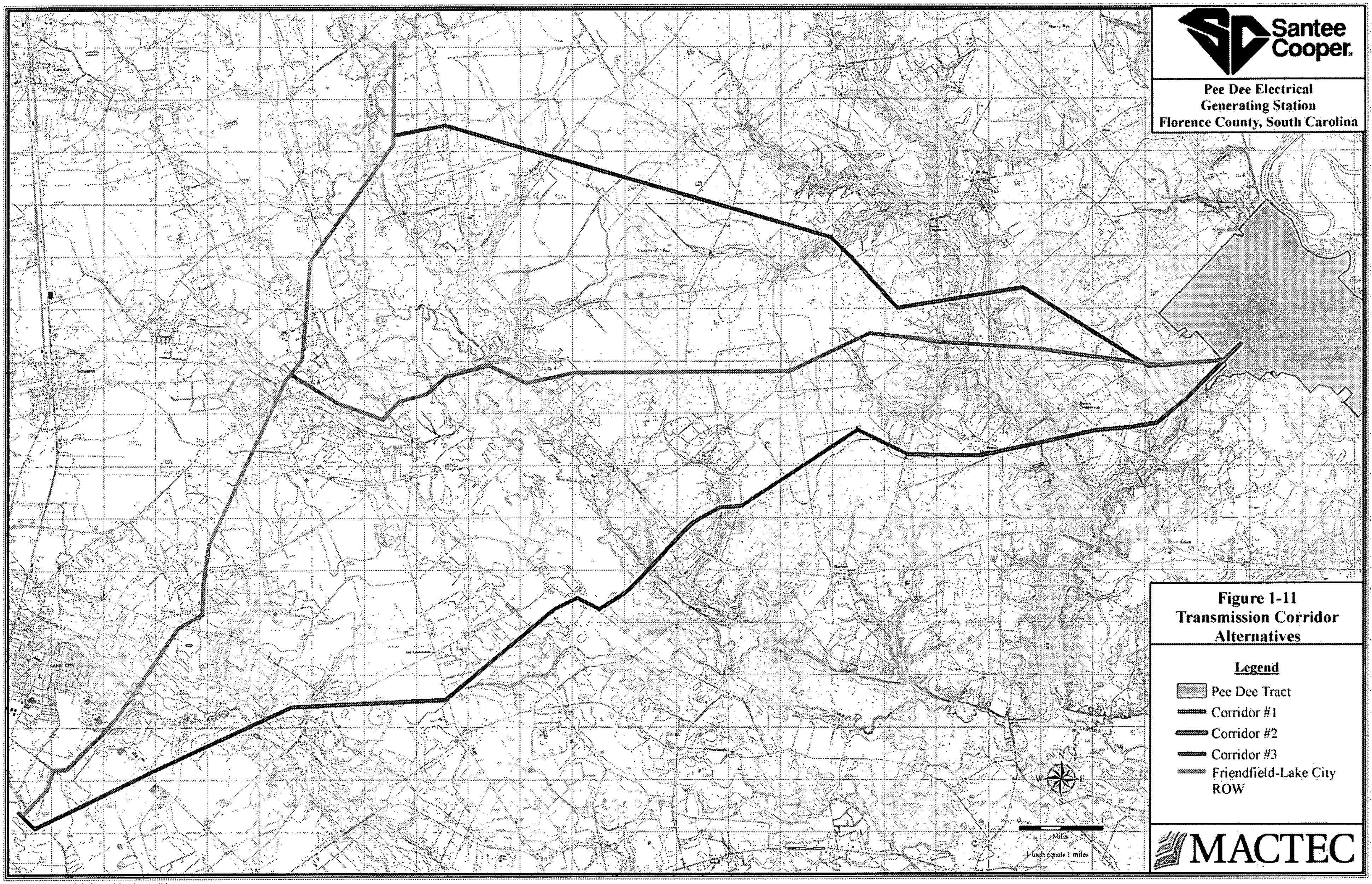


Figure 1-11 Transmission Corridor Alternatives

6) **Developed Areas** – The corridor should be located as far as possible from high density residential and business populations, and should minimize the number of affected land owners.

7) **Reliability and Safety** – The corridor should be routed to be as direct as possible while minimizing points of intersection (pi's), minimizing crossings, and providing easy access to the corridor. A "point of intersection" or pi is where the transmission line turns.

8) **Protected Species** – The corridor should minimize impacts to protected species and their habitats. The possibility of fragmentation of protected species habitat should be evaluated and minimized.

<u>Alternative Corridors Retained for Detailed Analysis</u>

The three corridor alternatives were compared using the evaluation criteria and all three were found to be viable alternatives for the transmission corridor. The locations of these alternatives are shown on Figure 1-11, and they are described in the following paragraphs.

Corridor Alternative #1 (20.6 miles) begins at the proposed Pee Dee Station site and runs in a westerly direction for approximately 0.9-miles before turning northwest for 1.8-miles. The corridor then turns west for approximately 1.6-miles before turning again in a northwestern direction for 6.7-miles to the intersection with the existing 69 kV transmission line near the town of Friendfield. This alternative would then parallel the existing transmission line, within the existing ROW, for approximately 9.6-miles to the Lake City Switching Station. The total length of new ROW is approximately 11.0-miles and the total length of corridor that will follow the existing Friendfield-Lake City line is approximately 9.6-miles for a total overall length of approximately 20.6-miles.

Corridor Alternate #2 (18.3 miles) begins at the proposed Pee Dee Station site and runs in a westerly direction for approximately 9.3-miles to Lynches River. The corridor will parallel the existing South Carolina Department of Transportation (SCDOT) ROW for Highway 378 as it crosses Lynches River. The corridor continues in a westerly direction for approximately 1.0-mile before turning slightly northwest for approximately 1.6-miles to the intersection with the existing transmission line east of Scranton. This alternative would then parallel the existing transmission line, within the existing ROW, for approximately 6.4-miles to the Lake City Switching Station. The total length of new ROW is approximately 11.94-miles and the total length of corridor that will follow the existing ROW is approximately 6.4-miles for a total overall length of 18.34-miles.

Corridor Alternate #3 (16.6 miles) begins at the proposed Pee Dee Station site and runs in a westerly direction for approximately 4.5-miles before turning to the southwest for approximately 3.1-miles to Lynches River. After crossing Lynches River, this alternative continues in a southwest direction for approximately 0.5-miles, turns northwest for approximately 0.3-miles and then continues southwest for approximately 8.2-miles to the existing Lake City Switching Station. The total length of this corridor is approximately 16.6-miles and would not utilize the existing 69 kV transmission corridor ROW.

Corridor Evaluation Criteria

The corridor evaluation criteria comparing the three alternatives are summarized in Table 1-5.

Table 1-5: Comparison of Transmission Corridor Alternatives

Corridor Evaluation Criteria	Corridor #1	Corridor #2	Corridor #3
Length	Total length of the corridor from the Pee Dee site to the Lake City Switching Station is approximately 20.6 miles with 11.0 miles being new corridor. This is the longest and most costly of the corridors.	Total length of the corridor from the Pee Dee site to the Lake City Switching Station is approximately 18.3 miles with 11.94 miles being new corridor.	Total length of this corridor from the Pee Dee site to the Lake City Switching Station is approximately 16.6 miles of new corridor. This alternative does not make use of existing right-of-way.
Stream Crossings	The new right-of-way will involve new crossings at 1 perennial stream and 11 intermittent streams. This alternative would cross Lynches River on an existing transmission right-of-way.	This alternative would cross Lynches River on new right-of-way. The affected right-of-way is adjacent to SCDOT US-378 right-of-way. The parallel right-of-way avoids fragmenting the river corridor in multiple locations. The new right-of-way will cross 2 perennial streams, including Lynches River, and 4 intermittent streams.	This alternative would cross Lynches River on new right-of-way. New right-of-way will cross 9 perennial streams, including Lynches River, and 23 intermittent streams.
Forested Wetlands	This alternative would require clearing of approximately 52.28-acres of forested wetlands.	This alternative would require clearing of approximately 58.68 acres of forested wetlands.	This alternative would require clearing of approximately 56.32 acres of forested wetlands.
Agricultural Land Use	Approximately 36.02-acres along this alternative are cropland or pastures.	The predominant land use classification along this 100-ft corridor is cropland and pasture comprising approximately 54.38-acres.	Approximately 55.25-acres of this alternative are classified as cropland or pasture.
Cultural Resources	Relatively few cultural resource occurrences are known to exist along this corridor.	Relatively few cultural resource occurrences are known to exist along this corridor.	Relatively few cultural resource occurrences are known to exist along this corridor.

Table 1-5: Comparison of Transmission Corridor Alternatives

Corridor Evaluation Criteria	Corridor #1	Corridor #2	Corridor #3
Developed Areas	This corridor does not contain any commercial or industrial land use. There are 41 parcels of land crossed.	This corridor does not contain any commercial or industrial land use. There are 50 parcels of land crossed.	This corridor contains approximately 0.5-acres of industrial land use. There are 71 parcels of land crossed.
Reliability and Safety	This corridor requires 27 points of intersection (pi's). There are 15 road crossings, one gas pipeline crossing, and one transmission line crossing.	This corridor requires 27 pi's. There are 13 road crossings, one gas pipeline crossing, and one transmission line crossing.	This corridor requires 19 pi's. There are 15 road crossings, one gas pipeline crossing, and one transmission line crossing.
Protected Species	There are no known occurrences of protected species or habitat along this corridor. One occurrence of a state protected plant species, Georgia false indigo (*Amorpha georgiana* var. *georgiana*), occurs within 1-mile of the corridor.	There are no known occurrences of protected species or habitat along this corridor. Two occurrences of a state protected plant species, Georgia false indigo (*Amorpha georgiana* var. *georgiana*), are known within 0.5-miles and 0.75-miles of the corridor.	There are no known occurrences of protected species or habitat along this corridor. One known occurrence of Red Cockaded Woodpecker is located less than 0.5-miles from this corridor.

1.3.4.4 Corridor Suitability for Transmission Line Development

Some of Santee Cooper's primary considerations for assessing a corridor's suitability for development of a transmission line and a comparison of the three alternative corridors based on these considerations are shown in Table 1-6.

Table 1-6: Transmission Corridor Comparison Matrix

	Corridor #1*	Corridor #2*	Corridor #3
Length in miles [total (new/existing)]	20.60 (11.05/9.64)	18.34 (11.94/6.40)	16.63 – new
Wetland Areas (acres/approx. percentage)	52.29 / 39%	58.79 / 41%	64.28 / 32%
Stream Crossings (perennial/intermittent)	1/11	2/4	9/23
Road Crossings (U.S. Highways/state routes)	0/15	2/11	1/14
Floodplain Area (acres/approx. percentage)	1.82 / 1%	28.45 / 20%	33.95 / 17%
Forested Area (acres/approx. percentage)	97.4 / 73%	85.38 / 59%	137.25 / 68%
Prime Farmland Area (acres/approx. percentage)	73.96 / 55%	73.41 / 51%	108.94 / 54%
Number of Parcels within 100-ft wide corridor	41	50	71
Permits (estimated number)	1	2	2
Estimated Cost (including material, construction, land, clearing, and mitigation)	$16,046,241	$14,272,418	$13,671,452

* Impacts are for length of new line only.

Wetland Areas: Wetland acres were determined by approximating the National Wetlands Inventory (NWI) wetlands within the 100-ft corridor of each alternative. NWI wetlands are used as an estimation of wetland acreage and can vary. However, NWI data was available for all three corridors and provides a useful tool for comparison.

Stream Crossings: This parameter was determined by overlaying the three alternative corridors on the United States Geological Survey (USGS) digital raster graphic (DRG) file. Perennial or intermittent status was based on USGS symbols, with the exception of Big Swamp. Big Swamp is shown as an intermittent stream on the USGS maps; however, based on field investigations it was categorized as a perennial stream for this report.

Floodplain Area: Acres of floodplain were approximated using Federal Emergency Management Agency (FEMA) floodplain data. This parameter can be compared to the number of stream crossings to estimate impacts to streams and their associated floodplains.

Forested Area: This parameter is an estimate of forested acres occurring within 100-ft of the transmission alternatives, also determined based on NWI data.

Prime Farmland Area: This parameter identifies the estimated acres of prime-farmland soils occurring within 100-ft of the transmission alternatives based on information from the Soil Survey of Florence County. Refer to Section 3.1 for additional information regarding prime-farmland soils.

Number of Parcels: This parameter considers the number of individually-owned parcels located within the corridor. The primary consideration is the effort to obtain the ROW easements for the transmission corridor.

Permits: This parameter identifies the preliminary estimate of the number of environmental permits (federal, state, and local) that could be required to construct the transmission corridor. A Section 10 Navigable Waters permit from the Army Corps of Engineers (USACE) will be necessary for any crossing of Lynches River. Any impacts to wetlands along the preferred corridor will require Section 404/401 permits from the USACE. Refer to Section 4.12 for additional information on permits.

1.3.4.5 Preferred Transmission Corridor Alternative

Based on a review of the evaluation criteria, Corridor #3 was the lowest ranked because it is all new corridor and will have the greatest impact. Although this is the shortest overall corridor, the new area to be cleared and developed is at least 40% greater than Corridor #1 and #2. There are significantly more perennial and intermittent stream crossings along this corridor as compared to the other two. Corridor #3 also has a large percentage of forested land that would require clearing for development of the transmission line. Dealing with a large number of landowners could potentially be another concern with this corridor as it has the greatest number of parcels.

Selecting either Corridor #1 or #2 will result in similar impacts. Both Corridor #1 and Corridor #2 make use of the special situation where the existing 69 kV Friendfield-Lake City transmission line was constructed to one side of the cleared ROW to allow room for construction of a 230 kV transmission line within this ROW. The overall length of the transmission line associated with Corridor #2 is shorter than the transmission line associated with Corridor #1. Despite having a slightly greater length of new corridor, Corridor #2 has the fewest forested acres, which will result in a smaller loss of forested wildlife habitat and lower clearing costs. Based on the above comparison of these two corridors, Santee Cooper has determined that Corridor #2 is the preferred alternative.

Prior to Corridor #2 being chosen as the preferred alternative, the corridor location was adjusted to minimize wetland and stream impacts along the Lynches River. The corridor is located adjacent to the US 378 ROW crossing of the Lynches River. Crossing the Lynches River at this location will avoid fragmentation of Lynches River downstream of the US 378 crossing. By relocating the transmission crossing of Lynches River, the corridor length increased slightly and includes additional angles in order to reduce wetlands and fragmentation impacts.

1.3.5 Raw Materials Transportation Alternatives

This alternatives analysis presents the alternatives considered to address the raw materials delivery component of the proposed Pee Dee Station. Significant amounts of raw materials, approximately 12,000 tons of coal, will need to be delivered to the site on a daily basis for necessary plant operations. It is anticipated that Appalachian Mountain coal will be used at the site and will either originate from eastern Kentucky or southwestern Pennsylvania. This section describes the No Action Alternative, trucking, barging and two rail alternatives that were considered for the delivery of raw materials to the site.

1.3.5.1 No Action Alternative

The No Action strategy fails to meet the requirements for successful plant operations and to address the need for delivery of raw materials (i.e. coal) to the Pee Dee site. If No Action is taken, the raw materials required to fuel the two coal-fired units would not be available. Therefore, the Pee Dee Station would not be able to generate electricity to limit projected brown- and black-outs during peak demand times. However, the No Action strategy was retained as a basis for comparison against other raw materials transportation alternatives.

1.3.5.2 Trucking or Roadway Alternative

The existing transportation network within Florence County is composed of interstate systems; federal highways; primary and secondary state highways; and county roads. Two interstate systems and numerous federal highways occur within Florence County. Interstate 95 (I-95), the principal north/south interstate, is located on the northwest side of Florence, approximately 25 miles from the Pee Dee site. Interstate 20 (I-20) begins in Florence, at its intersection with I-95, and continues westward towards Columbia. US 378 links the towns of Conway, Lake City, Sumter and Columbia. U.S. Route 52 (US 52) is a north / south corridor and connects the coastal city of Charleston to Florence and continues north to the North Carolina / South Carolina state line and beyond. Approximately 15 miles north of the Pee Dee site, U.S. Route 76 (US 76) travels in an east-west direction linking Wilmington, North Carolina to Florence. The site is located approximately 6 miles north of South Carolina Routes 41 and 51 (SC 41/SC 51).

In order to meet the coal demand for daily operations, the Pee Dee site would require approximately 545 truckloads, at an estimated 22 short tons per truckload (Milton, 2006, pers. comm.) of coal per day. This extreme volume of heavy traffic moving in and out of the site on a daily basis would generate numerous impacts to the natural and human environment at the Pee

Dee site and surrounding areas. A majority of the impacts would be a result of the increased traffic congestion in the area around the site which may include: a greater risk of motor vehicle accidents; an increased number of wildlife killed on roadways; a large increase in motor vehicle emissions, especially particulate matter (PM) from diesel-fueled trucks, affecting both human and ecosystem health; and an increased frequency and expenditure required for road and bridge maintenance.

1.3.5.3 Barging or River Alternative

Due to the site's location along the Great Pee Dee River, barging coal upstream from the coast is considered as an alternative for transporting raw materials to the site. Transporting raw materials to the site via the Great Pee Dee River would require a barge to maneuver approximately 75 miles up the river from the coastal port of Georgetown, South Carolina. Based on a capacity of 1,500 short tons per barge (Milton, 2006), operation of the generating station would require eight barge deliveries per day. This transportation alternative would require significant development of the shoreline at the Pee Dee site in order for material unloading to occur.

In 2002 a section of the Great Pee Dee River between the US 378 Bridge (approximately 2 miles southeast of the site) and the US 17 Bridge in Georgetown was designated as a State Scenic River. This designation provides a framework for cooperative conservation and management of the river; however no vessel or use restrictions are associated with this designation. The Great Pee Dee River is an un-maintained channel. Shallow areas and sand-bars occur frequently along the river and it is likely that dredging and/or channel maintenance will be required if this transportation alternative is chosen. Three roadway bridges and one railroad bridge cross the Great Pee Dee River between Georgetown and the site. The US 378 / SC 41 Bridge has a vertical clearance of 9 feet above mean high water (the lowest clearance of the four bridges). Depending on equipment and the type of tug used to transport the coal barges up river, a vertical clearance between 25 and 50 feet above mean high water is required. Because of these navigation problems, transporting raw materials by barge up the Great Pee Dee River is not a viable transportation alternative.

1.3.5.4 Railway Alternatives

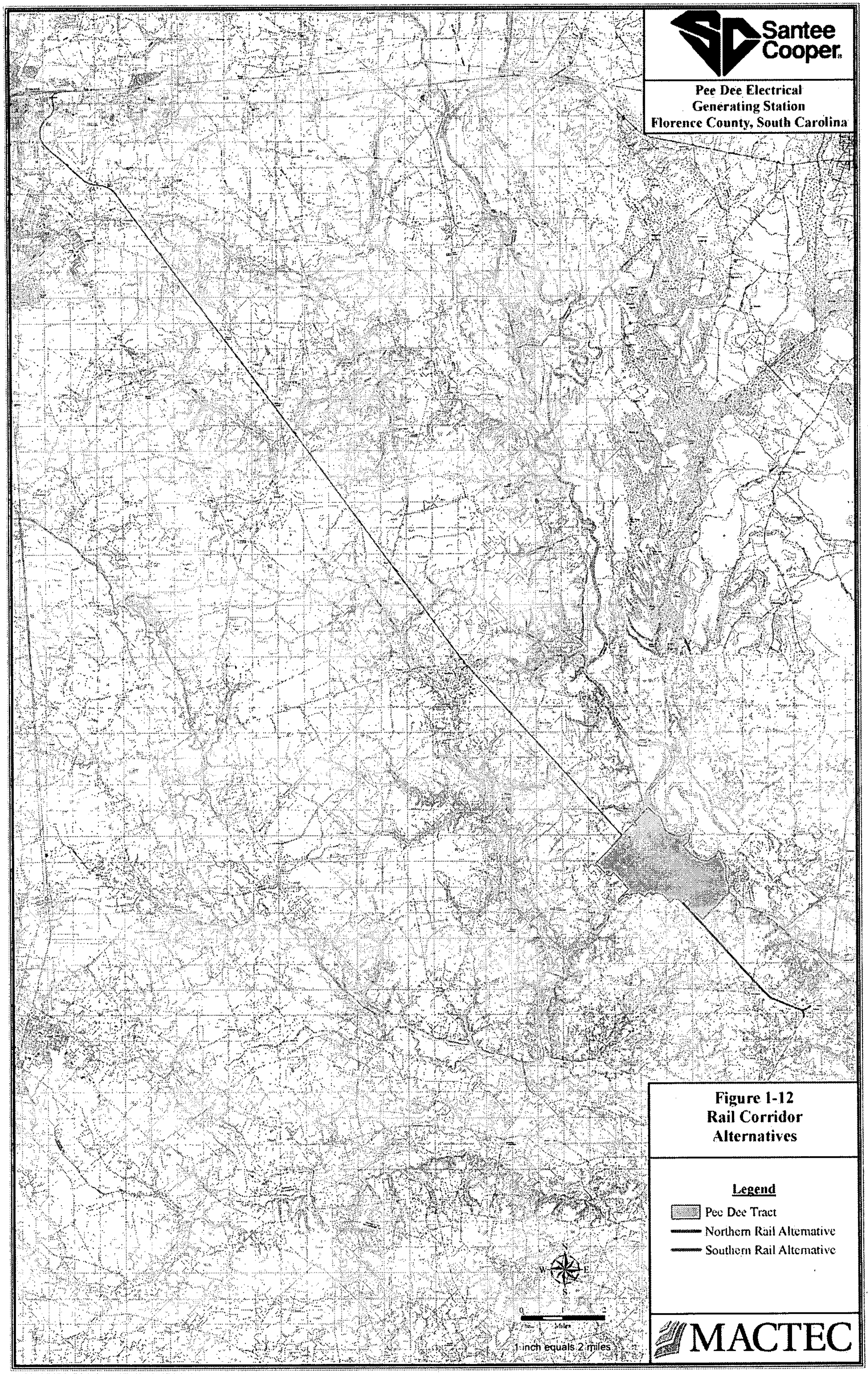
Rail delivery of raw materials to the Pee Dee site is the last transportation alternative considered in this alternatives analysis. An existing decommissioned rail corridor runs through the site in a northwest / southeast direction between Florence and Poston, South Carolina (Figure 1-12). This rail corridor, previously maintained by CSX Corporation, Inc. (CSX), has been dismantled for over 30 years. At the time the rail-line was in operation it connected two CSX railways at Florence and Poston, both of which remain active. Transporting materials by rail is significantly more cost effective and more fuel efficient than trucking the materials. According to the Energy Information Administration (EIA) the average coal transportation rate per ton-mile is nearly ten times greater for trucking versus rail, 14.5 cents per ton-mile and 1.48 cents per ton-mile, respectively (1996 dollars; EIA, 2006). Transportation by rail is also more fuel efficient and less polluting than trucking; moving a ton of freight nearly 410 miles for each gallon of diesel fuel used and emitting one-third of the pollution per ton-mile, compared to 100 miles per gallon per ton of freight moved for the average truck (CSX, 2006).

<u>Northern Rail Alternative</u>

The northern rail alternative exits the site in a northwestern direction for approximately 23.4 miles before connecting with an operational CSX rail-line in Florence. In addition to multiple road crossings, this rail corridor runs directly through the town of Pamplico, South Carolina, approximately five miles northwest of the site. According to information provided by Mr. John Milton, Regional and Site Development Director with CSX, numerous land-owners have purchased or otherwise re-acquired portions of the decommissioned rail ROW between Pamplico and Florence, leaving CSX with only fragmented ownership of the rail ROW in that stretch. Portions of the rail corridor not currently owned by CSX have been changed to alternative land uses, including converting the rail corridor to agricultural purposes in order to create contiguous fields that had previously been fragmented (Milton, 2006).

<u>Southern Rail Alternative</u>

The southern rail alternative exits the site in a southeastern direction for approximately 4.34 miles prior to connecting with an operational CSX rail-line in Poston. CSX maintains active easement/ownership of the rail ROW in its entirety between the Pee Dee site and the connection


Santee Cooper
Pee Dee Electrical Generating Station Florence County, South Carolina
Figure 1-12 Rail Corridor Alternatives
Legend
Pee Dee Tract
Northern Rail Alternative
Southern Rail Alternative
N
W
E
S
Miles
1 inch equals 2 miles
MACTEC

in Poston. This portion of the dismantled railway currently consists of the rail bed, with frequent ditches running parallel to the bed on either side. Much of the corridor is overgrown with vegetation, although a few partially cleared areas occur, especially near road crossings. The preferred rail alternative includes five road crossings prior to connecting to the line in Poston. These crossings include Chinaberry Road, Old River Road, US 378 and South Carolina Secondary Route 44 (S-44) twice, approximately 1.2 miles outside of Poston and again in Poston just prior to connecting to the operational line.

Corridor Suitability for Rail Line Development

Some of Santee Cooper's primary considerations for assessing a corridor's suitability for development of a rail line and a comparison of the two alternative corridors based on these considerations are shown in Table 1-7. Cultural resources were not initially investigated for the rail corridor alternatives because both routes consist of an existing but dismantled rail bed.

Table 1-7: Rail Corridor Comparison Matrix

	Northern Rail Alternative	**Southern Rail Alternative**
Length in miles	23.4	4.34
Wetland Areas (acres/approx. percentage)	52.12 / 18%	18.50 / 36.7%
Stream Crossings (perennial/intermittent)	6 / 15	0 / 2
Road Crossings (U.S. Highways/State Routes)	1 / 28	1 / 4
Floodplain Area (acres/approx. percentage)	8.04 / .03%	0 / 0%
Forested Area (acres/approx. percentage)	124.69 / 44%	18.83 / 37%
Prime Farmland Area (acres/approx. percentage)	181.44 / 64%	8.85 / 18%
Permits (estimated number)	3	2
Protected Species	0	0

Sources: Wetland Areas – NWI; Stream Crossings – USGS; Floodplain Area – FEMA; Prime Farmland Area – NRCS; Protected Species – SCDNR.

Wetland Areas: Wetland acres were determined by GIS measurement of the NWI wetlands within the 100-ft corridor width for each of the rail alternatives. NWI wetlands are used as an estimation of wetland acreage and can vary. However, NWI data was available for both corridors and provides a useful tool for comparison.

Stream Crossings: This parameter was determined by overlaying the two rail corridors on the USGS DRG file. Perennial or intermittent status was based on USGS symbols.

Floodplain Area: Acres of floodplain were approximated using FEMA floodplain data. This parameter can be compared to the number of stream crossings to estimate impacts to streams and their associated floodplains.

Forested Area: This parameter is an estimate of forested acres occurring on the rail corridor, also determined based on NWI data.

Prime Farmland Area: This parameter identifies the estimated acres of prime-farmland soils occurring on the rail corridor based on information from the Soil Survey of Florence County. Refer to Section 3.1 for additional information regarding prime-farmland soils.

Permits: This parameter identifies the preliminary estimate of the number of environmental permits (federal, state, and local) that could be required to construct the rail corridor. Refer to Section 4.12 for additional information regarding required permits.

Protected Species: This parameter indicates the number of protected species that are known to occur within a two-mile distance of the rail corridor between Poston and Florence, based on the Rare, Threatened and Endangered Species database from SCDNR.

1.3.5.5 Preferred Rail Alternative

Based on a review of the three methods of delivery (truck, barge and rail), rail delivery of raw materials has been selected as the most efficient and least environmentally-damaging. Of the two rail alternatives, the southern rail corridor between the Pee Dee site and Poston was chosen as the preferred alternative for several reasons. This alternative is significantly shorter than the northern rail alternative, therefore limiting the number of road and stream crossings, and minimizing impacts to environmental resources, including wetlands. This alternative is more viable because CSX already controls the ROW in its entirety and will not have to purchase the ROW back from multiple landowners in order to develop the rail corridor. Based on this selection, the southern (preferred) rail corridor was subjected to additional detailed assessment as described in this report.

2.0 PROJECT DESCRIPTION AND NEED FOR POWER

2.0 PROJECT DESCRIPTION AND NEED FOR POWER

The South Carolina Public Service Authority ("Santee Cooper") is a body corporate and politic of the State of South Carolina. Santee Cooper operates a vertically integrated electric utility system, including facilities for generation, transmission, and distribution of electric power and energy at retail and wholesale levels.

Santee Cooper has the responsibility to ensure sufficient capacity to provide safe, reliable electrical energy to consumers in its established territory. Historically, utilities have tried to maintain a 20% reserve capacity to allow for unforeseen emergencies including unscheduled outages of generating capacity. In recent years, Santee Cooper has lowered its reserves and is currently planning to maintain a 13% planning reserve.

The lowering of reserves is due to changes occurring in the power industry. In 1992, Congress passed the Energy Policy Act. This Act seeks to deregulate the power industry. As the various states move toward deregulation, electric utilities are moving from monopoly status toward open competition. Santee Cooper is the lowest cost electrical energy producer in South Carolina, and among the lowest in the Southeast. This status positions Santee Cooper well for deregulation and increased competition.

Deregulation, however, also presents a great deal of uncertainty including questions about stranded costs, obligations to serve, reliability, as well as reserve capacity. Resolution of these questions will effect future capacity additions. Other important factors for utilities with regard to capacity additions include availability of sites, regulatory actions, environmental restrictions, fuel pricing and availability, financing, and economic uncertainties. The move toward open competition will inevitably lead utilities, including Santee Cooper, to further re-evaluate their historical methods and processes for determining generating needs and sites. .

These uncertainties are resulting in hesitation on the part of electric utilities to add additional generating capacity, which require further, significant debt. Presently, the country has reserve electrical generating capacity. However, with continued growth and the reluctance to incur debt, these reserves will diminish.

2.1 Present Load and Capacity

The source of power for more than 1.8 million South Carolinians, Santee Cooper provides direct service to almost 138,000 residential and commercial customers in Berkeley, Georgetown and Horry counties. Santee Cooper is the primary source of power distributed by the state's 20 electric cooperatives to over 625,000 customers located in all of the state's 46 counties. Santee Cooper also supplies power to 31 large industrial facilities, the cities of Bamberg and Georgetown, and the Charleston Air Force Base.

Santee Cooper is the nation's fourth largest publicly owned electric utility of its type based on generation and megawatt-hour sales to ultimate customers.

Santee Cooper's current total summer peak generating capacity is 4,509 MWs. In addition, Santee Cooper presently receives 84 MW of firm supply from the U.S. Army Corps of Engineers (USACE) and 327 MW of firm hydroelectric power from the Southeastern Power Administration ("SEPA"). Santee Cooper has entered into a contract to purchase 275 MW of firm power from Progress Ventures, Inc. through August 31, 2006, with an additional contract of 115 MW of firm power for September 1 through September 15, 2006. There is also a contract for 165 MW of firm power for the summer of 2006 from Duke Energy. This additional capacity supplied under contract by the USACE, SEPA, Progress Ventures, and Duke Energy brings the total existing summer power supply peak capability to 5,360 MW.

2.2 Factors Affecting the Need for New Capacity

The territory currently served by Santee Cooper is attractive to industry, and growth in the industrial load class is highly likely. Along with new industry entering the load territory, there is usually a corresponding increase in support population resulting in positive net migration. Further, approximately 50 percent of the energy sales by Santee Cooper are made to electric cooperatives that serve suburban areas. Suburban areas of South Carolina and other Sun Belt areas are expected to experience above average population growth.

Myrtle Beach, which is Santee Cooper's primary retail service area, is a rapidly growing urban area. According to recent load forecasting analysis, the demand from Santee Cooper's retail customers is estimated to grow at an average annual growth rate between 2.5% and 3.5%.

2.2.1 Santee Cooper's Relationship with Neighboring Utilities

Santee Cooper is currently a member of the Virginia-Carolinas Electric Reliability Subregion (VACAR) of the Southeastern Electric Reliability Council (SERC). VACAR and other electric power reliability groups are organized such that each individual member's reliability and capability is enhanced during critical peak periods and in situations of unforeseen facility outages through coordinated system operations and sharing of operating reserves.

In the past, SERC has emphasized that loads are highly weather sensitive and that, unfortunately, member utility's needs tend to move in the same direction during critical peak load periods, thus reducing the desired load diversity. Temperature extremes, either above or below normal, add a great deal of variation to peaks actually experienced as compared to projected peaks.

The Summer Nuclear Station near Columbia, South Carolina, is a cooperative venture that began operation in the mid-'80's. This station is co-owned with South Carolina Electric and Gas (SCE&G) and provides savings to both utilities over what a single ownership facility would have provided. Future joint-efforts with other utilities, or by other utilities, may affect Santee Cooper's generation plans.

The Energy Authority (TEA), a wholesale power-marketing organization opened for business on August 18, 1997, in Jacksonville, Fla. TEA is composed of Santee Cooper, Jacksonville Electric Authority, the Municipal Electric Authority of Georgia, City Utilities of Springfield, Gainesville Regional Utilities, and Nebraska Public Power District. It is the first public power marketing alliance in the country and represents over 8000 MW of combined generating assets. This alliance allows members to more effectively use their generation resources to better serve their customers and to better compete in the marketplace.

2.2.2 Plant Retirements and Life Extensions

Santee Cooper's Jefferies Units 1 and 2 began operation in 1954. These oil-fired units are over 50 years old while Jefferies Units 3 and 4, which are coal fired, are more than 30 years old. The coal-fired units at the Grainger Station, near Conway, went on-line in 1966. Santee Cooper continuously evaluates the effectiveness of these older units. Life extensions are also considered as an option to plant retirement. This option involves major overhauls and additions that could delay the need for additional generation. Alternatively, retirements will hasten the need for additional generation. Other utilities throughout the nation are also faced with retirement and life extension decisions. Plant efficiencies and Clean Air Act requirements will also play significant roles in decisions regarding new generation.

2.3 Load Projections

On an annual basis, Santee Cooper staff in conjunction with its consultant, GDS Associates, Inc., develops a forecast, based on normal weather temperatures, of monthly energy and peak demand requirements over a twenty-year period. This load forecast is based on an analysis of historical events and on assumptions regarding the future. These assumptions relate to key factors known to influence energy consumption and peak demand (e.g., economic activity, weather conditions, and local area demographics).

The annual load forecast takes into account all of Santee Cooper's direct customers, which currently includes 32 large industrial customers, Central Electric Power Cooperative Inc. ("Central"), and two municipal electric systems, the City of Georgetown and the City of Bamberg. Central is an association of 15 electric distribution cooperatives and Saluda River Electric Cooperative, Inc. ("Saluda"). Saluda is an association of five electric distribution cooperatives. Central serves primarily residential, commercial and small industrial customers in all 46 counties of the State. Through Central, Saluda and the two municipal electric systems, more than 665,000 customers are served indirectly by the Authority. The Authority also serves directly more than 150,000 residential, commercial and small industrial retail customers in parts of Berkeley, Georgetown and Horry counties.

For energy, the weather-sensitive portion of the forecast (residential and commercial classifications) is developed using econometric models. The non-weather sensitive industrial energy forecast is developed based on historical trends and information provided by individual industrial customers.

For demand, an econometric model is developed to project long-term peak demand based on temperatures on historical peak days. Industrial customer demand is forecast based on contract demand. In addition to the peak demand base case forecast, high and low-range scenarios are developed to address uncertainties regarding the future.

Current projections predict growth in the projected summer peaks (Table 2-1). These projections reflect a still dynamic, yet maturing South Carolina economy as compared to the explosive growth of the late sixties and early seventies. These projections are reviewed periodically and are subject to change based on cyclical and trend economic analysis.

Table 2-1: Projected Demand and Energy based on 2005 Load Forecast

	Summer Peak (MW)	WinterPeak (MW)	Energy Sales (GWH)
2005	5,190	5,253	27,675
2006	5,307	5,393	28,258
2007	5,422	5,534	28,848
2008	5,537	5,675	29,448
2009	5,659	5,821	30,071
2010	5,773	5,960	30,654
2011	5,886	6,098	31,235
2012	6,003	6,240	31,833
2013	6,122	6,385	32,441
2014	6,243	6,532	33,059
2015	6,364	6,679	33,678
2016	6,486	6,827	34,301
2017	6,610	6,977	34,934
2018	6,736	7,129	35,577
2019	6,864	7,284	36,229

Source: Santee Cooper

At present, Santee Cooper plans to add additional capacity in the near future via construction of 2 new generating units at a site on the banks of the Great Pee Dee River near Florence, SC. However, as discussed above, there are many factors that can change expected capacity additions.

2.4 Project Description

2.4.1 General Description

The planned installation will consist of two (2) pulverized supercritical coal-fired steam generating (PC) units, one near term and one later, with a gross generating capacity of 1320 MWs. Each PC unit will be nominally rated for 660 MW each, but the net power generation will be approximately 600 MW each.

The general arrangement of the Pee Dee Electrical Generating Station is shown on Figure 1-10. The installation will include a coal storage area, bottom ash ponds, and solid waste disposal areas. Each PC unit will have a mechanical draft multi-cell cooling tower, a wet limestone scrubber (sulfur dioxide removal (FGD) system), a selective catalytic reduction (SCR) system, and either an electrostatic precipitator (ESP) or fabric filter (FF). Unit trains, utilizing an existing railroad right-of-way, will deliver coal to the site.

Solid waste, including bottom ash, fly ash, and gypsum, manufactured onsite from flue gas desulfurization (FGD) residual solids, will be sold as raw materials to various industries. Materials without a market will be disposed of on-site.

Common facilities for both PC units will include a switchyard, river water intake and station discharge structures, material handling systems for coal, petroleum coke (petcoke), limestone, ash and gypsum, two emergency generators, a fire pump, and storage tanks. Excess cooling tower blowdown and treated wastewater will be returned to the Great Pee Dee River via the station discharge structure. A gypsum manufacturing facility may also be located on site.

One freestanding reinforced concrete chimney with two fiberglass liners is planned to service the two units. A chimney height of 650 feet was modeled to evaluate air dispersion impacts, and an application for the SCDHEC Prevention of Significant Deterioration (PSD) Permit has been submitted.

The planned 230 kV switchyard will utilize the Santee Cooper standard double bus, one-and-a-half breaker arrangement. Currently, two transmission lines are proposed to exit the switchyard. One transmission line will extend approximately 2.5 miles from the switchyard to the eastern most corner of the site, within a 150-foot wide corridor entirely inside the site boundary, where it will enter the existing 230 kV, Marion to Hemingway transmission line right-of-way (ROW) corridor. The Marion-Hemingway corridor is part of Santee Cooper's transmission grid that extends across the state and is inter-connected at a number of locations with other utilities.

The second transmission line will be a 230 kV H-frame pole or single pole design that will connect the switchyard on the Pee Dee Tract to the existing Lake City Switching Station. This transmission corridor will include approximately 11.94 miles of new ROW development and 6.4 miles within the existing Friendfield-Lake City ROW.

Construction of the generating units will extend over a number of years. A six-year construction period is required to place the first coal-fired unit at a "greenfield site" similar to the Pee Dee site and a four year construction period is required for each subsequent coal-fired unit. The infrastructure for coal-fired units including, but not limited to, rail, coal pile, administration and maintenance facilities, switchyard and transmission lines, intake and discharge facilities, ash pond, material handling systems, and the stack, etc. must be constructed with the first unit. Also, each coal-fired unit will include a SCR system, a wet limestone scrubber, and either an ESP or a fabric filter, as applicable to meet air emissions regulatory limitations.

2.4.2 Power Generation Cycles -- Pulverized Coal Units

The steam generators will be balanced draft, pulverized coal-fired, supercritical type boilers. Supercritical coal-fired steam units use higher initial turbine pressures coupled with high temperature to produce higher efficiencies than subcritical units. Numerous supercritical units have been constructed worldwide. This class of unit is a proven reliable source of energy for electric generation with distinct advantages of lower operating costs by virtue of their higher efficiency and lower fuel consumption with corresponding lower emissions.

The boilers are anticipated to be Alstom Power design and will be tangentially fired with two levels of separated over-fire air above the burners. They will burn primarily Eastern Kentucky bituminous coals and will be permitted to burn up to 30% of petroleum coke by weight. Sulfur content of the design coals will range from 1.0 to 3.1%, and from 3.4 to 7.0% for petroleum coke, for a combined average condition of approximately 3.75% sulfur content. Ash content for the design coals will range from 4.5 to 17% and from 0.3 to 1.4% for petroleum coke. Heating values of design coals will range from 11,000 to 13,000 Btu/lb and from 13,600 to 14,700 Btu/lb for petroleum coke, with an approximate heating value of 12,500 Btu/lb.

During startup, each boiler is capable of firing No. 2 fuel oil or natural gas at a maximum rate of 480 million British Thermal Units (MMBtu) / hr[3]. Each boiler will have a maximum heat input capacity of 5,700 MMBtu/hr and will supply steam to a steam turbine/generator set. The standard operating mode for the boilers will be continuous operation at normal rated capacity. Both units will have a design maximum continuous rating of 4,500,000 pounds per hour at 3800 pounds per square inch gauge (psig) and 1050 degrees Fahrenheit (° F) with an 1100° F reheat.

The turbines will be tandem-compound four-flow machines. All units will be rated 640,000 kWs with valves 95% open at 3600 psig - 1050° F throttle conditions.

The units will use recirculating cooling water systems that will convey the hot circulating water from the condensers to evaporative cooling towers, which will dissipate the waste heat to the atmosphere by latent and sensible heat transfer. The cooled water will be recirculated from the tower basins to the condensers for reuse. The cooling towers will also be used to dissipate heat from various station cooling systems. The circulating water nominal maximum flow rate for each unit will be 287,100 gallons per minute (gpm). The cooling towers will be multi-fan, mechanical draft units. Design drift will not exceed 0.01 percent of the circulating water flow.

[3] A natural gas pipeline is adjacent to the site. However, there is very limited capacity currently available on the line, and it is unclear whether sufficient capacity could be purchased to provide adequate natural gas for startup. Regardless, the boiler design is intended to include natural gas as a potential startup fuel.

2.4.3 Raw Materials Handling

In addition to coal, the operating station will require the use of fuel oil and/or natural gas, limestone, pet coke, gypsum, anhydrous ammonia, and other chemicals as noted in Section 2.4.3.4, below.

2.4.3.1 Coal

The station will burn an eastern bituminous coal from the Appalachian Region. Both units will burn about 205 tons per hour (tph) each. This burn rate is based on a maximum heat input capacity of 5,700 MMBtu/hr and a blend ratio of 90% coal / 10% pet coke having an average heating value of 12,500 British Thermal Unit (Btu) per pound. A typical analysis range of the "as received" coal is presented in Table 2-2. Unit trains of approximately 10,000 tons capacity will deliver coal to the site. The average annual coal consumption of two units at 70% annual capacity factor is approximately 2,500,000 tons. Coal deliveries for both units will be no more than one train per 24-hour period.

Table 2-2: Pee Dee Unit 1 Fuel Specification

		Coal		Pet Coke
		Design Range	**Performance**	**Design Range**
Proximate Analysis (% As Received)	Moisture	4-10	6.8	3.65-8.90
	Volatile Matter	22-38	33	8.00-15.00
	Fixed Carbon	45-65	52	80 - 85
	Ash	4.5-17	8.5	0.30 - 1.37
Higher Heating Value (Btu/Lb)		11,000 - 13,000	12,500	13,600 - 14,700
Grindability (HGI)		36-54	43	35 - 60
Ultimate Analysis (% As Received)	Carbon	63-80	70.87	75 - 85
	Hydrogen	3.5-7.5	4.86	3.00 - 4.00
	Nitrogen	.95-1.9	1.44	0.70 - 2.30
	Chlorine	0.0-0.3		0.01 - 0.04
	Sulfur	1.0-3.1	1.57	3.40 - 7.00
	Moisture	4-10	6.78	3.65 -10.00
	Ash	4.5-17	8.46	0.30 - 1.37
	Oxygen	2.5-8.8	6.02	0.15 -1.00
Mineral Analysis of Ash (%)	SiO_2	45-60	47.37	0.20 - 20.0
	Al_2O_3	20-30	27.10	0.50 - 5.00
	TiO_2	1-4	1.53	0.05 - 0.50
	Fe_2O_3	4-15	12.74	2.0 - 23.0
	CaO	1-5	1.56	2.0 - 15.0
	MgO	0.5-3.0	0.77	0.50 - 5.0
	Na_2O	0.10-1.0	0.55	0.50 - 11.0
	K_2O	1.0-3.2	2.60	0.10 - 1.0
	P_2O_5	0.1-1.0		0.01 - 0.02
	SO_3	0.1-1.5		-------
	V_2O_5			12 .0 - 89.0
	Vanadium Pentoxide (ppm of fuel)			300 - 3000
	Undetermined		5.78	
Ash Fusion (F)	**Reducing**			
	Initial Deformation	2400	2400	2500 - 2800
	Softening (H = W)	2500	2500	2500 - 2800
	Hemispherical (H = 1/2 W)	2550	2500	2500 - 2800
	Fluid (H = 1/16")	2600	2550	2500 - 2800
	Oxidizing			
	Initial Deformation	2600	2600	2500 - 2800
	Softening (H = W)	2700	2600	2500 - 2800
	Hemispherical (H = 1/2 W)	2700+	2650	2500 - 2800
	Fluid (H = 1/16")	2700+	2650	2500 - 2800

Source: Santee Cooper

2.4.3.2 Fuel Oil

No. 2 fuel oil will be used for boiler ignition firing and combustion support. The average annual consumption of the two pulverized coal-fired steam generating units is expected to be about 1,000,000 gallons. The oil will be delivered by truck (and/or rail) and stored in one tank, which is anticipated to be a 300,000-gallon steel tank.

2.4.3.3 Limestone

Limestone for the FGD system will be obtained from local sources and delivered by truck. Each unit will use on average 24 tph of limestone. Truck deliveries of limestone for each unit will average 94 thirty-ton trucks per week. Rail delivery will be considered for the multiple unit development.

2.4.3.4 Chemicals

Chemicals will be delivered to the plant in trucks and will include sulfuric acid, sodium hypochlorite, hydrazine, sodium hydroxide, aqueous ammonia, anhydrous ammonia, lime, alum, adipic acid (DBA), silt dispersant, activated carbon, and polyelectrolyte coagulant aid. The estimated quantities of chemicals required for each unit are shown in Table 2-3.

TABLE 2-3: ESTIMATE OF ANNUAL CHEMICAL USAGE
(For Complete Site – 2 Units)

CHEMICAL	ANNUAL QUANTITY
Sulfuric Acid	490 tons
Demineralizer Regeneration	
Ashpond/Cooling Water pH Control	
Aluminum Sulfate	42 tons
Water Pretreatment Coagulant	
Wastewater Treatment Coagulant	
Sodium Hypochlorite (approx. 12%)	167,000 gallons
Water Pretreatment Biofouling Control	
Cooling Water Biofouling Control	
Hydrazine (100%)	3 tons
Feedwater Trace Oxygen Removal	
Aqueous Ammonia	7 tons
Feedwater pH Control	
Polyelectrolyte, Potable Water Grade	0.5 tons
Water Pretreatment Coagulant	
Wastewater Treatment Coagulant	
Sodium Hydroxide	300 tons
Demineralizer Regeneration	
Adipic Acid (DBA)	300 tons
Flue Gas Desulfurization	
Activated Carbon	8 tons
Water Pretreatment	
Anhydrous Ammonia	5,700 tons
Selective Catalytic Reduction	
Silt Dispersant	63 tons
Cooling Tower	
Corrosion Inhibitor	44 tons

Source: Estimates derived from Cross Generating Station's 2005 records

2.4.4 Air Pollution Control

The PC units will employ electrostatic precipitators (ESPs) or fabric filters (FFs) for particulate removal and wet limestone scrubber (FGD) systems to reduce sulfur dioxide (SO_2) emissions. Nitrogen oxide (NO_x) emissions will be controlled in the combustion process and with post-combustion technology. The pair of units will have a 650 foot high reinforced concrete chimney shell containing two flues.

The ESPs of FFs will limit the particulate discharge to 0.018 pound per million Btu. The boiler design parameters and post-combustion technology will limit the NO_x emissions to comply with applicable regulations. The wet limestone FGD system will be designed to limit the discharge of SO_2 to less than 0.15 pound per million Btu with 97.5% removal.

2.4.5 Solid Waste Systems

Station solid waste consists primarily of bottom ash, fly ash, and FGD residual solids. These will be stored temporarily on-site and marketed as raw materials for various industries. The remaining amounts of these materials that cannot be sold will be disposed of on-site. Solid Waste Landfill Areas will be used for gypsum and stabilized fly ash. Initial plans call for a 120 acre solid waste landfill area. Future solid waste disposal areas are set aside to be used as needed.

2.4.5.1 Flue Gas Desulfurization (FGD) System Solid Waste

Solid waste generated by the FGD system will be sold as gypsum for use in various industries as quality and markets allow. The scrubber waste slurry will be oxidized and dewatered to produce a solid material containing 10 to 15 percent moisture. The resulting material will be suitable for agricultural use or used in the manufacture of portland cement or wallboard. It is estimated the two units will produce about 300,000 tons (dry weight) of gypsum annually. Gypsum which is not marketable will be disposed of on-site in the solid waste landfills.

2.4.5.2 Ash System

Fly ash will be conveyed dry from the precipitator hoppers by an air system to storage silos. Fly ash will be loaded into trucks from the silos for use in the cement industry. Fly ash not sold will be disposed of on-site in the solid waste landfills.

Bottom ash will be collected in a wet hopper below the furnace. Periodically, the ash will be withdrawn and sluiced to the on-site ash pond. Economizer ash and coal mill rejects will be handled in the same manner. Ash transport water will be recirculated from the ash pond. Bottom ash material from the ponds may be sold as aggregate.

2.4.6 Cooling Water System

A closed-cycle recirculating cooling water system will be used for the steam surface condensers and unit auxiliary coolers. Mechanical draft cooling towers will be used for the heat sink. Performance criteria for the cooling towers for each unit is expected to be based on a design flow rate of 287,100 gpm to be cooled from 113.6° F to 95° F at an 81° F wet bulb. The maximum evaporation loss from each tower is estimated to be approximately 5300 gpm[4] at an 81° F wet bulb temperature. Drift loss will be less than 0.01% (29 gpm) of the circulating water flow rate. Maximum blowdown assuming 6 cycles of concentration will be 348 gpm for each unit. About 60 % to 80 % of this discharge is expected to be used for FGD scrubber make-up and other service water uses.

2.4.7 Water and Wastewater Treatment Systems

2.4.7.1 Water Supply System

Process water will be taken from the Great Pee Dee River. The raw river water will be used directly for cooling tower makeup and treated for general station use and boiler makeup. The normal operating consumption for the fully developed site will be 13,000 gpm and the maximum consumption for the fully developed site will be 19,500 gpm. Water for potable uses will be obtained from on-site wells. Water used for boiler makeup will be treated through a precipitator-clarifier and anthracite filter, followed by demineralization.

2.4.7.2 Wastewater Treatment System

Wastewater sources from the PC units will include cooling tower blowdown, bottom ash sluice water, coal pile and limestone storage area runoff, industrial area runoff, sanitary waste, and low volume waste sources, including but not limited to, wastewaters from wet scrubber air pollution control systems, ion exchange water treatment system, floor drains, cooling tower basin cleaning

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[4] Based on equation from Online Chemical Engineering Information Website, http://www.cheresources.com/ctowerszz.shtml : Evaporation loss = 0.00085 X water flow rate X (T1-T2), where T1 = hot water temperature and T2 = cold water temperature.

wastes, recirculating house service water systems, sampling streams, water treatment wastes, laboratory and equipment drains, transformer area drains, and boiler blowdown. Most wastewater will be sent directly to the bottom ash pond, which in conjunction with a pH adjustment system, acts as the primary wastewater treatment system. Two bottom ash ponds are planned for the station with the first pond to be 102 acres and the future pond to be 104 acres.

Cooling tower blowdown will be used as makeup to the FGD scrubber system, be sent to the bottom ash pond, or be discharged to the Great Pee Dee River. Equipment and floor drains and boiler and transformer area drains will be routed through an oil/water separator before discharge to the bottom ash pond. Coal and limestone storage areas and the industrial site drains will be routed to ponds designed to contain the runoff from a 10-year, 24-hour storm and transferred to the bottom ash pond.

The bottom ash pond serves as a settling, surge, and collection basin. In this regard, it serves as a detention and clarification pond that receives bottom ash sluice water and wastewaters as described above. In addition, the bottom ash pond collects rainfall directly and runoff from the coal pile, limestone storage and industrial areas indirectly. In this sense, it acts as a stormwater detention (equalization) pond. Water in the bottom ash pond is recycled for bottom ash sluicing. The discharge from the bottom ash pond will be pH adjusted between 6 and 9, or as required in the station's NPDES permit, and monitored for all applicable SCDHEC regulatory discharge limitations prior to release to the Great Pee Dee River.

Sanitary sewage will be collected in a separate system and treated in a sewage treatment plant before discharge to the river. The sanitary sewage treatment plant will be designed to ensure the effluent will meet the applicable SCDHEC regulatory discharge limitations in the station NPDES permit.

Non-routine chemical metal cleaning wastewaters, boiler fireside washes, air preheater washes, condenser and feedwater flushes, will be collected in tanks and either incinerated as permits allow or disposed offsite in accordance with applicable regulations.

2.4.8 Industrial Development Area

Santee Cooper is actively engaged in economic development and works closely with state, regional, and county development groups for the creation of jobs and increasing commerce for South Carolina's growing population. To this end, Santee Cooper is reserving fifty (50) acres of the Pee Dee Tract for potential industrial use.

The location of the 50-acre industrial area was selected primarily due to factors including; dual road frontage, proximity to electrical service, and the avoidance of wetland and cultural resource impacts. Possible industrial uses would likely be those related to electrical generation, those that could provide products or services for use at the Pee Dee Station (and perhaps others) and those that could utilize byproducts from coal combustion. Examples of byproduct utilization would include wall board manufacturing, cement block production, road construction materials, and products for agricultural applications. There would also be the possibility of interrelated uses such as steam or hot water for heating purposes or other beneficial steam or water recycling or reuse.

2.5 River Water Intake and Discharge

2.5.1 Design Criteria

The river intake system will provide raw water make-up for the station, including the cooling towers, boilers, FGD units and general station service. A single intake structure will be located on the Great Pee Dee River approximately 200 feet upstream of the existing boat ramp. The makeup water will be withdrawn from the Great Pee Dee River via two or three 6500 gallon per minute (gpm) pumps located at a common intake structure. A fourth 6500-gpm backup pump and a 2500-gpm emergency fire pump are also located at the intake structure. It is anticipated that the maximum makeup flow, will be 13,000 gpm (29 cfs) using 2 of the 6500 gpm pumps.

Due to potentially high suspended solids in the Great Pee Dee River, the Station has been designed with a third 6500 gpm pump. The total makeup flow for the fully developed site (two (2) generating units), with 3 pumps in operation would be 19,500 gpm (approximately 43.5 cfs). Given that the high suspended solids will be coincidental with high river flows following storm events, low flow critical condition calculations presented in this report are based on 29 cfs being the maximum withdrawal rate. Since these critical calculations are based on low river flows (7Q10 or minimum recorded) with low suspended solids concentrations, the 29 cfs withdrawal is considered and referred to in the report as the maximum withdrawal.

The station discharge structure will be located approximately 200 feet downstream of the existing boat ramp, for cooling tower blowdown and other treated discharges such as the decanted bottom ash pond water and sanitary wastewater. Design performance calculations indicate that the maximum cooling tower blowdown, assuming 6 cycles of concentration, will be 989 gpm for each unit during high ambient conditions (high temperatures) and maximum electrical generating conditions. Approximately 60% to 80% of this discharge is expected to be used for FGD scrubber make-up. This results in a cooling tower blowdown rate of 696 gpm (1.55 cfs) and a maximum discharge from the cooling water blowdown and ash pond, with two units in operation, of approximately 1980 gpm (4.4 cfs).

As with the maximum withdrawal, the cooling tower blowdown rates will increase when the river suspended solids concentrations increase. When the suspended solids concentrations are high, the cooling tower's concentration cycles may be as low as 2. Under these conditions, cooling tower blowdown and ash pond flow rates will increase to a total of approximately 3000 gpm (6.7 cfs).

Similar to the withdrawal, the higher discharge rates will occur during high river flows. Therefore, the critical condition calculations presented in this report use and refer to 4.4 cfs as the combined maximum discharge, and 1.55 cfs as the maximum cooling tower blowdown discharge.

2.5.2 Intake and Discharge Structures

The intake and discharge structures will be located on the south bank of the Great Pee Dee River as shown on Figure 2-1.

2.5.2.1 Station Intake Structure

The intake structure will be rectangular with space for four make-up water pumps and one fire pump in the pumping chamber. For the initial installation, the fire pump and three make-up water pumps will be installed. Two make-up pumps will be used for regular operation and one will be provided for reserve. The fourth make-up pump will be installed when the second unit is constructed.

The river water will enter the structure through up to four well-screen type intake tees located in the river. The intake screens will be made of stainless steel wire having a wedge-shape cross section with spacing between wires (slot width) of 1/8 inch and a slot velocity of 0.5 feet per second (fps) or less at maximum river water demand. The system will use compressed air for backflow cleaning.

By employing wedge wire well screens suspended off the river bottom and located in the high velocity section of the river flow, impingement and entrainment of aquatic organisms will be minimized. It is expected that actual flows will ensure a thru-slot velocity of $\leq$ 0.5 feet per second per the requirements of Subpart I of Section 316(b) of the Clean Water Act. The general arrangement and design of the intake structure is shown on Figure 2-1.

2.5.2.2 Station Discharge Structure

Cooling tower blowdown, treated sanitary wastewater effluent, and bottom ash pond discharge is conveyed to the discharge orifice as shown in Figure 2-2[5] via a mile-long collector pipe. Flow will be monitored and discharge water will enter the river through a reducer section effectively creating the discharge orifice shown. The station's effluent returns to the river through the orifice which terminates on the river shoreline just below the 7Q10 surface level. Thus, adequate velocity will be assured for proper mixing.

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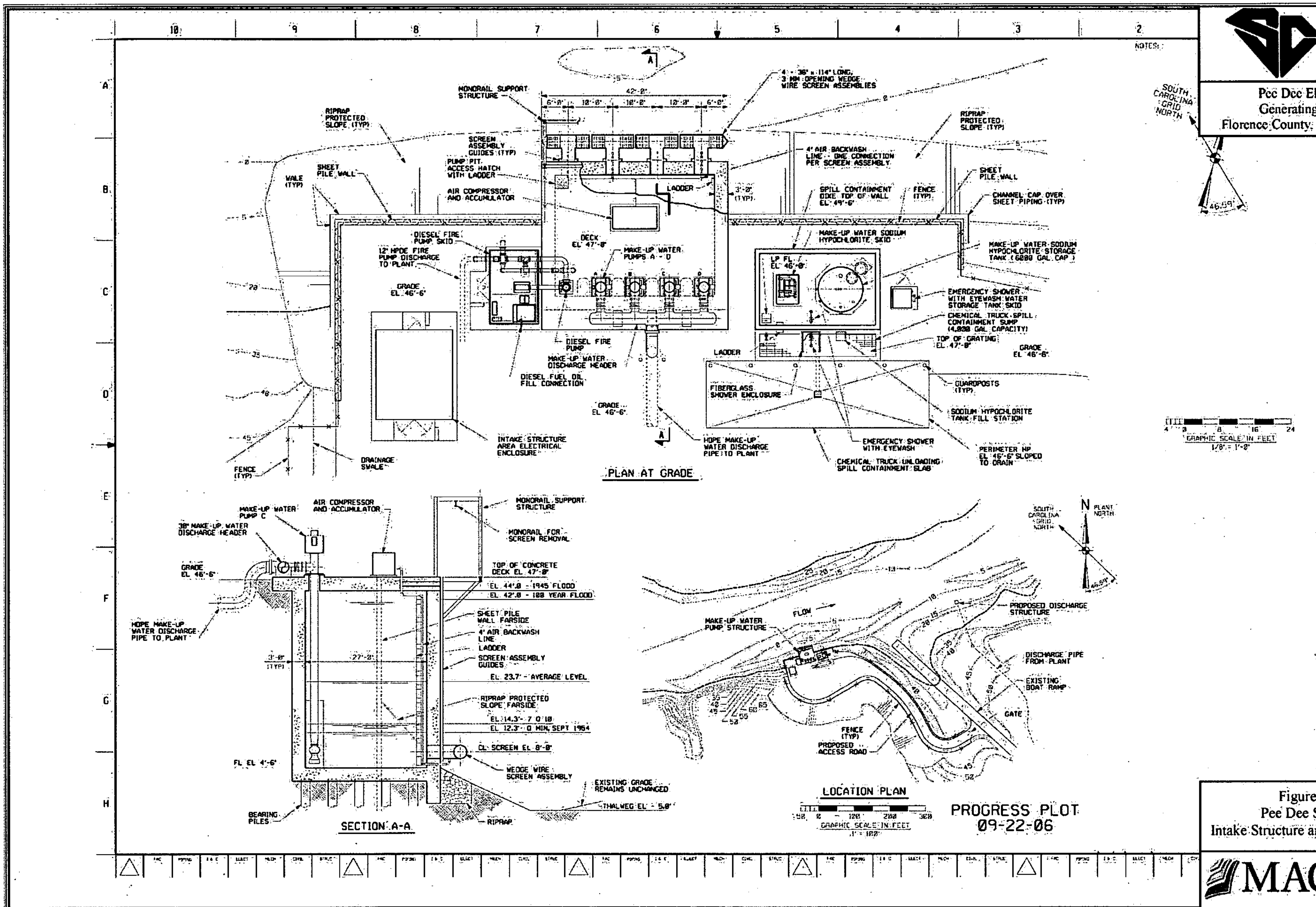
[5] Although Figure 2-2 shows an 18-inch orifice and a 48-inch pipeline, these sizes were based on four generating units and the ultimate buildout for this station has been reduced to two generating units. Thus, it is anticipated the size of the orifice and conveyance pipeline will be reduced commensurate with the actual flows anticipated for two units. Figure 2-2 has not been revised to reflect the current plans in order to expedite permitting, so the figure actually represents a worst case scenario that was the basis for the permit (Permit No. 84-3Z-005) that was issued on August 21, 1984 for the four-unit station.



Santee Cooper

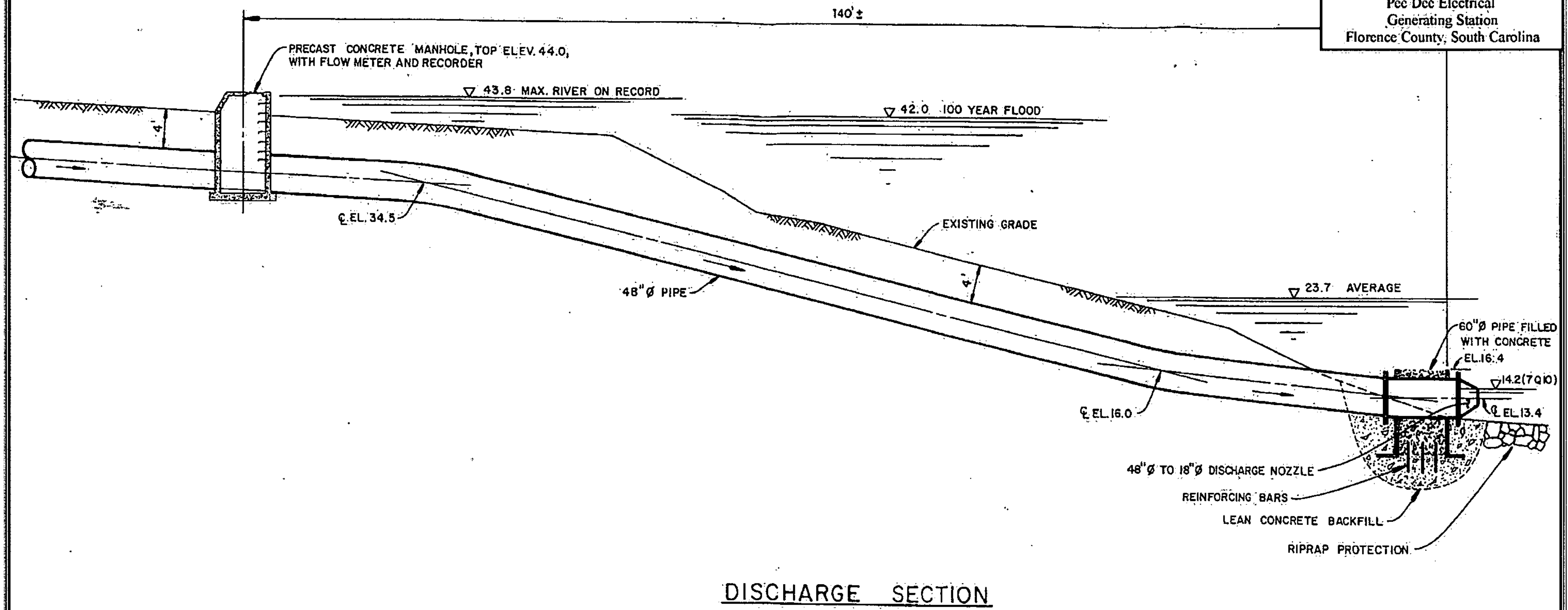
Pee Dee Electrical Generating Station
Florence County, South Carolina

Figure 2-1
Pee Dee Station
Intake Structure and Pump House

MACTEC

Santee Cooper

Pee Dee Electrical Generating Station
Florence County, South Carolina



DISCHARGE SECTION

Figure 2-2
Pee Dee Station
Discharge Structure

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3.0 DESCRIPTION OF EXISTING ENVIRONMENT

3.1 Landform, Geology and Soils

The Pee Dee site (Figure 3-1) is situated in the Coastal Plain Physiographic Province (CPPP). This province is a seaward sloping surface which is physiographically divided into three regional belts which generally parallel the Atlantic coastline. The subdivisions of the CPPP are the Upper, Middle and Lower coastal plain. The Pee Dee site is located in the Lower Coastal Plain of the CPPP.

The CPPP contains a thick sequence of sedimentary deposits which rest upon a surface of ancient crystalline rocks (1983 EA). In the area of the site, these sedimentary deposits vary in age and approach a thickness of approximately 1,200 feet (360 meters). Section 2.1.1.2 of the original 1983 EA contains a detailed discussion of sedimentary formations underlying the site. An abbreviated summary of site geology is found on page A-4 of the "Geocheck Addendum" in Appendix J.

The Pee Dee site is within a region of southeastern United States which has experienced a moderate amount of earthquake activity. Occasionally earthquakes have occurred in the CPPP, however, no earthquakes have been recorded within 50 miles of the site (1983 EA). An analysis of earthquakes in the CPPP indicates a 2 percent probability that the site will experience a seismic event with peak ground acceleration exceeding 0.40 g in a 50 year period (1983 EA).

At the Pee Dee site, sand and gravel have previously been extracted from a quarry which adjoins the Great Pee Dee River. This quarry lies east of South Carolina Secondary Route 57 (S-57), and has an approximate length and width of 500 feet, and an approximate depth of 25 feet. Although the duration of the past quarrying operation is not known, previous quadrangle mapping indicates that the quarry was in existence as early as 1946. An on-site field investigation, conducted in May 1998, revealed no recent activity in the quarry.

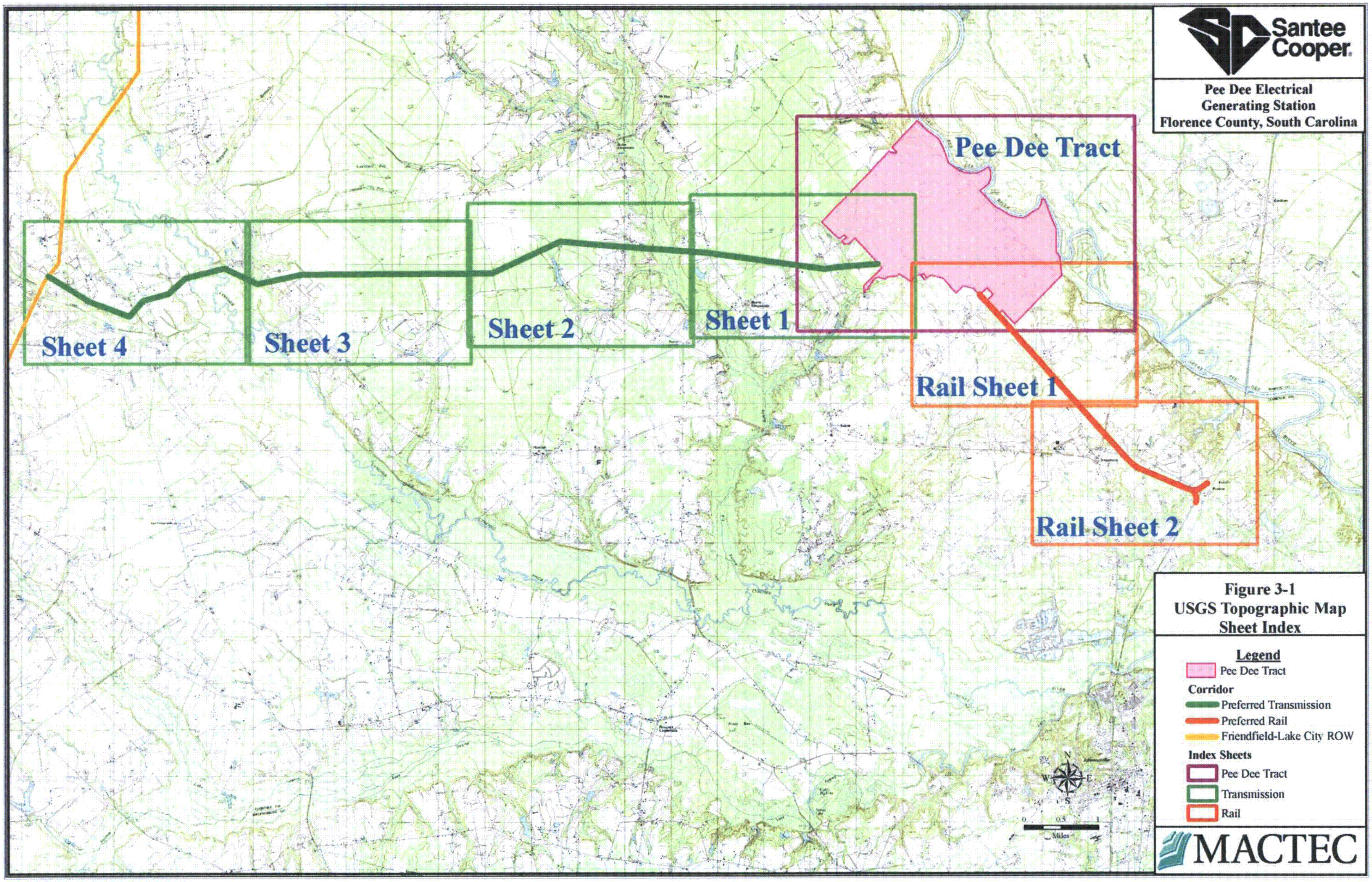


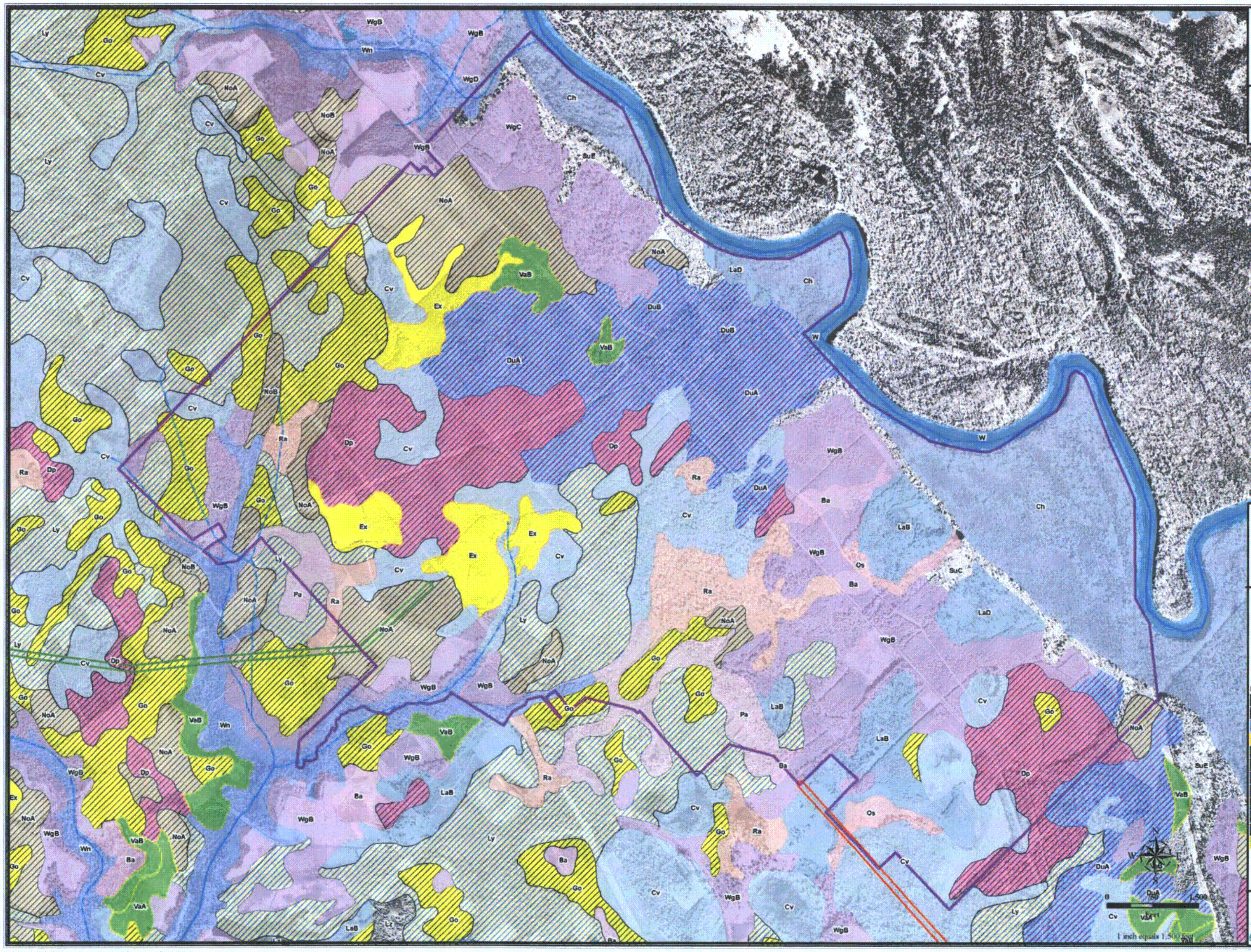
Figure 3-1
USGS Topographic Map
Sheet Index

Gilbert/Commonwealth, in conjunction with Law Engineering, Inc., (now known as MACTEC Engineering and Consulting Inc.) executed a subsurface exploration and groundwater-monitoring program in 1982 to define the subsurface geology at the Pee Dee site. Over forty test borings were drilled to determine the subsurface conditions and geotechnical characteristics of the Coastal Plain sediments underlying the site. In total, over 2,600 linear feet of exploratory drilling was performed. The average depth of each boring was approximately 50 feet with ten borings being extended to depths of 100 feet or greater. Additional geotechnical evaluations are currently being conducted (August – September 2006).

A series of twenty-three groundwater monitoring wells were constructed on-site to collect background data pertinent to water level fluctuations and groundwater quality. In addition, nine former residential wells were incorporated into the monitoring program. Water level measurements and water quality samples were made on a monthly and quarterly basis, respectively.

During the course of the subsurface exploration program, bowl-shaped depressions were noted in areas north of Old River Road (South Carolina Secondary Route 57). Investigations indicated the depressions were due to groundwater solutioning of the underlying Pee Dee Formation, which could indicate a potential problem with subsidence. No such warpage was observed in the Black Creek Formation that directly underlies the Pee Dee Formation. In addition, it was learned that the Black Creek Formation occurred at a much higher elevation in the southwest portion of the site.

As mapped by the U.S. Department of Agriculture (USDA), Soil Conservation Service, the soils comprising the Pee Dee site can be grouped into three associations (USDA/SCS, 1974; Figure 3-2). These associations, which incorporate soil series occurring on upper parts of slopes, lower parts of slopes, and in floodplains, include the Wagram-Lakeland-Norfolk Association, the Lynchburg-Goldsboro-Coxville Association, and the Chastain-Chewacla-Congaree Association. More specifically, the soil units which occur in the area of the proposed generation station include Coxville, Duplin, and Exum series; the predominant soil units which occur in the preferred transmission corridor include Lynchburg, Coxville, Goldsboro, Norfolk, Duplin and



Santee Cooper

Pee Dee Electrical Generating Station
Florence County, South Carolina

Figure 3-2
Soils & Prime Farmland
Pee Dee Tract

Legend

- Pee Dee Tract
- Preferred Transmission Corridor
- Preferred Rail Corridor
- Friendfield-Lake City ROW

Prime Farmland		Other Soils	
Cb	CAHABA Loamy, 0 to 3	Ba	BARTH
Dp	DUPLIN	Ch	CHASTAIN-CHEWACLA-CONGAREE
DuA, DuB	DUPLIN AND EXUM, 0 to 2	Cv	COXVILLE
Ex	EXUM	FuB	FUQUAY
Go	GOLDSBORO	LaB	LAKELAND
Jo	JOHNS	Ls	LEAF
Ka	KALMIA	Os	OSIER
Ly	LYNCHBURG	Pa	PANTEGO
NoA, NoB	NORFOLK, 0 to 6	Ra	RAINS
On	OLANTA	Rt, Ru	RUTLEGE
OrA, OrB	ORANGEBURG, 0 to 6	WgB	WAGRAM
VaA, VaB	VARINA, 0 to 6	Wh	WAHEE
		W	WATER
		Wn	WEHADKEE AND JOHNSTON
		Wk	WEHADKEE-CHASTAIN

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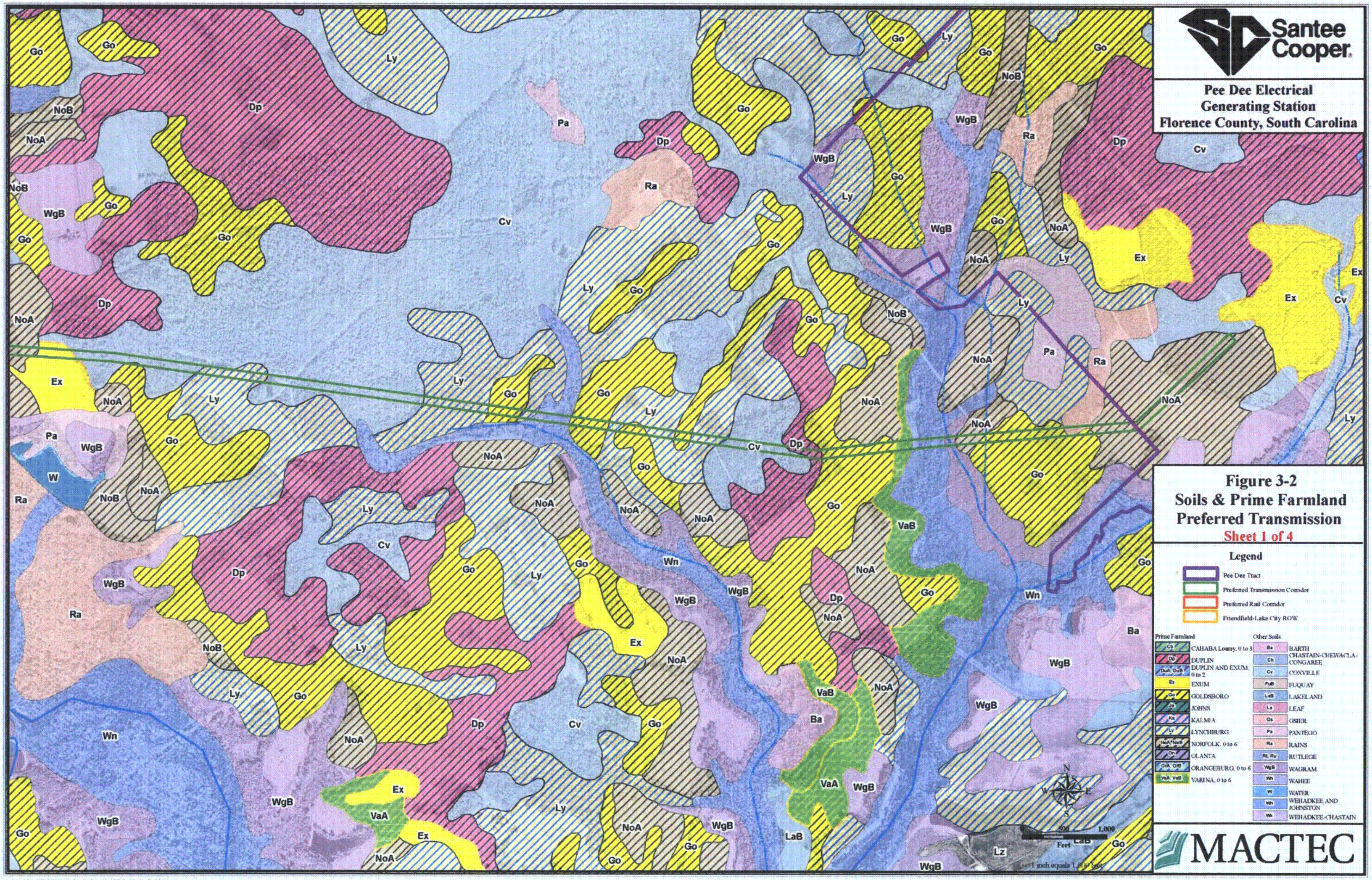
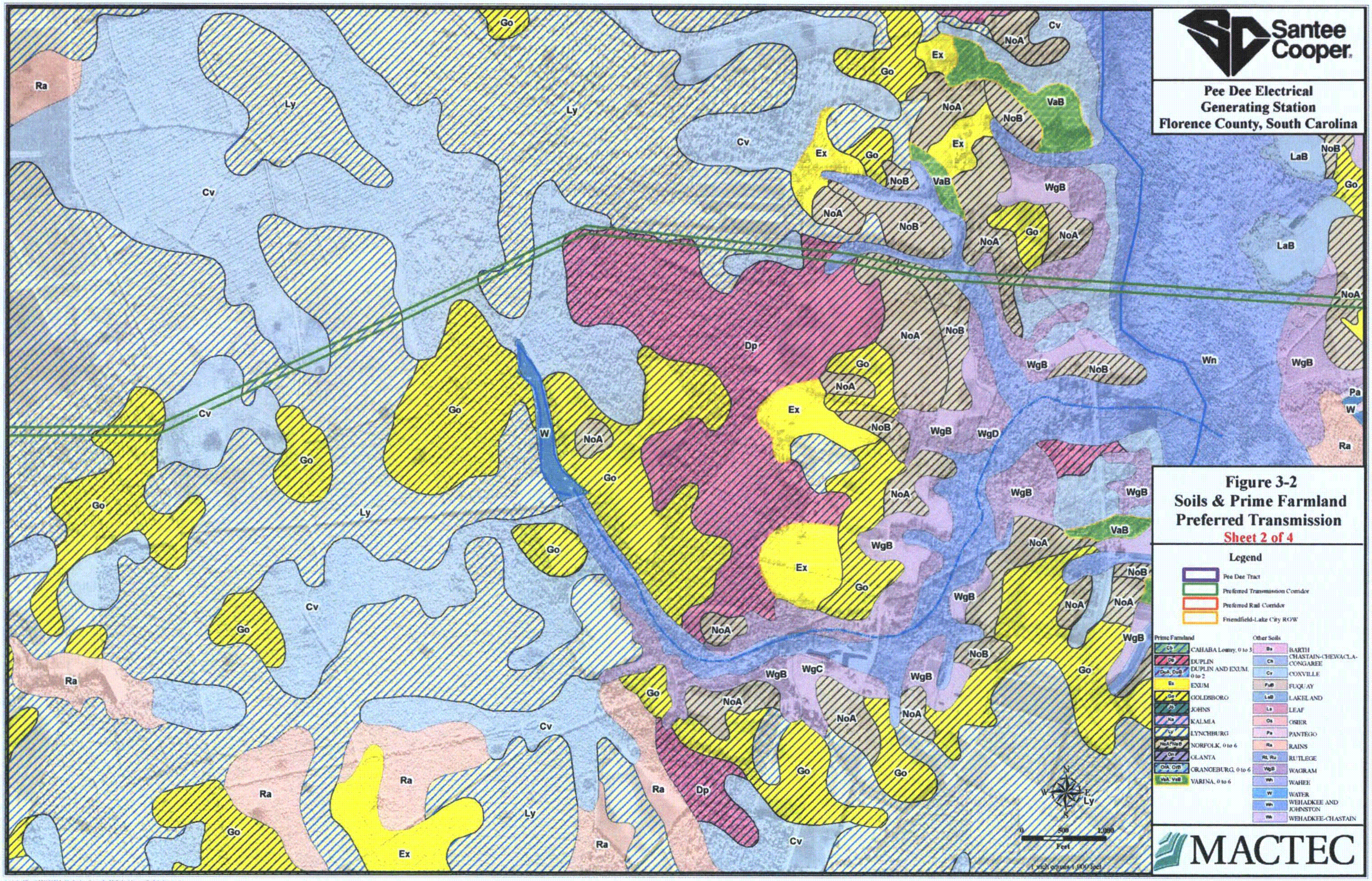

Santee Cooper
Pee Dee Electrical Generating Station
Florence County, South Carolina
Figure 3-2
Soils & Prime Farmland
Preferred Transmission
Sheet 1 of 4
Legend
Pee Dee Tract
Preferred Transmission Corridor
Preferred Rail Corridor
Friendfield-Lake City ROW
Prime Farmland
CAHABA Loamy, 0 to 3
DUPLIN
DUPLIN AND EXUM, 0 to 2
EXUM
GOLDSBORO
JOHNS
KALMIA
LYNCHBURG
NORFOLK, 0 to 6
OLANTA
ORANGEBURG, 0 to 6
VARINA, 0 to 6
Other Soils
BARTH
CHASTAIN-CHEWACLA-CONGAREE
COXVILLE
FUQUAY
LAKELAND
LEAF
OSIER
PANTEGO
RAINS
RUTLEGE
WAGRAM
WAHEE
WATER
WEHADKEE AND JOHNSTON
WEHADKEE-CHASTAIN
MACTEC


Santee Cooper
Pee Dee Electrical Generating Station
Florence County, South Carolina
Figure 3-2
Soils & Prime Farmland
Preferred Transmission
Sheet 2 of 4
Legend
Pee Dee Tract
Preferred Transmission Corridor
Preferred Rail Corridor
Friendfield-Lake City ROW
Prime Farmland
CAHABA Loamy, 0 to 3
DUPLIN
DUPLIN AND EXUM, 0 to 2
EXUM
GOLDSBORO
JOHNS
KALMIA
LYNCHBURG
NORFOLK, 0 to 6
OLANTA
ORANGEBURG, 0 to 6
VARINA, 0 to 6
Other Soils
BARTH
CHASTAIN-CHEWACLA-CONGAREE
COXVILLE
FUQUAY
LAKELAND
LEAF
OSIER
PANTEGO
RAINS
RUTLEGE
WAGRAM
WAHEE
WATER
WEHADKEE AND JOHNSTON
WEHADKEE-CHASTAIN
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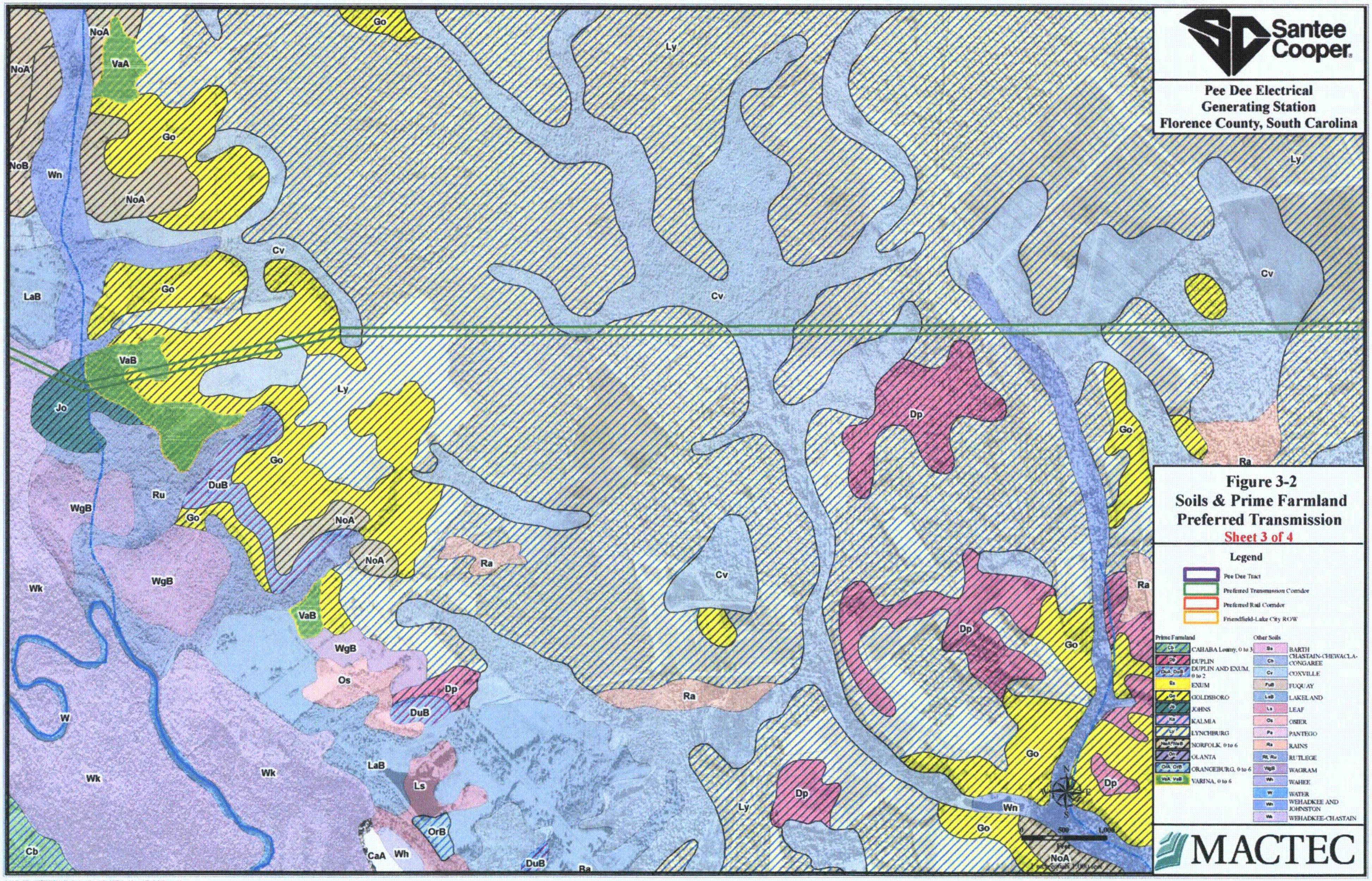
Santee Cooper
Pee Dee Electrical
Generating Station
Florence County, South Carolina
Figure 3-2
Soils & Prime Farmland
Preferred Transmission
Sheet 3 of 4
Legend
Pee Dee Tract
Preferred Transmission Corridor
Preferred Rail Corridor
Friendfield-Lake City ROW
Prime Farmland
CAHABA Loamy, 0 to 3
DUPLIN
DUPLIN AND EXUM, 0 to 2
EXUM
GOLDSBORO
JOHNS
KALMIA
LYNCHBURG
NORFOLK, 0 to 6
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ORANGEBURG, 0 to 6
VARINA, 0 to 6
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BARTH
CHASTAIN-CHEWACLA-CONGAREE
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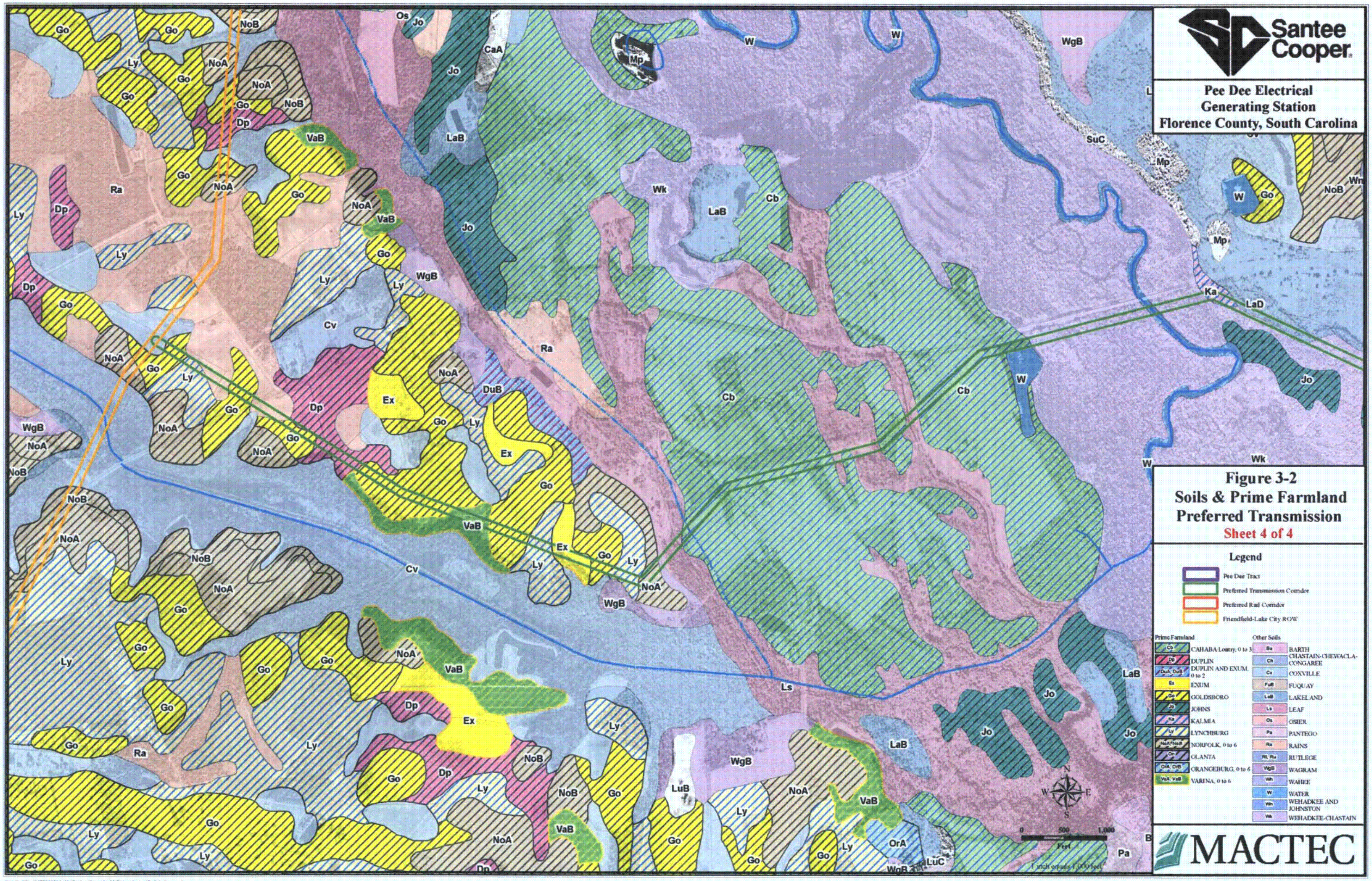
Santee Cooper
Pee Dee Electrical Generating Station
Florence County, South Carolina
Figure 3-2
Soils & Prime Farmland
Preferred Transmission
Sheet 4 of 4
Legend
Pee Dee Tract
Preferred Transmission Corridor
Preferred Rail Corridor
Friendfield-Lake City ROW
Prime Farmland
CAHABA Loamy, 0 to 3
DUPLIN
DUPLIN AND EXUM, 0 to 2
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Other Soils
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WEHADKEE AND JOHNSTON
WEHADKEE-CHASTAIN
MACTEC

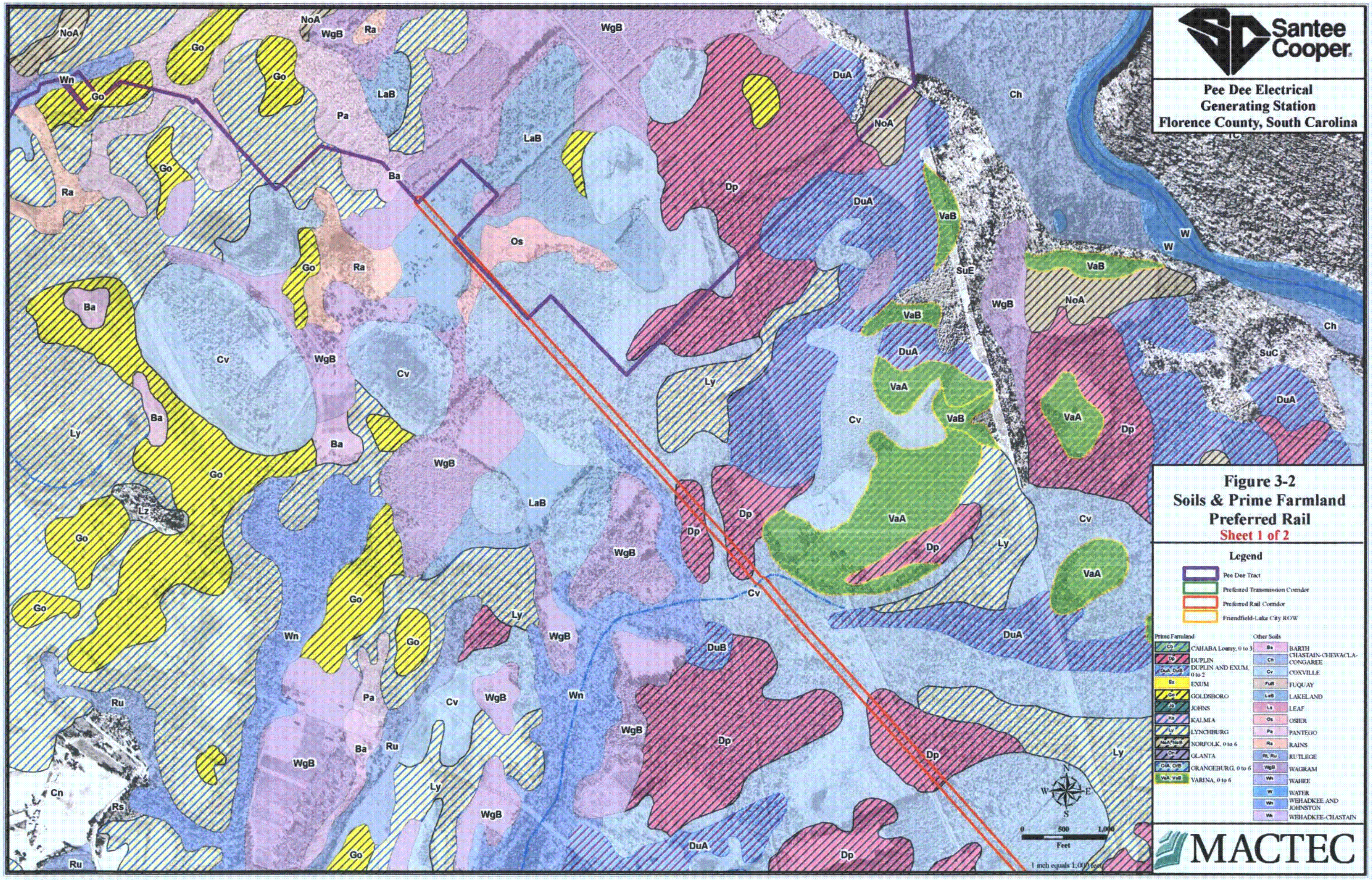
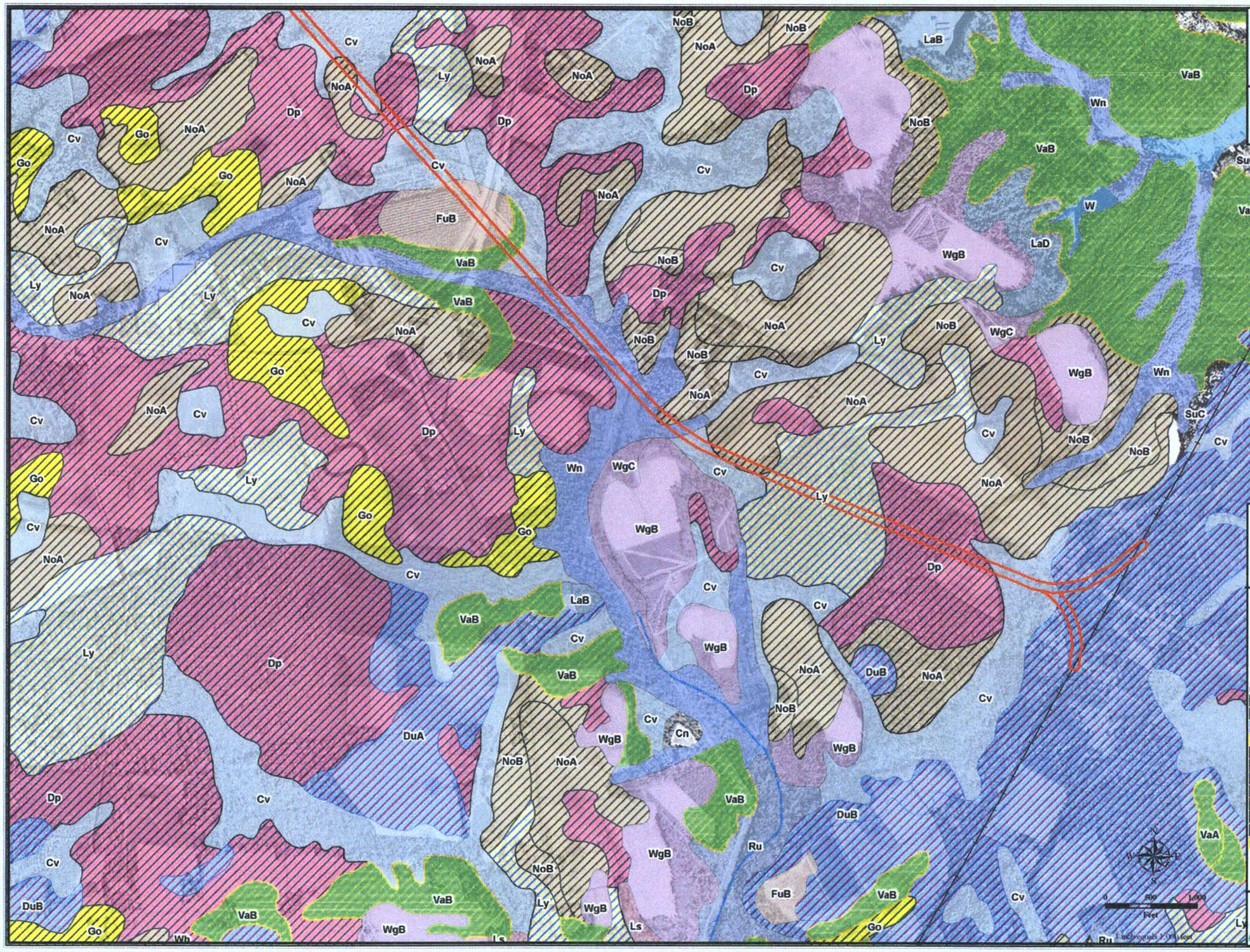


Figure 3-2
Soils & Prime Farmland
Preferred Rail
Sheet 1 of 2



Santee Cooper

Pee Dee Electrical Generating Station
Florence County, South Carolina

Figure 3-2
Soils & Prime Farmland
Preferred Rail
Sheet 2 of 2

Legend

Pee Dee Tract
Preferred Transmission Corridor
Preferred Rail Corridor
Friendfield-Lake City ROW

Prime Farmland		Other Soils	
Cb	CAHABA Loamy, 0 to 3	Ba	BARTH
Dp	DUPLIN	Ch	CHASTAIN-CHEWACLA-CONGAREE
DuA, DuB	DUPLIN AND EXUM, 0 to 2	Cv	COXVILLE
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On	OLANTA	Rt, Ru	RUTLEGE
OrA, OrB	ORANGEBURG, 0 to 6	WgB	WAGRAM
VaA, VaB	VARINA, 0 to 6	Wh	WAHEE
		W	WATER
		Wn	WEHADKEE AND JOHNSTON
		Wk	WEHADKEE-CHASTAIN

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4.0 ENVIRONMENTAL IMPACTS

4.1 Landform, Geology and Soils

Potential impacts to the geologic environment as a result of the construction of the proposed generating station and the transmission and rail corridors include erosion, sedimentation, relocation of soils, topographic changes, variation of existing drainage patterns, and potential loss of mineral resources and prime farmland soils.

The construction of the proposed generating station and ancillary facilities will require both excavation and grading work. Development of the corridors will primarily consist of clearing any existing vegetation in the ROWs and may require additional fill material on either side of the existing railbed. In the performance of this work, vegetation will be removed from each construction area, exposing soils to potential erosion from both precipitation and wind. In order to minimize the potential for erosion of site soils, all excavations, construction grading, and finish grading activities will follow a designed soil sedimentation and erosion control program as part of the Stormwater Pollution Prevention Plan (SW3P). The SW3P will specify the design and construction of grading dikes, ditches, sedimentation basins and/or level spreaders in specified areas to prevent or minimize erosion and sedimentation in receiving waters.

Topsoil and subsoils will be displaced in the construction of the proposed generating station, including several hundred acres of prime farmland soils. Impacts to topsoil and subsoil within the wetland corridors will be negligible as limited excavation will occur during development of these areas. Topsoil will be stripped and stockpiled in designated areas which will be part of a designed soil relocation program, with special attention given to the prime farmland soils. Upon completion of excavated or graded areas, topsoil will be replaced as required or stockpiled for future use during plant operations. Exposed areas will then be seeded and mulched, paved, riprapped, or protected with crushed stone ground cover depending upon the intermediate and ultimate use of the cleared areas. Subsoils displaced during construction of the plant and ash/coal pile runoff ponds and embankments will be utilized as much as possible, with a focus on minimizing stockpiles through balanced cut and fill procedures. Excess volumes of displaced subsoils will be stockpiled as required.

Side slopes formed from excavating plant foundations or disposal of solid wastes, and graded dikes constructed for the ash ponds will be designed to maximize stability. Surface water will be diverted to curtail erosion. Completed slope areas will consist of seeded, mulched topsoil or will be protected with rip rap or crushed stone. In addition, to protect the floodplain and slope forest areas from erosion and sedimentation impacts, a buffer strip will be left undisturbed along portions of the crest of the scarp.

The implementation of these control measures, and any others specified in the SW3P, are expected to minimize erosion and sedimentation during construction activities. As a result, no significant impacts are expected to landform and geology.

4.2 Hydrology and Water Quality

Potential impacts to hydrology and water quality will be directly related to the following: 1) storm water runoff from the construction phase of the project; 2) storm water runoff from storage and process areas during facility startup and operations; 3) withdrawal of makeup water; and 4) discharge of the proposed station's effluent. The Clean Water Act provides that storm water discharges associated with industrial activity from a point source to surface waters must be authorized by a National Pollutant Discharge Elimination System (NPDES) permit. A permit, administered by SCDHEC, will be required for both the construction and operation phase of the project, with conditions reflecting requirements for control measures and discharge limitations.

The NPDES requirements for the plant's wastewater discharge, during operation, will be based on federal New Source Performance Standards and on the criteria for treated sanitary wastewater established by SCDHEC. Site-specific requirements may be included in the permit based on results of analysis performed by SCDHEC. This analysis includes a review of river parameters and loading rates in order to assess potential impacts to the river's aquatic life and may result in additional design criteria for the station in order to minimize such impacts.

The 1983 EA detailed the proposed Pee Dee Station operations and the regulatory programs designed to minimize or avoid impacts to surface water quality that were in effect at that time. The subsections below include a summary of water quality impacts associated with the construction and operation of the plant, and also update the original information contained in the 1983 EA.

4.2.1 Storm Water Runoff

Site preparation and plant construction have the potential for impacting surface water quality because of sediment runoff. The NPDES permit authorizes storm water discharges from construction sites to surface waters, provided that various conditions are met, including the implementation of a site-specific Storm Water Pollution Prevention Plan (SW3P). The SW3P must address how activities for earthmoving, removal and replacement of ground cover, sedimentation, erosion, and dust control operations will be conducted. These control measures are expected to minimize potential impacts associated with sediment and soil erosion during development of the Pee Dee Tract and the transmission and rail corridors. Santee Cooper has obtained the SCDHEC Construction General Permits for these projects. Their permit number for the Pee Dee Electrical Generating Station and the rail corridor is SCR10D512. Their permit number for the transmission corridor is SCR10D515.

During the operation phase of this project, the NPDES permit will also include conditions for implementing a SW3P. The majority of storm water runoff from the plant, including industrial plant yards, immediate access roads and rail lines, material handling sites, shipping and receiving areas, storage areas and tank farms, and the electrical generating building, will be routed to the bottom ash pond. The coal pile runoff pond will route all excess runoff generated within the coal pile and limestone storage areas to the bottom ash pond. The implementation of these facility control measures and other requirements included in the SW3P are expected to prevent significant impacts to receiving waters.

4.2.2 Water Quality Impacts During Construction

There will be no sanitary wastewater discharges from the site during construction of the generating station and ancillary facilities. Portable toilets will be utilized during the construction phase, with the exception of a possible septic tank installed for the construction offices.

Because of the relatively shallow depth to the groundwater table, dewatering of foundation excavations will likely be required during construction. Dewatering will be accomplished using a well point dewatering system. Flow from dewatering operations will be discharged to sedimentation basins which will eventually discharge to tributary streams, including Little Swamp and its tributaries following settling of suspended sediments. This discharge is required to be low in Total Suspended Solids (TSS) before exiting the sedimentation basin and should meet all criteria set forth in the NPDES permit and the SW3P plan.

The transmission line is expected to cross the Lynches River along US 378. However, it is expected that construction can be accomplished by setting the transmission poles on the banks in such a way that runoff will be diverted, and thus not an impact to the river. Transmission poles will not be set in the river channel. Therefore, no impacts to water quality are expected from transmission line construction.

4.2.3 Water Quality Impacts During Operation

Wastewater discharge sources at the station will include the ash pond, cooling tower blowdown, sanitary waste and various low volume sources. Each source will be subject to federal New Source Performance Standard (NSPS) requirements and SCDHEC Water Quality Standards. The NPDES permit for stormwater discharges from industrial activity will include conditions to meet the requirements of these regulations.

The proposed Pee Dee Station will be similar in design and construction to Santee Cooper's electric generating station located in Cross, South Carolina. Historical wastewater effluent characteristics and the NPDES permit for Santee Cooper's Cross facility were reviewed to assess potential wastewater impacts to the Great Pee Dee River. In addition, several meetings and phone conversations were held with SCDHEC to discuss discharge issues and a potential NPDES permit for the project. A comparison of the wastewater effluent analysis from the Cross site with current and proposed effluent standards is shown in Table 4-1. Based on these numbers, the facility should be able to meet the various effluent criteria and in-stream water quality standards.

Mr. Larry Turner of the SCDHEC identified several issues of special concern during a meeting in early 2006 (personal communication, 2006). Issues of special concern identified include the potential increase in the Great Pee Dee River temperature, impacts to the dissolved oxygen (DO) concentrations in the Great Pee Dee River, salt water intrusion impacts to downstream raw water intakes as the result of the Pee Dee Station withdrawal, and mercury discharge into a river that is listed on the states' 303(d) list for mercury impairment. These issues are explored further below. The first three of these issues were addressed using state-accepted models to estimate impacts on the Great Pee Dee River. Mercury discharge effects were addressed using mercury discharge data from the Cross Generating Facility, a power plant of comparable size, located in Cross, South Carolina.

Based on discussions with SCDHEC, the discharge limits for Pee Dee Station will be similar to those in the Cross Station permit with the possible exception of the 5-day Biochemical Oxygen Demand (BOD_5) and ammonia. If the Pee Dee Station has any measurable impacts on the DO concentrations in the river, the NPDES permit requirements for BOD and ammonia and/or DO may be more restrictive.

Table 4-1: Comparison of Relevant Effluent Standards to Santee Cooper - Cross Electric Generating Station

Source / Regulated Parameter[1]	New Source Performance Standards	SCDHEC Water Quality Standards	Min / Avg / Max Analyzed at Cross Facility (2003-2006)
Cooling Tower Blowdown			
Temperature (F)	-	Freshwaters shall not increase by 5° above natural conditions or exceed 90°	43 / 77 / 104
pH (std. units)	6.0 -9.0	6.0 - 8.5	6.2 / 7.7 / 9.0
Chromium (mg/l)	0.2	0.028	No Discharge (ND)
Mercury (μg/L)	-	0.05	0.003 / 0.019 / 0.11
Zinc (mg/l)	1	0.037	0.08 (min) / 0.5 (max)[2]
FAC[3] (mg/l)	0.5	-	0.0 / 0.04 / 0.5
Ash pond			
pH (std. units)	-	6.0-8.5	6.1 / 6.7 / 9.0
TSS (mg/l)	100	Less than 50 NTU turbidity	6/14/37
Mercury (μg/l)	-	0.05	0.01 / 0.15 / 0.74
Manganese (mg/l)	-	0.05	3.32 / 6.4 / 9.5
Sanitary Treatment Plant			
DO (mg/l)	-	Daily average not less than 5.0 with a low of 4.0	3.3 / 8.54 / 16.8
BOD_5 (mg/l)	-	-	2.0 / 9.9 / 29
pH (std. units)	-	6.0 - 8.5	6.5 / 7.7 / 8.8
Ammonia (mg N/l)	-	3.17[4]	0 / 2.2 / 13.0
TSS (mg/kg)	-	Less than 50 NTU Turbidity	4.2 / 15.56 / 45.4
TRC[5] (mg/l)	-	-	0.0 / 0.07 / 0.9
Fecal Coliform (#/100 ml)	-	200	1/8.33/642

Created by: MACTEC

Source: Cross Facility Data is unpublished data provided by Santee Cooper, other sources are cited in reference section.

1. Other parameters that are not listed may be included in the NPDES permit depending on results of SCDHEC's review of the permit application.
2. Zinc data for Cross Facility is from 1997-1998.
3. Free Available Chlorine
4. Calculated based on SC Water Regulation 61-68, using a water pH of 7.1 and a water temperature of 23.5° C.
5. Total Residual Chlorine

The QUAL2e (USEPA/NCASI, 1985) dissolved oxygen computer model was used to analyze the Great Pee Dee River (Appendix F). It was provided by SCDHEC and used to evaluate the impacts of the project discharge on the river's dissolved oxygen resources. Two scenarios were modeled. The first scenario was based on commonly accepted secondary treatment levels while the second scenario was based on increasing the efficiency of the sanitary wastewater treatment by 50%. The suggested discharge concentrations that would be expected for a wastewater treatment facility that provides what is commonly referred to as "secondary treatment" levels are BOD_5 (30 mg/l) and ammonia (20 mg/l). A 1.5 f-ratio (ultimate BOD/ BOD_5) was used for both scenarios. The resulting ultimate BOD (BOD_U) and ammonia concentrations for scenario 1 are 45 mg/l and 20 mg/l, respectively. Scenario 2 BOD_U and ammonia concentrations are 22.5 mg/l and 10 mg/l, respectively. Due to model limitations, only 3 discharge/intake point sources could be specified. However, it is unlikely that the limitations would compromise the results and conclusions. The above sanitary wastewater was modeled using a 0.077 cfs (50,000 gpd) discharge rate. The intake was modeled using the 29 cfs maximum withdrawal. The blowdown and ash pond discharge were combined using a maximum 4.4 cfs discharge with a 3.0 mg/l BODu and 0.5 mg/l of ammonia. The modeling results (Appendix F) indicate that the impact of the withdrawal and combined discharge, using either of the two sanitary wastewater treatment scenarios, would result in lowering the downstream DO by 0.01 to 0.02 mg/l. The reduction predicted by the model is primarily due to a lower river velocity as a result of the station's withdrawal as opposed to the impact of the station's wastewater discharge. This very small decrease would be difficult to measure accurately in the field, and poses *de minimis* adverse impacts to aquatic resources.

SCDHEC's monitoring of the Great Pee Dee River, in the vicinity of the Pee Dee site, indicates trends of decreasing DO and pH, and increasing turbidity and fecal coliform bacteria (Table 3-2). Based on the data contained in Table 4-1 and the results of the model, these parameters are not expected to be significantly impacted as a result of the proposed Pee Dee Station. SCDHEC also reports that the copper and chromium aquatic life acute standard have been exceeded for some of the sampling events on the Great Pee Dee River. Wastewater discharge from the proposed project is not expected to contain detectable levels of copper or chromium.

In spite of several mercury trapping BMPs installed in the combustion units, some amount of mercury will be deposited into the bottom ash pond. Although efforts to reduce mercury release will be taken, some mercury will be carried with the discharge from the bottom ash pond into the Great Pee Dee River. This section of the Great Pee Dee River has a fish consumption advisory for mercury of one meal per month for largemouth bass and bowfin (SCDHEC, 2006). The Great Pee Dee River is also identified on the South Carolina 303(d) list as impaired for mercury and copper (SCDHEC, 2004). Mercury impairment in this reach is specifically related to the fish consumption advisory. Elevated mercury levels have existed in the Great Pee Dee River for at least the past several decades (Harned, 1983).

Santee Cooper collected ten river water samples (nine distinct samples and one duplicate) to analyze for mercury on May 23 and 24, 2006 (Table 3-6). Nine of the ten samples analyzed by General Engineering Laboratories (GEL) were below the detection limit of 0.05 μg/L for the standard method used. These very low levels are consistent with data downloaded from USEPA STORET database, which recorded no detectable mercury (i.e., < 0.05 μg/L) in the Great Pee Dee River during 48 sampling events from 1999-2004. Since mercury has been detected in only one of ten samples collected at the site, and in one of 58 samples collected at the site and adjacent SCDHEC monitoring sites, there is insufficient basis to specifically estimate the concentration in the river water, other than to conclude that it is less than 0.05 μg/L in over 98% of samples analyzed. The average concentration is probably much less than 0.05 μg/L, but a reliable estimate cannot be determined from the available monitoring data.

Mercury is a contaminant of special interest for this assessment. Therefore additional investigation of mercury levels in the Great Pee Dee River was performed through the comparison of the Great Pee Dee River to a comparable watershed, the Middle and Lower Savannah River Watershed. USEPA has undertaken an investigation of mercury in the Savannah River watershed to support development of a TMDL for mercury (USEPA, 2001). Fifteen freshwater segments of the Savannah River were investigated in detail. Table 4-2 summarizes information from these segments, and compares the results with monitored results at the site.

From Table 4-2 it can be seen that concentrations of mercury in fish tissue from the Pee Dee River are within the range observed in the Savannah River, while the average mercury concentration is less than the average concentration in the Savannah River. Similarly, the sediment concentrations in the Great Pee Dee River at the site are within the range of sediment concentrations observed in the Savannah River, while the average is less than the average in the Savannah River. Also the biota/sediment accumulation factor (BSAF) calculated from the fish and sediment mercury concentrations sampled from the Great Pee Dee River at the site, is within the range of BSAFs observed in the Savannah River. Under the assumption that fish tissue, surface water, and sediment concentrations are approximately at equilibrium, it is expected that water concentrations in the Great Pee Dee River at the site are similar to, though perhaps somewhat less than, concentrations in the Savannah River, i.e., approximately 1 ng/L (0.001 μg/L). This is consistent with the observation that 98% of water samples collected from the Great Pee Dee River in the vicinity of the site since 1999 have been less than the detection limit of 0.05 μg/L.

In a meeting with staff from SCDHEC on June 5, 2006, SCDHEC indicated that the Cross Facility discharge data should be similar to what will be expected from the Pee Dee Station. SCDHEC staff present at this meeting included Larry Turner, Erica Johnston, Maria Berry, and Melinda Vickers.

Therefore, by comparing current Great Pee Dee river flows and mercury levels with expected discharge flows and Cross Facility mercury levels, an estimate of mercury loading on the Great Pee Dee River can be determined as a result of discharge from the Pee Dee Station. The average river flow is approximately 10,184 cfs at the site (Table 3-1). The maximum plant discharge is expected to be approximately 4.4 cfs. Mercury discharge data from the bottom ash pond of the Cross Generating Facility (Table 4-1) had an average concentration of 0.15 μg/L total mercury and a maximum value of 0.74 μg/L total mercury for the 2003-2006 monitoring period. Analysis of Great Pee Dee River flow and mercury data, and Cross Facility mercury data indicate that 4.4 cfs containing 0.15 μg/L of mercury mixing into the 10,184 cfs river flow would have a small effect on mercury levels in the Great Pee Dee River (Table 4-3). Under typical conditions, mercury concentrations in the Pee Dee River would increase by approximately 0.1 nanograms (ng) /L. At the maximum estimated mercury release rate and at low flow conditions in the river, Great Pee Dee River mercury concentrations would increase by less than 0.005 μg/L. Assuming the concentration of total mercury in the river is currently about 0.001 μg/L under baseline conditions, as supported by the comparison to the Savannah River, the expected concentration of total mercury would be approximately 0.005 μg/L, or approximately one tenth of the state standard for protection of human health assuming use of water for fishing and potable water supply. The mercury discharge is expected to be predominantly inorganic mercury, which has the potential to slowly methylate in sediments further downstream, but the near-field impact would not be in the methylated form, and therefore not readily susceptible to bioaccumulation or biomagnification in the aquatic food chain.

Table 4-2: Comparison of Mercury Concentrations in the Great Pee Dee River with Concentrations Observed in the Middle and Lower Savannah River Watershed

Water Body	**Fish Tissue[1] (mg/kg)**	**Total Hg, Water (ng/L)**	**MeHg[2], Water (ng/L)**	**Water Fraction MeHg**	**BAF[3] (kg/L)**
Savannah River[6]	0.49 0.07 – 1.27	3.4 0.3 – 9.5	0.16 0.02 – 0.65	0.07 0.01 – 0.19	5E6 7E5 – 1E7
Pee Dee River at Site	0.19	< 50			
	Total Hg, Sediment (ng/g)	**MeHg, Sediment (ng/g)**	**Sediment Fraction MeHg**	**Kd[4] (kg/L)**	**BSAF[5]**
Savannah River[6]	22 3 - 143	0.08 0.00 – 0.58	0.001 0.00 – 0.05	9000 300 - 43000	131 7 – 347
Pee Dee River at Site	8.6				23

Notes:

1. The Savannah River investigation targeted largemouth bass and other fish at trophic level 4. Therefore only catfish data from this investigation were considered comparable, and the Pee Dee summary is based on catfish only.
2. MeHg is methylmercury
3. BAF is biota accumulation factor, specifically Fish Tissue ÷ MeHg, Water
4. Kd is sediment adsorption coefficient, specifically Total Hg, Sediment ÷ Total Hg, Water. Kd was calculated from information provided by USEPA (2001).
5. BSAF is biota/sediment accumulation factor, specifically Fish Tissue ÷ Total Hg, Sediment (dimensionless). BSAF was calculated from information provided by USEPA (2001).
6. Source of Data for Savannah River is USEPA (2001). Information is the average and range for fifteen (15) segments, i.e., the average fish tissue concentration, all segments of Savannah River is 0.49 (mg/kg), and the range was 0.07 to 1.27 mg/kg.

Table 4-3: Mercury (Hg) Loading Rate on the Great Pee Dee River from Plant Discharge

	Great Pee Dee River Hydrologic Conditions	
Plant Discharge	**Average Flow**	**Minimum Flow of Record**
Average Hg release (µg/L) (% of standard)	0.0001 (0.13%)	0.0009 (1.9%)
Maximum Hg release (µg/L) (% of standard)	0.0003 (0.63%)	0.0047 (9.3%)

SOURCE: GEL Labs, USGS

There is the possibility at the proposed station that the cooling tower blowdown will be directly discharged into the River. In an attempt to create the 'worst case' scenario, the mercury concentrations from the cooling tower blowdown should be incorporated into the calculations. The cooling tower blowdown at the Cross Generating Facility is routed to the bottom ash pond. Therefore, the data that was used from the Cross Generating Facility incorporated both the mercury from the cooling tower blowdown and the mercury from the ash pond into the calculation. This represents the most accurate way to determine 'worst case' scenario. Also, it should be noted that the mercury concentrations in the cooling tower blowdown at Cross Generating Facility are approximately 1% of the concentrations in the ash pond.

Mercury speciation was not analyzed as a part of this project. It is well established that Total Mercury, the species measured in this study and monitored in the discharge water at the Cross Generating Facility, is less toxic to animal receptors than methylmercury (reviewed in Scheuhammer, 1987; USEPA, 1993 and others). However, measuring Total Mercury data are useful and relevant because state criteria are for Total Mercury (SC Regulation 61-68).

The estimated concentrations of total mercury do not exceed aquatic life toxicity thresholds. Fish-eating wildlife may be exposed to potentially toxic levels of mercury in this system (per wildlife criteria developed by EPA's Great Lakes Initiative; USEPA, 1993).

The state of South Carolina is in the process of developing TMDLs for listed water bodies in South Carolina. The Great Pee Dee River, as well as all the other water bodies in the state with fish consumption advisories due to mercury, is listed on the State's 303(d) list as impaired due to the levels of mercury in fish tissue. It is anticipated that this TMDL will result in not allowing any additional impediment due to mercury, and an allocation of the mercury load reductions to existing and future mercury contributors.

Once the mercury TMDL is implemented, through target waste load allocation reductions for NPDES permit holders and through load allocation reductions for non-point sources, it is anticipated that Santee Cooper will be required to adhere to stringent BMPs in response to this requirement in order to prevent potential new releases of mercury from the proposed facility.

SCDHEC is also addressing point source discharges through the NPDES Program, having issued 115 permits requiring mercury monitoring and 13 with mercury discharge limitations (SCDHEC, 2006b). In some cases where there is a known source of mercury, SCDHEC is requiring Mercury Minimization Plans. The NPDES Permit for the Pee Dee Station is expected to require mercury monitoring, possible mercury limitations, and a Mercury Minimization Plan. SCDHEC is also addressing non-point sources of mercury through the Storm Water NPDES Program, requiring BMPs to control storm water runoff, and in some cases, requiring mercury monitoring.

The USEPA has proposed a cap and trade program for mercury (CAMR) as opposed to specific limits on mercury emission sources (USEPAf). Based on USEPA material published in support of CAMR, USEPA clearly believes mercury is a regional problem in their support of the trading plan. Air emissions from the Pee Dee Station units will be subject to CAMR in addition to the mercury limits listed in Subpart D of the New Source Performance Standards (Mike Harrelson, personal communication, 2006).

Currently, the SCDHEC in-stream mercury criteria of 0.05 μg/L is used as the basis for most new NPDES permits issued in South Carolina (Amy Bennett, personal communication, SCDHEC, 2006). This value is approximately three times lower than current mercury discharge rates at the Cross Generating Facility. To comply with SCDHEC regulations, the proposed facility process must reduce estimated mercury discharges. To do this, Santee Cooper may be required to implement BMPs to reduce mercury discharge from the bottom ash pond. Identification of the exact source and speciation of mercury will help focus options, but considerations such as the source of coal, and improving bottom ash pond management techniques may help reduce mercury in the system.

Manganese is a non priority pollutant with a water quality standard of 0.05 mg/L (SCDHEC, 2004). This criterion is not based on toxic effects but rather on objectionable aesthetic qualities such as laundry staining and objectionable tastes. Data from the Cross Generating Facility show discharge concentrations of total manganese that are over 100 times the standard (Table 4-1). Because of this, manganese was evaluated to determine if it would be present at potential effect levels after construction. Santee Cooper collected water samples from the Great Pee Dee River, ten samples to analyze for total manganese and six samples for dissolved manganese, on May 23 and 24, 2006 (Table 3-6). These samples were analyzed by GEL and contained an average of 71.53 μg/L total manganese and 6.00 μg/L dissolved manganese. These concentrations are consistent with data downloaded from the USEPA STORET database, which indicate an average concentration of 109 μg/L total manganese measured in samples from the Great Pee Dee River near the site between 1999 and 2004. If two outliers from the STORET dataset are disregarded (values of 1100 and 830 μg/L), the STORET data set average is 71.11 μg/L total manganese. These concentrations are already above the state standard of 0.05 mg/L (50 μg/L).

Discharge data from the Cross Generating Facility (Table 4-1) report an average concentration of 6.43 mg/L total manganese and a maximum value of 9.46 mg/L for the 2005 through 2006 period. Analysis of Great Pee Dee River flow and manganese data, and Cross Facility manganese data indicate that manganese levels in the Great Pee Dee River would increase substantially under low flow conditions (4.4 cfs of discharge water containing 6.43 mg/L of manganese mixed into the 691 cfs river volume). Under such low-flow conditions the average manganese concentrations in river water would rise to 111.8 μg/L. Under average flow conditions, Great Pee Dee River manganese concentrations increase by less than 6% (Table 4-4). Under conditions of severe low flow and maximum release, manganese concentrations would increase by approximately 83% (Table 4-4). The manganese loading estimates listed below are for total manganese. The values are well within the range of typical surface water manganese concentrations found in the United States, where levels in freshwater typically range from 1 to 200 μg/L (USEPA, 2004).

Table 4-4: Total Manganese (Mn) Loading on the Great Pee Dee River from Plant Discharge

Plant Discharge	Pee Dee River Hydrologic Conditions: Average Flow	Minimum Flow of Record
Average Mn Release (µg/L) **(% increase in Mn levels)**	74.3 (3.8%)	111.8 (56.2%)
Maximum Mn Release (µg/L) **(% increase in Mn levels)**	75.6 (5.7%)	130.9 (83.1%)

SOURCE: GEL Labs, USGS

The state currently has a criterion for total manganese in freshwater of 0.05 mg/L (Table 4-1). This criterion is a non-priority standard and is not based on toxic effects but rather on objectionable aesthetic qualities such as laundry staining and objectionable tastes. The concentrations present in the Great Pee Dee River, while the Pee Dee Station is operating, could be up to 2.5 times the current standard of 50 µg/L during extreme conditions.

A literature review on the aquatic toxicity of manganese indicated that hardness influences the toxicity of manganese. Manganese is more toxic in "soft" waters with low hardness, like the Pee Dee River. Hardness was measured at six sampling locations in the 2006 monitoring study, and an average hardness of 31.3 mg/L was found (Table 3-5). One evaluation of chronic toxicity of manganese in freshwater species was completed by Reimer (1999) and reported a chronic toxicity relationship between manganese and hardness of:

Manganese chronic toxicity value in mg/L = (0.0176 * hardness in mg/L) + 2.42

Although Reimer's chronic toxicity value was derived mostly for coldwater species, the general lack of literature on the toxicity effects of manganese allow limited opportunities to compare toxicity effects. So, if we assume that the hardness in the Great Pee Dee River at the site is 31.3 mg/L, the chronic effects level for manganese would be 2.97 mg/L. In-stream concentrations measured in the 2006 survey were over an order of magnitude lower than that (see Table 3-6). Expected in-stream concentrations once the plant is in operation are expected to also be over an order of magnitude lower than the chronic aquatic toxicity value (see Table 4-4). Therefore manganese is not expected to pose a threat to aquatic life once the plant is operational.

Although unlikely, it is possible that trace amounts of herbicides may make their way into the Lynches River system at the Transmission Corridor crossing, once the Pee Dee Station is in operation. According to Santee Cooper's (2005b) ROW management program, "*In areas that have standing water and are connected to a larger aquatic system (e.g. river, swamp, etc.), only EPA approved herbicides registered for use in wetland or aquatic sites are used.*" Therefore, it is assumed that herbicide impacts in the Lynches River system will be negligible.

4.2.4 Water Temperature Impacts

The maximum discharge from the generating station with two units in operation is expected to be approximately 4.4 cfs. The station's discharge is composed primarily of cooling tower blow down (1.55 cfs) and decanted ash pond discharge (2.85 cfs). Although these waters will normally be returned to the Great Pee Dee River through a single discharge pipe, the Station will be designed with the option to directly discharge the blowdown into the river. The discharge structure will be located on the south shoreline of the river approximately 200 feet downstream of the intake structure. The thermal effluent jet will discharge horizontally at a right angle to the direction of river flow (1983 EA).

The potential impact of waste water discharge on river water temperature is a function of: 1) the station's combined discharge temperature and flow rate; 2) the river water temperature and flow rate, and 3) the mixing (thermal dissipation) characteristics of the station's discharge plume within the river. The average and extreme temperatures of combined discharge of the cooling tower blowdown and ash pond discharge was determined in the 1983 EA. That analysis included a determination of the station's combined discharge temperatures on a monthly basis and the Great Pee Dee River's mean maximum and mean minimum monthly temperature to obtain comparisons.

SCDHEC criteria for freshwater river water temperature allow for a mixing zone for thermal discharges, in which the mixing zone edges (i.e., at unaffected river water) cannot exceed a specified temperature. The criteria are based on a variety of factors, including biological, chemical, engineering, hydrological and physical. The areal extent of the allowed mixing zone is based on the river cross sectional width at the point of discharge. The maximum mixing zone width allowed by SCDHEC is one-half the river's width and the maximum longitudinal length is two times the river's width. The river is approximately 250 feet wide at the proposed discharge, making the allowable mixing zone 125 feet wide and 500 feet long.

CORMIX (MixZon, 1993) was used to analyze the mixing zone associated with the proposed Pee Dee Station maximum blowdown discharge (1.5 cfs). The report contained in Appendix F details an analysis of the mixing zone (plume) characteristics, including mixing zone surface area and depth, and time and distance for various isotherms to reach various temperatures. Results of the analysis indicate that less than 25 feet downstream the average plume will have mixed with the river water so that the resulting downstream water temperature is within 5° F (2.8° C) of the upstream water temperature. The maximum plume temperature in the mixing zone is expected to be 95.0° F with the highest temperature differential between the plume and ambient river expected to be 16° F, both at the point of discharge. These temperatures meet the state temperature criteria for freshwater and are not expected to cause an appreciable adverse effect on water quality or aquatic biota (Section 4.3.4).

4.2.5 River Water Use

The average makeup water withdrawal rate for the two units will be approximately 29 cfs and will be supplied from a common intake structure to be constructed along the Great Pee Dee River shoreline, about 200 feet upstream from the existing Bostick Boat Ramp. The average discharge from the generating station with two units in operation will be approximately 4.4 cfs and will be returned to the Great Pee Dee River through an above referenced discharge pipe located about 200 feet downstream of the existing Bostick Boat Ramp.

The operation of the cooling system for the proposed two units requires the diversion of a small percentage of the flow available in the Great Pee Dee River for makeup purposes. The difference between the maximum makeup and discharge rates is approximately 25 cfs, and represents a net loss of water from the river. This withdrawal quantity is considered relatively low, even when compared to the river's low flow of record (Table 4-5). River flow data is from USGS Gauge Station 02131000, approximately 25 miles upstream from the proposed Pee Dee Station. The watershed at Gauge Station 02131000 is slightly smaller than the watershed at the proposed site (approximately 4% smaller), so the values from the USGS Gauging Station have been increased by 4% (as in Table 3-1). At minimum flows, the net station withdrawal is less than 4% of the total river flow. During periods of average flow, it only comprises 0.25% of the river flow (Table 4-5).

Table 4-5: Estimated Station Intake and Discharge Effects on Great Pee Dee River Flow (using USGS Station 02131000 Data)

Hydrologic Event	Upstream River Flow (cfs)	Station Withdrawal Flow (%)	Remaining River Flow (cfs)	Station Discharge Flow (%)	Downstream River Flow (cfs)
Minimum Flow of Record	691	4.2	662	0.7	666
7-day 10-year low flow at site	1,727	1.7	1,698	0.3	1,702
Average Flow	10,184	0.3	10,155	0.04	10,159
Maximum Flow in Past 25 Years	101,400	0.03	101,371	0.004	101,375

Source: USGS Gauge Station 02131000, 1980-2005
1. Flow values have been increased by 4% to account for the increase in watershed size at the site vs. USGS Station 02131000.

The municipalities located downstream are affected by the upstream flows in the Great Pee Dee and Waccamaw Rivers. In the late 1990's and early 2000's, some downstream municipalities experienced salt water intrusion resulting from 1) low flows in the upstream watersheds, and 2) meteorological conditions that resulted in extended periods of higher than normal tidal elevations. As a result of these droughts, a computer model was developed to assist the users of the Great Pee Dee River with evaluating and managing their water resources. This model, called the Pee Dee River and Atlantic Intracoastal Waterway Salinity Model (PRISM; USGS *et al.*, 2005), is discussed in more detail in Appendix F. It was used to evaluate the downstream effects of the 29 cfs Pee Dee Station maximum withdrawal.

PRISM correlates total upstream river flow to downstream specific conductance at nine U.S. Geological Survey (USGS) gauges. USGS Station 02110815 is the most downstream gauge and is often used to measure the resulting impact from low river flows. The results of the model indicate that the specific conductance (a measure of salt water concentrations) would have increased, on average, 26 μmhos during the 1995 through 2002 simulation period at USGS Station 02110815 if the proposed Pee Dee Station had been in operation. The maximum specific conductance increase over this time period at USGS Station 02110815 was 327 μmhos/cm. The median increase at all nine USGS gauges is 1 μmhos for the simulation period.

These average and median increases represent less than a one percent change in the measured specific conductance. See Appendix F for more discussion and modeling results for the PRISM model.

4.2.6 Sediment Quality Impacts

Construction related impacts on sediment quality are expected to be fairly minimal and mostly related to the potential input of additional sediments associated with stormwater runoff during the land-clearing phases. However, implementation of erosion-control BMPs and a SW3P should minimize potential impacts to the river sediments.

Sediment quality impacts from the operation of the proposed facility would mainly be expected to occur as elevated metal concentrations in the sediments from discharge-borne inputs. Current metal concentrations in the sediment in the Great Pee Dee River (Table 4-6) have relatively high amounts of several metals, including manganese, mercury, and zinc. Implementation of pollution-control and stormwater management requirements associated with the NPDES permits should help to minimize future impacts to river sediments.

Table 4-6: Metal Concentrations in Great Pee Dee River Sediment

Analyte	Unit	Value
Arsenic	mg/kg	2.02
Cadmium	mg/kg	0.144
Chromium	mg/kg	9.36
Chromium (Hexavalent)	mg/kg	0.0569
Copper	mg/kg	3.89
Lead	mg/kg	2.69
Manganese	mg/kg	373
Mercury	ug/kg	8.63
Nickel	mg/kg	4.41
Selenium	mg/kg	0.811
Zinc	mg/kg	20.1

Source: Santee Cooper, General Engineering Laboratories, 2006

The impact of metals on sediment quality is largely influenced by the speciation of the metals in the water column. Dissolved metals tend to affect sediment quality less than suspended metals that may settle out quickly when water velocity decreases. The in-stream velocities near the proposed Pee Dee Station are fairly swift, indicating that the trace concentrations of metals that will be discharged are likely to disperse over a great distance downstream, which will minimize the chance of adverse impacts. The discharge water dataset from Santee Cooper's Cross Generating Facility, that was used to help derive reasonable assumptions for this EA, does not include results from dissolved metals analyses. Thus, inferences about the proportion of total metals which are actually dissolved into the effluent cannot be drawn in this regard.

Bioaccumulation/sediment factors (BSAFs) can also be calculated for interactions between the sediment and fish, especially for bottom dwelling fish such as catfish. The direct measures (from May 2006) of total mercury in sediment and a resident fish species with a high trophic level diet (blue catfish), allows for site-specific estimates of BSAFs (see Table 4-2 where site-specific BSAFs were compared with BSAFs observed in the comparable Savannah River watershed). The project is not expected to significantly increase concentrations in surface water or sediments near the site, although a small increase may occur.

The transmission line is expected to cross Lynches River along US 378. However, it is expected that construction can be accomplished by setting the transmission poles on the banks in such a way that runoff would not be an issue. Transmission poles will not be set in the river channel. Adherence to the project specific SW3P should eliminate potential impacts to sediment quality during transmission line construction.

4.3 Biological Resources

4.3.1 Wetlands Impacts

Jurisdictional waters of the U.S. including wetlands were defined and summarized in Section 3.3.1 (wetlands) and Section 3.3.4 (aquatic resources). This section addresses the impact of the proposed facility on jurisdictional and non-jurisdictional waters of the U.S., including wetlands. Impacts will fall into four main categories as defined by the USACE: Fill, Clear, Dredge and Armor. "Fill" refers to depositing material used for the primary purpose of replacing an aquatic area with dry land; "Clear" refers to removing vegetation without disturbing the existing topography of the soils; "Dredge" means to dig or excavate; and "Armor" means to use rigid methods such as riprap to contain stream channels.

The wetlands on the Pee Dee Tract are shown in Figure 3-4. A recent delineation and survey by Newkirk Environmental has been submitted to the U.S. Army Corps of Engineers for approval (see request for determination in Appendix D). Based on this recent wetland survey, constructing the generating station (within the Pee Dee Tract) will impact approximately 17.59 acres of jurisdictional wetlands (Table 4-7) and 8.09 acres of non-jurisdictional wetlands. These impacts include a total (both jurisdictional and non-jurisdictional) of 15.22 acres of fill (including 0.04 acres for bedding and backfill, and 0.68 acres for excavation) and 10.46 acres of vegetation clearing (see Table on Figure 1-10).

Table 4-7: Expected Impacts (Acres) to Jurisdictional Wetlands

	Clearing Impacts	Acres Filled	Total 404 impacts	Total 404 wetlands on site
Pee Dee Tract	8.25	9.34*	17.59	443.66
Preferred Transmission Corridor	58.68	0.00	58.68	58.79
Preferred Rail Corridor	4.90	4.49	9.39	18.50
Total	**71.83**	**13.83***	**85.66**	**520.95**

Source: MACTEC, 2006
*Includes 0.04 acres for bedding and back-fill, and 0.09 acres excavated

The Transmission Corridor will impact approximately 58.68 acres of jurisdictional wetlands. No impacts to non-jurisdictional wetlands on the transmission corridor are expected. There will be no fill impacts associated with the Transmission Corridor, only vegetation clearing impacts.

In anticipation of the project, Santee Cooper has prepared a SW3P for construction of the new transmission line (S&ME, 2006). For the purposes of this report it is assumed that the construction sequence will include:

1) tree topping / removal of large canopy trees and saplings via standard forestry practices;
2) trimming / clearing of lower growing vegetation, and
3) embedding new poles into augered holes and/or vibratory caissons, which may then be stayed with guy wires.

During transmission line construction, it is Santee Cooper's stated preference (S&ME, 2006; and Santee Cooper, 2005a) that: grubbing be avoided if at all possible; no clear-cutting occur in wetlands; natural short-shrubby vegetation be preserved; land contours be left in-tact; and that work in wetlands be accomplished by hand if at all possible, and if not possible, then only with high flotation rubber tired and tracked vehicles.

Management of the right-of-ways (ROW) is accomplished via an *Integrated Vegetation Management* approach (Santee Cooper, 2005b). This typically includes:

1) mechanized and manual re-clearing at 2-3 year intervals
2) herbicide applications via selective, low volume methods using only compounds approved by the USEPA for the particular upland or wetland habitat to be treated
3) tree maintenance via removal of "danger trees" outside the ROW and/or side-trimming of encroaching limbs
4) erosion control when needed via a variety of methods including grading, terracing and planting
5) regular inspections for early identification of potential problems

Santee Cooper's ROW maintenance program will likely improve over the years that the proposed transmission line is in operation as new technologies and best practices become available.

The SW3P for the transmission line construction portion of this project (S&ME, 2006) states that:

> *"The crossing of wetlands will have minimal environmental impact and does not require an Army Corps of Engineers (ACOE) 404 permit. Instead the approval for work may be granted under Section 10 of the CWA and a letter of permission issued by the ACOE. .... No grubbing, land disturbance, filling or alterations are planned, only trimming of vegetation and tree cutting will be performed at wetland areas in order to provide suitable space for the electrical distribution lines. High flotation rubber tired and track vehicles will be used in completing the work to minimize the disturbance in wetland areas. Trees and vegetation will be cut to three (3) inches above the ground and root mats left in place to maintain soil stability. Soil removal and alteration will be kept to a minimum."*

Furthermore, wetland protections methods are written into the contracts that will be awarded to the construction firms (Santee Cooper, 2005a). It is expected that the classification of the cleared wetlands in the transmission corridors may change as the plant community is forcibly modified. However, they will still be functional wetlands. These wetland changes may be regulated under the USACE Section 404 permit process because the new transmission line is tied to the larger Pee Dee station.

Transmission line maintenance may involve vegetation management in wetlands. When possible that will be accomplished by hand. Ground crews may travel within wetlands using All Terrain Vehicles (ATVs). Foliar treatment with selective low volume herbicides may also be used in wetland areas. Only EPA-approved herbicides registered for use in wetlands will be used (Santee Cooper, 2005b). Thus, it is expected that there are unlikely to be significant impacts to wetlands associated with maintenance of the ROW for the transmission line.

Jurisdictional wetland impacts associated with the Rail Corridor will include approximately 4.49 acres of fill and 4.90 acres of vegetation clearing. The impact areas for the rail are based on a 60-foot wide cleared corridor and typical cross sections. There are no non-jurisdictional impacts along the Rail Corridor.

The wetlands at the intake and discharge points consist of a narrow fringe of floodplain wetlands near the edges of the existing boat ramp. The banks of the river are steep and give way to the open water of the Great Pee Dee River in a short distance. This floodplain wetland on the Pee Dee Tract, consists of the jurisdictional wetlands below the 33 foot elevation contour that will be impacted by the installation of the intake and discharge structures based on the original permit design. The total area of wetland impact will consist of an estimated 0.53 acres to include 0.49 acres of fill and 0.04 acres of backfill and bedding for intake and discharge pipes). Stream impacts to the Great Pee Dee River will be an estimated 372 linear feet of river bank modification, including a 42 foot long intake structure, an additional 300 feet of riprap associated with the intake structure (100 linear feet of riprap upstream and 200 linear feet downstream of the intake structure), and a 30 foot section of riprap associated with the discharge structure. The intake will extend 30 feet into the river channel, the discharge will extend an estimated 85 feet into the channel.

The 100 foot wide Transmission Corridor will cross floodplain wetlands associated with Big Swamp and the Lynches River. Clearing impacts to bottomland hardwood and cypress-tupelo forests will occur at these locations. There will be no impacts to open water habitats.

An estimated 23 isolated non-jurisdictional wetlands occur throughout the Pee Dee Tract. These depressions range in size from 0.09 acre to 6.7 acres. The layout of the current proposed facility will impact ten of these isolated depressions, all of which are less than one acre in area.

Jurisdictional, non-alluvial swamp and hardwood depression type, wetlands on the Pee Dee Tract will be impacted by construction of the bottom ash ponds, solid waste landfills, cooling towers, gypsum storage/stockpiles, and rail and transmission lines that occur within the Pee Dee Tract boundary. Impacts to these wetlands are unavoidable due to the large footprint of this facility, the economy of the facility's size, and the need to have support structures as close to the main plant as possible (Figure 3-4).

4.3.2 Vegetation

4.3.2.1 Direct Losses of Vegetation from Construction

Initial construction of plant facilities and phased development of the facility over the life of the station will ultimately result in the loss of approximately 1,245 acres of various plant community types within the Pee Dee Tract, primarily consisting of forested areas. The majority of natural, semi-natural or cultivated landcover types to be ultimately impacted by removal consists of pine plantation, pine forest, hardwood forest, mixed forest and agricultural or wildlife fields. However, clearing and development of land for bottom ash and solid waste landfills will proceed in a phased approach. Dikes, berms and landfill caps will be covered with soil and grassed, once the disposal areas have reached capacity.

Initial construction of the transmission line will ultimately result in the loss of approximately 144 acres; mostly of pine plantation, pine-hardwood forest, forested wetland and agricultural fields. Reestablishment of the rail corridor will result in the loss of approximately 31 acres; primarily consisting of pine plantation, pine-hardwood forest, forested wetland and agricultural fields. The land under the transmission line and adjacent to the rail line will be maintained in an early successional grassland or shrub/scrub vegetation (via mechanical mowing and herbicide applications), or agricultural fields.

The removal of forested landcover types is expected to have little overall impact on Florence County timber resources. Florence County occupies 512,200 acres, of which about 270,000 acres are forest, mostly in private ownership (S.C. Statistical Abstract, 2005). The loss of approximately 1,420 acres of forest (minus some agricultural acreage) on the site thus represents less than 0.5% of the county's woodlands. In addition, the value of site timber resources is about average relative to the region. Merchantable timber that exists in areas to be cleared has been sold by Santee Cooper and harvesting operations are nearing completion. Remaining woody vegetation will be disposed of by methods such as chipping for use in soil stabilization and revegetation operations, firewood, and/or by other environmentally appropriate methods.

The removal of row crop areas is expected to have an even smaller overall impact on Florence County agricultural resources. Florence County occupies 512,200 acres, of which about 170,000 acres are farmland (S.C. Statistical Abstract, 2005). The development of the site will include minimal amounts of lost farmland (less than 300 acres), representing less than 0.2% of the county's farmland. In addition, the value of the row crops located on the site is about average relative to the value of row crops in the region.

The majority of landcover types that will be lost including pine plantation, pine forest, mixed forest, agricultural field, appear to be common in the region. In addition, several large tracts of forest on the 2,709 acre tract, including the floodplain forest and slope forest along the Great Pee Dee River and the bottomlands and slope forest associated with the Bullock Branch ravine, will not be subject to site clearing operations. These forested tracts include some of the most valuable vegetation on the site from a natural resources standpoint.

A significant direct loss of vegetation will be from clearing and permanent alteration of the diverse Hardwood Forest landcover type that is adjacent to the river bluff for the construction of future ash ponds and future solid waste landfills northeast of Old River Road, should the need for them occur. A good example of this landcover type, known as an Oak-Hickory plant community, is rare due to forestry and agriculture pressure (Nelson, 1986). This highly productive mature forest at the site shows a lack of human disturbance due to the presence of canopy oaks, hickories and other trees that range between 1.5 to 3.0 feet in diameter at breast height, and a diverse, well-developed understory that includes several species of blueberry, sparkleberry, witch hazel, chinquapin, redbud, horse sugar, hound's tongue and others.

The current project plan does not include development of the Slope Forest landcover type other than limited clearing of this vegetative type for the construction and placement of the river intake and discharge structures and associated piping. This slope forest supports a well developed and unusually diverse forest, which can be described as a mesic mixed hardwood and marl forest that is unique to the Coastal Plain. The major impact to this landcover type will be from the clearing of the adjacent hardwood forest associated with the construction of future ash ponds and future solid waste landfills northeast of Old River Road, should the need for them occur. Negative edge effects from habitat fragmentation would include increased light in the understory, increased temperature, decreased moisture, invasion of pioneering or invasive species, and changes in animal-plant interactions, all of which will affect the ecology of this plant community. Changes in hydrology from impervious ash ponds and landfills could also adversely affect several seepage wetlands and springs along the base of the river bluff.

A decrease of plant species diversity in the region as a result of the elimination of portions of the site's pine plantation, pine forest, mixed forest, and agricultural field communities during construction is not expected as a result of this project. These on-site landcover types (not including the slope forest) cover large areas of Florence County and are common in the Coastal Plain.

The loss of Hardwood Forest landcover types on-site, in areas northeast of Old River Road, are more likely to affect species diversity in the region due to edge effects this will have on the adjacent slope forest. The hardwood forest on-site is an excellent example of an Oak-hickory plant community. The loss of this hardwood forest landcover combined with the indirect impacts to the slope forest community could have an impact on overall plant species diversity in the region.

To manage right-of-way vegetation, Santee Cooper uses an approach called Integrated Vegetation Management. During the construction phase this will include:

1) tree topping/removal via standard forestry practices,
2) some stump removal and grubbing when necessary,
3) shrubby vegetation trimming and clearing,
4) localized (stump) treatment with herbicides to prevent sprouting,
5) active erosion control measures if deemed necessary, and
6) regular inspections of contractor's work by Santee Cooper staff.

Some forested lands will be converted to an open vegetation habitat as a result of transmission line construction. That land cover change is unavoidable. However, given the high proportion of forested landcover in the county and region, the acres to be converted for this project are minimal.

4.3.2.2 Changes in Species Composition

Forest communities remaining on the border of areas to be cleared for construction, previously in woodland interiors, can be expected to undergo some changes in species composition as a result of increased exposure to sunlight and other factors mentioned above. Such changes will be most evident in the herbaceous and shrub layers, with the invasion of shade-intolerant species, some of which are common weeds including non-native invasive species. Species likely to invade these newly created edge habitats include Japanese honeysuckle (*Lonicera japonica*), blackberries, trumpet creeper, and others depending upon the soil conditions and other habitat variables. Changes in the woodland buffer strips left in place along roadways and similar areas will probably be less pronounced, since a high incidence of shade intolerant species are already present. None of the terrestrial weedy species expected to benefit from site clearing holds a high nuisance potential in the context of land use changes within the project's disturbance footprint.

To manage right-of-way vegetation, Santee Cooper uses an approach called Integrated Vegetation Management. During the operation phase this will include:

1) mechanized and manual re-clearing at 2-3 year intervals
2) herbicide applications via selective, low-volume methods
3) tree maintenance via removal of "danger trees" outside the ROW and side-trimming encroaching limbs
4) regular inspections for early identification of potential problems

Some previously forested lands will be converted to an open vegetation habitat as a result of transmission line maintenance. That land cover change is unavoidable. However, given the high proportion of forested landcover in the county and region, the acres to be converted for this project are minimal.

4.3.2.3 Erosion and Soil Moisture

Erosion potential over most of the site area is minimal due to the generally high permeability of soils, flat topography, and appropriate planning. Also, erosion and sedimentation control devices and practices, incorporating timely revegetation of disturbed areas, will be applied throughout the site during the development of the facility. Possible exceptions to this are the ravines, drainages, and seeps associated with the river bluff above the floodplain. These areas in particular, as well as the floodplain, are susceptible to erosion or decreased soil moisture resulting from increases in stormwater runoff and less permeable surfaces resulting from landuse alterations northeast of Old River Road.

4.3.2.4 Impact on Federal Protected Plant Species

As noted in Section 3.3.2.4, two plant species of federally endangered status, Canby's drop-wort (*Oxypolis canbyi*) and American chaff-seed (*Schwalbea americana*), were listed as potentially occurring on the Pee Dee site. Literature and records searches and a review of the Pee Dee site habitats revealed that neither plant is likely to occur on this site. Therefore, officially protected plant species are not expected to be impacted as a result of the project.

4.3.3 Wildlife

The construction of an electric generating station on the Pee Dee site will require the removal of vegetation from certain portions of the property. This vegetation provides habitat for the wildlife species utilizing the site, and it is the loss of habitat that will have the most impact on fauna in the vicinity of the proposed facility.

On-site mitigation that should be considered to offset these impacts include:

- Revising forest management practices to allow more acreage to convert to mixed-age stands;

- Introducing / encouraging natural recruitment of native hardwoods into managed forest lands;
- Conducting land-clearing activities outside of spring/summer bird nesting season to minimize direct take of chicks; and
- Landscaping with native species, preferably plants with food or habitat value for native birds.

4.3.3.1 Wildlife Habitat Losses

Construction of the proposed electrical generating station will necessitate the alteration or elimination of wildlife habitat as it presently exists on site. Plans for clearing include approximately 1,245 acres for the build-out of the facility on the Pee Dee Tract, as currently envisioned. The impact areas on the site will be minimized as a result of a "cluster type" of development, (i.e., plant facilities will be built close together and within the 1,245 acre "footprint" area). These steps will minimize impacts to some of the most valued wildlife habitat on the site. Although not all the disturbed areas will be reclaimed, certain revegetated areas could provide limited habitat for a number of species. Specific impacts on various wildlife groups are addressed in the following discussion.

Re-development of the rail line corridor and construction of the transmission corridor will result in the conversion of approximately 31 acres and 144 acres, respectively, of a variety of wildlife habitat types.

As discussed above, in Section 4.3.2, construction and operation of the transmission line ROW will result in conversion of some forested land to a more open habitat. In some cases, this may fragment habitats that will require some individuals to reconfigure home-ranges. It is possible that there may be a small decline in abundance of those species which require large tracts of unfragmented forest habitat. For other species which prefer edge-type habitats, the lengthy unbroken transmission corridor will provide good habitat and may result in an increase in abundance. In general, no significant impacts to wildlife are expected as a result of the construction and operation of the transmission line.

Santee Cooper participates in a wildlife habitat enhancement program called "POWER for Wildlife". The new transmission ROW associated with the Pee Dee station will be eligible for inclusion in this program. Individuals owning/leasing property where this new right-of-way traverses, and who are interested in this wildlife enhancement program, can request an application from Santee Cooper. Once the application is completed and submitted to Santee Cooper, it will be reviewed, and either approved or declined based on current program specifications.

The railroad bed will not support wildlife once it has been converted to active use.

4.3.3.2 Impact on Mammals

Construction activities on the Pee Dee site will result in impacts to nearly all segments of the mammalian fauna on-site and in the immediate vicinity of the site. Removal of the various habitats for the proposed electric generating station will generally result in changes in population density and structure. The loss and/or changes in habitat types will limit the use of existing territories and reduce the availability of food and cover within these areas. Increased vehicular traffic will result in more road-kills.

Big Game Mammals: The only big game species known to utilize the Pee Dee site is the white-tailed deer. The loss of the pine/hardwood forests in the vicinity of the proposed power block will displace deer utilizing these areas. The deer will likely move off-site to suitable habitats or move to other portions of the site not being disturbed. Relocation of these individuals may stress the existing populations within the off-site areas, including the possibility of reducing reproduction over the short term. Such impacts will depend on the population density at the particular on-site location. It is noted that once construction activities cease and the site is stabilized, deer may repopulate some of the area where suitable forage and cover will be available. With a reduction in harvesting expected from more limited public access for hunting, the deer population could eventually increase to greater levels than at present. Increased traffic to the site will likely cause on-going road kill impacts to populations.

Small Game Mammals: The principal small game mammals on the site are rabbits and squirrels. The land clearing within the croplands and young pine stands will negatively affect the Eastern cottontail (*Sylvilagus floridanus*) population structure and density in the immediate vicinity of the plant site. Initially, the areas surrounding the impact zone will undergo population density increases as individuals are displaced due to construction activities. The presence of these individuals being displaced into adjacent areas of suitable habitat will lower the quality and quantity of available habitat and some loss can be expected to occur through increased predator success and possibly physiological or disease fatalities. Once revegetation occurs after construction, the cottontail will likely reestablish in areas of suitable habitat.

Gray and fox squirrels have both been observed on the Pee Dee site. Fox squirrels were observed in the upland pine/hardwood habitat types, while gray squirrels were observed throughout forested areas of the site. Portions of the pine/hardwood habitat will be cleared, and as a result, squirrel habitat will be negatively affected. The ability of surrounding areas to absorb displaced individuals is not apparent, and no predictions can be made about the success of squirrels that do relocate. Loss of or reduction in territory size will probably reduce the reproduction potential of both gray and fox squirrel populations in the immediate vicinity of the Pee Dee site. If prescribed burning is discontinued in remaining pine forests, fox squirrel habitat could be severely impacted within the site.

Furbearers: A number of furbearers have been reported from the Pee Dee site. These include red and gray foxes, opossum, raccoon, beaver and muskrat. The beaver and muskrat utilize the river and its shoreline almost exclusively and will probably not be adversely affected by proposed construction plans. Clearing of upland habitat types will result in reducing foraging and denning habitat for the foxes, opossums and raccoons, particularly where mature hardwoods occur on-site. The loss of habitat will require readjustment of surrounding territories. This readjustment may increase stress on resident individuals and possibly result in a reduced reproductive rate. Changes in population density and structure are unavoidable and will probably be permanent in relation to the loss of habitat. Increased losses of furbearers may occur during construction as a result of road kills from construction traffic. However, the reproductive rate of most of these species is fairly high; therefore, overall losses to the local population would be minimal.

Nongame Mammals: As a group, the nongame mammals (bats and small rodents) will be more highly impacted than any other mammalian groups on site. This is due to the small home ranges associated with various small nongame mammals. The importance of this group to the ecosystem on the Pee Dee site is primarily that of being the most abundant prey base for the majority of the predatory species found on site. The loss of significant portions of these mammals will force local predators to expand their ranges into other areas off-site. This result would tend to magnify impacts on predator groups as a whole and will probably extend into the population of individuals that may otherwise be unaffected by the construction activities. Additionally, the loss of individual small mammals, particularly insectivores and rodents, will be unavoidable.

4.3.3.3 Impact on Birds

The mobility of birds will generally allow them to escape direct losses resulting from clearing activities and construction of the generating station on the Pee Dee site. Some nesting individuals and unfledged young may be lost should any clearing operations occur during the breeding season. For this reason, every attempt will be made to limit clearing activities during bird breeding and nesting seasons. However these losses should be minor relative to regional populations. Other adverse impacts to birds will result from changes in habitats including overall loss in nesting and foraging territories for most species as well as a reduction in the food supply on site.

There are approximately 250 species of birds that could potentially occur on the Pee Dee site at one time or another throughout the year. Nearly all of the summer residents are expected to lose nesting habitat within the areas to be cleared for construction.

4.3.3.4 Impact on Herptofauna

<u>Reptiles:</u> Turtles occupying or utilizing upland habitat types likely will be lost during construction of the generating station on the Pee Dee site. The box turtle (*Terrapene carolina*) will be most affected because its primary habitat requirements are found in the uplands and adjacent wetland and streams. Those reptile species that utilize the river and floodplain habitat areas are unlikely to be impacted by construction activities.

Lizards as a group will undergo population declines on the Pee Dee site during construction activities. Following construction, there will be shifts in the population structure within the group. Lizards which have shown adaptability to human activities, such as the green anole and five-lined skink, will most probably return to preconstruction population levels following revegetation of the site. Other species with strict ecological requirements, such as the broad-headed skink, will likely undergo population reductions that may not recover during the life of the plant.

Depending on habitat requirements, snakes will also be impacted to varying degrees by construction on the Pee Dee site. Those species utilizing upland habitat types, such as the black racer and eastern kingsnake, will lose some of their foraging and nesting habitat on the Pee Dee site. The brown watersnake and eastern cottonmouth will undergo little impact because little activity will occur in their wetland and aquatic habitat.

Amphibians: Salamanders utilizing upland habitats will be lost when construction activities occur within their range. The loss of isolated wetland depressions will represent a significant decrease in habitat required for reproduction.

Frogs and toads will lose some of their aquatic breeding habitats in the isolated wetlands, within the area of construction. In addition, direct loss of the populations within the clearing limits is expected.

4.3.3.5 Impact on Federal Protected Wildlife Species

Based on the results of surveys conducted in and around the Pee Dee site over the past nine years, it would appear that the RCW is no longer present on the site. Future activities on the Pee Dee site directed toward the RCW must first consider that the management plan implemented for the RCW failed to maintain the existing population. There has been no natural replacement of the lost birds. The information obtained from the SCDNR and the results of these studies indicate that extant RCW colonies are not present on the property or in surrounding areas. Additionally, although there is only marginal to fair habitat for RCWs on and around the Pee Dee site, artificial excavations would be of little value, considering the likely absence of RCWs within ten miles of the site. Based on the available information, it is unlikely that the project will impact RCW populations. Considering the requirements for RCW surveys (USFWS, 1989), no additional work to confirm this conclusion should be necessary. No other protected species are expected to be impacted by the proposed project.

There are no known occurrences of other federal listed wildlife species, bald eagle and wood stork, in the vicinity of the Pee Dee site. Thus, no impacts are expected to occur to those species.

4.3.4 Aquatic Resources

The proposed Pee Dee Station will potentially impact aquatic resources during both the construction and operational stages of the project. Construction impacts will primarily be related to temporary effects on water quality as a result of land- and channel-disturbing activities and near-field changes to the river bank habitat resulting from installation of intake and discharge structures and planned improvements to the public boat ramp. Operational impacts will occur throughout the operating life of the power plant. Operational effects will be associated with withdrawal of water from the Great Pee Dee River and wastewater discharges back to the river. The subsections below address these impacts on aquatic biota, including the protected species that may occur in the project area.

4.3.4.1 Construction Impacts

The proposed site preparation and construction activities will have temporary, indirect effects on the aquatic resources resulting from changes in water quality (Section 4.2) and direct effects of land-disturbance and excavation activities. The magnitude of these effects will be minimized by meeting conditions of permits required by SCDHEC (including a storm water permit and a Section 401 Water Quality Certification) and the USACE (including an Individual Section 10/404 Permit for construction of discharge structures and associated intake structures).

Installation of the intake and discharge structures will result in temporary, localized effects during the construction period and will permanently modify a short segment of the Great Pee Dee River shoreline. The intake structure will be located approximately 200 feet upstream of the Bostick boat ramp and the buried discharge pipe will be located approximately 200 feet downstream of the boat ramp. The intake structure will require modification of approximately 372 feet of river bank. The intake will extend approximately 30 feet into the river channel. The buried discharge pipe will cross approximately 85 feet of floodplain. It will extend approximately 55 feet into the river channel just above the river bottom. Boulder riprap will be placed 100 feet upstream and 200 feet downstream of the 42-foot wide concrete intake structure to prevent erosion. The discharge pipe at the river bank will be protected by a 30-foot section of riprap.

Construction effects related to the installation of the intake and discharge structures will be localized along the south bank of the Great Pee Dee River. Other water features on the site that were projected to be impacted in the 1983 EA (including three farm ponds and the quarry impoundment) will not be impacted based on the currently proposed project footprint. Site preparation and construction activities will necessitate clearing and earthwork that will temporarily increase turbidity and total suspended solids released from the site. The release of suspended solids will be minimized through the implementation of the SW3P and compliance with SCDHEC's Construction General Permit (No. SCR10512D), and implementation of BMPs such as: cofferdams, temporary detention ponds, and use of excavated materials as backfill.

Installation of the cofferdams will create shock waves resulting from driving the required sheet piles which may result in the short-term avoidance of the area by mobile aquatic species. Aquatic life trapped within the cofferdams would be impacted as a result of excavation and other construction activities, including placement of the riprap. These effects should be considered minor because they are, for the most part, temporary. Furthermore, the affected area represents a small area (total area enclosed by the cofferdams was estimated to be approximately 5,000 square feet) of habitat that is common along the Great Pee Dee River. Although approximately 372 feet of shoreline will be permanently altered through the placement of riprap to protect the structures, the riprap will increase the surface area of stable substrates available for colonization by benthic macroinvertebrates and periphyton. This riprap should be readily colonized by the aquatic organisms documented in the drift net and artificial substrate samples collected for the 1983 EA.

Dredging activities could impact water quality and aquatic biota through resuspension of environmental contaminants in the bottom sediments. Site-specific sediment samples were taken in March and October 1982 from the upstream boundary, intake area, and downstream boundary (Section 2.1.3.8, 1983 EA). Comparison of the analytical laboratory results with sediment quality guidelines (discussed in Section 3.2.3.4) indicate that concentrations of some metals are elevated in this reach of the river, although suspension associated with the temporary construction activities is not likely to cause any catastrophic events to the biota in the reach. The use of cofferdams and temporary detention ponds should minimize potential impacts of metals and nutrients in the river sediments during construction activities.

Table 4-8: Comparison of Metal and Nutrient Concentrations in Sediment Samples from the Great Pee Dee River to Sediment Quality Guidelines

Analyte (ppm)	Upstream (range)	Intake	Downstream (range)	Lowest Effect Level	Severe Effect Level
Cadmium	<1.12-1.05	<1.21	<1.23-3.46	0.6	10
Chromium	15.5-22.0	23.2	21.2-29.8	26	110
Copper	9.53-12.2	18.8	11.7-18.0	16	110
Lead	10.6-14.5	16.9	14.5-18.9	31	250
Mercury	0.029-0.033	0.022	0.037-0.042	0.2	2
Nickel	10.7-11.9	16.7	13.8-15.0	16	75
Zinc	4.8-50.4	11.2	6.9-72.0	120	820
Total Organic Nitrogen	392-474	330	398-845	550	4800
Total Phosphorus	215-255	210	301-356	600	2000

Source: Table 2.1-10; 1983 EA.

The transmission line is expected to cross Lynches River along US 378. Construction will be accomplished by setting the transmission poles on the banks in such a way that runoff is unlikely to be an issue. Transmission poles will not be set in the river channel. Therefore, no impacts to aquatic species are expected from transmission line construction.

4.3.4.2 Operational Impacts

Operation of the proposed Pee Dee Station will impact the aquatic resources of the Great Pee Dee River as a result of water withdrawal from the river and discharge of cooling tower blowdown and other treated waste effluents to the river. Potential impacts are associated with the reduction of habitat as a result of consumptive water use, mortality of aquatic life through impingement on the intake screens and entrainment into the cooling system, and discharge effects. Discharge effects are related to conditions created in the receiving water including elevated water temperatures and altered water and sediment quality. The proposed intake structure, closed cycle cooling system, and other environmentally sensitive design and operational features for the facility, will be designed to reduce the potential adverse impacts of these effects to acceptable limits.

Although unlikely, it is possible that trace amounts of herbicides may make their way into the Lynches River system at the Transmission Corridor crossing, once the Pee Dee Station is in operation. According to Santee Cooper's (2005b) ROW management program, "*In areas that have standing water and are connected to a larger aquatic system (e.g. river, swamp, etc.), only EPA approved herbicides registered for use in wetland or aquatic sites are used.*" Therefore, it is assumed that herbicide impacts on aquatic species in the Lynches River system will be negligible.

Impingement and Entrainment: The proposed intake structure for the facility was located and designed to provide a reliable source of cooling water and to minimize operational impacts. The location selected is a relatively stable, deep portion of the river channel that will provide water at low river flows and has low potential for sediment deposition near the structure that could affect operational reliability. The aquatic habitat in this area also should minimize encounters of aquatic biota with the intake screens because of the lack of cover and relatively high current velocities. In addition, the intake screens will be approximately 4.3 feet above the river bottom to minimize effects on bottom dwelling organisms.

Design criteria for the wedgewire intake screen modules include a 0.125-inch (3mm) slot width and maximum through-slot velocities of 0.4 and 0.5 feet per second (fps) under average and maximum withdrawal rates. The screen slots will be oriented perpendicular to the river flow. The differential between the through-slot and river velocity reduces the likelihood of organisms being impinged on or entrained through the intake screens. The 0.125-inch slot width excludes smaller organisms than conventional 0.375-inch mesh screens and the proposed compressed air backwash system will maintain the low design through-slot velocities by reducing clogging.

The proposed intake screens will not eliminate entrainment of fish eggs and larvae. However, the flow characteristics across the wedgewire screens will exclude organisms smaller than the slot width (Hanson et al., 1977; Hanson, 1981).

The fish species and life stages most susceptible to impingement and entrainment losses are species that spawn in the main river channel and utilize drift as a mechanism in their early life history The catfish and sunfish that are predominant species in the Great Pee Dee River are less likely to be affected by operation of the intake than broadcast spawners because of their spawning and rearing habits. Catfish and sunfish typically spawn in protected areas with low velocities, they lay adhesive eggs in nests, and provide parental care. The occurrence of catfish and sunfish eggs and larvae in the Great Pee Dee River was shown in 1982 to be incidental compared to common broadcast spawners that included American shad, other clupeids, and striped bass.

Quantitative estimates of entrainment rates in the proposed cooling system can not be precisely estimated because the exclusion efficiency of the proposed wedgewire screens is not known. However, the 1982 drift data indicated that the average fish egg and larval fish densities at the intake location were generally less than the river cross-section average passing the intake location (Section 3.3.3.2; 1983 EA). Therefore, the most conservative entrainment estimate was assumed to be equivalent to the proportion of cooling water withdrawn from the river. Based on flow records from 1980-2005, the maximum impact would be approximately four percent assuming a 29 cfs withdrawal rate and the record low river flow of 691 cfs (Table 4-5). The intake flow would be approximately two percent when the river reaches the 7Q10 flow of 1,727 cfs (Table 4-5). Based on mean monthly flows, less than one-half of one percent of the drift would be entrained, except during the month of September, where slightly over one-half of one percent would be entrained. Entrainment calculations were based on periods of high flow when 43.4 cfs could be withdrawn by the station. Based on 17 larval fish in a million gallons of Great Pee Dee river water (MACTEC entrainment study, 2006), this corresponds to approximately 480 larval fish per day (using 43.4 cfs intake) that would be entrained by the proposed Pee Dee Station intake.

These projected entrainment losses should be considered minimal based on the low withdrawal rates, especially during the higher flow portion of the reproduction season (March through May) when American shad, other clupeids, and striped bass spawn. Lower flows later in the spawning season result in slightly higher entrainment rates (less than five percent), but species spawning after May (e.g., catfish and sunfish) are less susceptible to entrainment as discussed above. The significance of the projected entrainment losses is further reduced by abundance of the early life stages affected by entrainment. Population levels are highest during the egg and larval stages because of the high fecundity of most species that is required to offset normally high mortality rates. The incremental effect of entrainment mortality rates are commonly thought to be compensated by population control mechanisms that benefit the survival and growth rates of the surviving individuals within the carrying capacity of the fishery (McFadden 1977).

Thermal Effects: The use of closed-cycle cooling towers, the low discharge rate of the thermal effluent (maximum 1.55 cfs), and rapid mixing of the thermal discharge in the river will minimize the potential thermal impact of the facility. A worst case condition (16°F temperature increase over the ambient river temperature) would affect no more than five percent of the river cross-section at the 5°F isotherm. The initial rapid mixing would lower the thermal plume temperature to 5°F above ambient within 25 feet of the point of discharge. The small thermal plume allows a zone of passage for mobile aquatic organisms and allows for active avoidance when the plume temperatures reach upper tolerance levels. For example, juvenile American shad have been shown to actively avoid lethal water temperatures (Marcy et al., 1972). Time-excess temperature regimes for striped bass, white perch, and white catfish (Jinks et al., 1980) suggest that a 10-minute period at a Δ-T of 13 to 16°F would be required to cause mortality exceeding five percent under ambient (acclimation) river temperatures as high as 82°F. These time-excess temperature regimes are more severe than those projected for this facility. Furthermore, fish tend to avoid water temperatures above their preferred temperatures.

The overall thermal effects of the discharge from the cooling towers should be considered minor based on the rapid mixing of the thermal plume with the river, the small area of the plume, the location of discharge, habitat that does not attract fish, and the behavioral response of fish to critical water temperatures.

<u>Contaminant Effects:</u> The potential impacts of contaminants generated by the proposed facility (including trace metals, biocides, and sanitary wastes) will be minimized through the use of an advanced solid waste disposal system and other appropriate control technologies as described in the project description. Anticipated impacts to water quality are discussed in Section 4.2. Waste streams will be required to meet NPDES permit requirements that will be based on NSPS. Other treatment technologies that will be incorporated into the project include electrostatic precipitators (ESPs; to reduce stack emissions), SCRs and FGD. The effluent from the stormwater ponds and other waste streams (e.g., bottom ash sluice water and coal pile runoff) will be discharged to the bottom ash pond for equalization and clarification. The decanted flow from the bottom ash pond will be treated through pH adjustment prior to discharge to the Great Pee Dee River. Dissolved constituents in the makeup water will be concentrated. Therefore, the potential exists for accumulation of metals in the sediments and sedentary organisms in the immediate discharge area. This small discharge represents only 0.04% (Table 4-5) of the average river flow and any effluent will be rapidly mixed, thereby reducing the potential impact of the concentrated constituents.

Periodic injections of sodium hypochlorite will be required to control biological fouling of the cooling water system. The negative effects of chlorine on aquatic biota are well documented and detrimental effects can be minimized by maintaining total residual chlorine (free chlorine plus chloramines) below threshold exposure levels. Discontinuation of cooling tower blowdown during chlorination to meet NPDES limits and rapid mixing of the plant discharge in the river will effectively minimize adverse impacts of chlorination.

4.3.4.3 Impact on Federal Protected Aquatic Species

The shortnose sturgeon is the only federally-protected aquatic species known to occur in the vicinity of the proposed Pee Dee Station. The 1982 study established the use of the Great Pee Dee River by shortnose sturgeon in the vicinity of the proposed facility. Based on the known seasonal movements in the Great Pee Dee River (Section 3.3.4.6), the potential effects of the

Pee Dee Station on this species would occur between February and May. Avoidance of instream construction activities during that period would eliminate potential effects on shortnose sturgeon in the vicinity of the project.

Potential operational effects are related to the intake and discharge structures. Entrainment and impingement of the early life stages of shortnose sturgeon eggs will be minimized by the location of the intake screens, small slot width of the wedgewire screens and associated low through-slot velocities, and expected distribution of eggs and larvae. Sturgeon eggs would not typically occur in the drift because they are demersal and adhesive. At hatching, larvae are only capable of "swim-up and drift behavior". At this stage they are thought to be demersal because of photonegative behavior. However, movements of juvenile shortnose sturgeon in the Great Pee Dee River are unknown and early juveniles may be exposed to impingement. The current plan would have the intake structure located 4.3 feet above the bottom which should reduce impingement of drifting swim-up larvae and early juveniles. The large size and swimming ability of spawning adults greatly reduces the likelihood that adults will be impinged because of the low approach velocities to the intake screens. Unlike the adults, juveniles older than one or two years are generally considered non-migratory and typically are found at the saltwater/freshwater interface (Section 3.3.4.6) and therefore are not expected to be affected by the facility.

Effects of the discharge should be minimal based on the projected small size of the discharge plume that will provide for a zone of passage for migrating fish. The seasonal occurrence of adults will not expose shortnose sturgeon to critical summer water temperatures. Migrating juveniles could encounter the thermal plume, but the exposure time would be short because of the predicted rapid mixing in the river and the likelihood that drifting larvae occur in the lower column below the surface plume. This factor further reduces the potential of significant impacts on shortnose sturgeon. Finally, suitable substrates for spawning were identified about two to four miles downstream of the proposed discharge, which is well removed of any potential operational impacts.

Because the presence of the Carolina heelsplitter and the robust redhorse have not been confirmed at this site; it is assumed for this analysis that they are not distributed in this reach of the river and that therefore no impacts would occur, nor is mitigation required.

4.4 Air Quality

The primary pollutants of concern that will be emitted by the Pee Dee Station are particulate matter (PM), sulfur dioxide (SO_2) and nitrogen oxide (NO_x)[6]. NO_x is a major contributor to smog and acid rain. The ground-level ozone found in smog can damage lung tissue, cause congestion, reduce vital lung capacity, and damage vegetation. Acid rain can damage buildings and crops and degrade lakes and streams. PM can cause headaches, eye and nasal irritation, chest pain, and lung inflammation. PM impacts the environment by reducing visibility and causing deterioration of buildings (USEPA, 1997).

The coal-fired steam generating units will employ either fabric filters or ESPs for PM removal and a wet limestone scrubber (FGD) system to reduce SO_2 emissions. NO_x emissions will be controlled in the combustion process through low NO_x burners and with selective catalytic reduction post combustion technology. Air modeling conducted by Santee Cooper shows that the operation of the units at the Pee Dee Station would not cause or contribute to a violation of any of the National Ambient Air Quality Standards (NAAQS).

The particulate control device will limit the PM discharge to 0.018 pounds per million Btu. The NO_x emissions will be limited by the boiler design parameters and specifications to comply with a 0.07 pound per million BTU limit. The wet limestone FGD system will be designed to limit the discharge of SO_2 to less than 0.15 pounds per million Btu with 97.5% removal.

Santee Cooper has proposed a co-benefit approach for control of mercury emissions. That is, mercury emissions will be reduced as a co-benefit of controls installed for the other pollutants, SO_2, NO_x, and PM. This facility will be subject to the mercury standards contained in the New Source Performance Standards (NSPS) and will be designed to attain these standards. As an

[6] As of the date of this document, carbon dioxide (CO_2) is not defined as a pollutant. As such, this document does not discuss carbon dioxide mitigation.

added measure, Santee Cooper is designing a plant layout that will accommodate future installation of a specific add-on mercury control method in order to ensure adequate mercury controls.

The area in which the Pee Dee Station will be located is in attainment with the State Implementation Plan and the national standards for all criteria pollutants, including PM, sulfur dioxide and nitrogen oxide (USEPA, 2006b). Air modeling completed by Santee Cooper shows that the operation of the units at the Pee Dee Station would not cause violation of standards for any of the criteria pollutants. The Pee Dee Station will have to comply with the Prevention of Significant Deterioration (PSD) Program (USEPA, 2006b). As part of this program, the facility must show through air dispersion modeling that it will not exceed increments developed to limit the impact of new large facilities. For the purposes of the Pee Dee Station, Class I and Class II increments must be met. The Class I increments are applicable for facilities that may impact a Class I area - in this case the Cape Romain National Wildlife Refuge located approximately 90 kilometers (km) away. A PSD Class I and Class II impact analysis is required for fine particulate matter, SO_2, and NO_x (USEPA, 2006b). The modeling results (2006) indicate that at present, Florence County has sufficient Class II increment available for consumption for the Pee Dee Station for all three pollutants and sufficient Class I increment for all three pollutants at Cape Romain.

Before any of the units at the Pee Dee Station are built and allowed to operate, they will have to comply with all the requirements of the Clean Air Act including the PSD requirement. A PSD application was submitted to SCDHEC in May 2006, with additional information sent in July 2006.

4.4.1 Air Quality of the Preferred Transmission Corridor

Construction and operation of the preferred transmission corridor will not result in any emission of primary pollutants. Therefore, the transmission corridor will have no affect on the air quality of Florence County or neighboring counties.

4.4.2 Air Quality of the Preferred Rail Corridor

The primary pollutants of concern that will be emitted by the locomotives used to transport coal to the Pee Dee site are NO_x, PM, hydrocarbons (HC), and carbon monoxide (CO). Specific mandates of the 1990 Clean Air Act Amendments require the EPA to regulate emissions from locomotives. This rulemaking took effect in 2000 and focuses on reducing NOx emissions from locomotives by 60% and PM emissions by 46% by 2040, compared to 1995 baseline levels (USEPA, 1997). New research by government scientists is prompting EPA to issue draft regulations by the end of this year or early next year for trains that would reduce NOx and PM emissions by 80 to 90 percent (Eilperin, 2006).

Table 4-9 shows the current emissions standards for locomotives and locomotive engines depending on when the locomotive (or engine) was originally manufactured.

Table 4-9: Exhaust Emission Standards for Locomotives

Tier and duty-cycle	Original year of manufacture	Gaseous and Particulate Emissions (g/bhp-hr)			
		HC[1]	CO	NO_x	PM
Tier 0 line-haul duty cycle	1973-2001	1.00	5.0	9.5	0.60
Tier 0 switch duty-cycle	1973-2001	2.10	8.0	14.0	0.72
Tier 1 line-haul duty-cycle	2002-2004	0.55	2.2	7.4	0.45
Tier 1 switch duty-cycle	2002-2004	1.20	2.5	11.0	0.54
Tier 2 line-haul duty-cycle	2005 or later	0.30	1.5	5.5	0.20
Tier 2 switch duty-cycle	2005 or later	0.60	2.4	8.1	0.24

Source: USEPA, 1997.

1. HC standards are in the form of THC for diesel, bio-diesel, or any combination of fuels with diesel as the primary fuel; NMHC for natural gas, or any combination of fuels where natural gas is the primary fuel; and THCE for alcohol, or any combination of fuels where alcohol is the primary fuel.

While there will be an increase in the air emissions due to the use of the railroad in this area, the EPA currently has standards to control these emissions, which could become even more stringent in the near future. All locomotives used to transport coal to the Pee Dee site will have to comply with the EPA's current emissions standards for locomotives. Compliance with these standards should allow Florence County to remain in attainment of the NAAQS for the pollutants of concern.

4.5 Land Use

Construction of the Pee Dee Electric Generating Station, including the transmission and rail corridors, in Florence County calls for approximately 1,420 acres to be ultimately impacted. Construction and operational impacts should be limited to the Pee Dee Tract, transmission corridor, rail corridor, and immediate vicinity.

As stated previously, there is no land-use zoning in this area of Florence County, thus the proposed use would not be in conflict with any zoning regulations nor would a re-designation of land-use zoning be required.

4.5.1 Construction and Operational Impact on Land Use

Construction and operational impacts of the proposed project will be limited to the site and immediate vicinity. The layout of the final site plan consists of a 1,245 acre 'footprint' within the Pee Dee Tract. This area will ultimately be cleared for construction of the following: buildings; access roads and railroads; coal pile runoff pond; solid waste disposal areas; bottom ash ponds, areas temporarily required for material storage, equipment lay-down areas and parking. This facility footprint is slightly larger than was evaluated in the 1983 EA. This will result in more acreage impacted for the construction of the generating station. However, 297 acres of this footprint are reserved for future ash ponds and solid waste landfills, which are not expected to be needed, and therefore constructed, for at least 20 years. The proposed transmission and rail corridors include development of approximately 144 and 31 acres, respectively.

The 1983 EA estimated the removal of 1,188 acres of agricultural, upland forest and wetlands as a result of full build-out for the original proposed project. The current proposal requires the manipulation of approximately 1,420 acres for full build-out construction and operation. Considering that over 86% of all land in Florence County is either agricultural or forested land, the project is not expected to cause significant potential adverse impacts to local or regional land use. All ash and solid waste disposal areas will be re-soiled and re-vegetated as they are completed. Clean closure protocols will be followed at the time that the disposal areas reach design capacity.

Temporary construction facilities such as buildings, parking areas, equipment lay-down and storage areas, roads, railroads, and soil and material stockpiles will be located within the initial construction area. Following construction activities, cleanup of these areas will be undertaken to remove debris, structures, and all construction equipment and materials which are not essential to the operation of the plant.

Trench excavation, pipeline installation and backfill activities associated with pipeline construction will be conducted using standard construction practices. These activities will be conducted within the designated rights-of-way, and are not expected to affect land outside of these areas.

An existing 115 kV transmission corridor, owned by Progress Energy, will be rerouted around the power block of the proposed Pee Dee Station, on the site. Clearing for this rerouted corridor will replace approximately 7.2 acres of upland forest cover and 1.88 acres of forested wetland cover with an equal area of maintained herbaceous uplands and wetlands. Also, a new 230 kV transmission corridor will be constructed to connect the power block to the existing Marion-Hemingway 230 kV transmission line that is located at the southeast corner of the Pee Dee tract. Approximately 4.88-acres of forested wetlands will be cleared for construction and maintenance of this corridor. These on-site wetlands impacts are discussed in Section 4.3.1.

Recreational land use within the Pee Dee site will be impacted during construction. The station discharge pipe will pass through the parking lot associated with the existing boat ramp (Bostick Landing). During construction of the pipeline, access to the boat ramp will be temporarily closed. However, it is anticipated that demand for recreational facilities during construction will be primarily met through other existing facilities in Florence and Marion Counties. Following the installation of the pipeline, Santee Cooper has committed to making improvements at the Bostick Landing. At a minimum, these improvements will consist of removing the accumulated silty material at the lower end of the boat ramp, re-paving the parking lot and periodic patrols of the boat ramp and parking area by Santee Cooper security personnel. Public access to the Great Pee Dee River via the Bostick Landing will resume after the construction phase and will continue once the plant is in operation.

Hunting activities may be prohibited throughout the entire property during the construction period. Hunting may eventually be allowed on a portion of the site, furthest removed from the power block, once the plant is in operation. However, the details regarding future management and operation of the WMA have yet to be negotiated with SCDNR.

4.5.2 Impact of the Preferred Transmission Corridor on Land Use

The preferred transmission corridor will traverse approximately 11.94-miles from the site to the existing Friendfield-Lake City 69 kV transmission ROW (Figure 3-1). Clearing impacts will be limited to 11.94-miles of new ROW and will occur within a 100-ft wide corridor (50-ft. on either side of the centerline). Approximately 30-acres of upland planted pine and 58.68-acres of forested wetlands will be cleared for the transmission corridor (Figure 3-6). Refer to Section 4.3.1 for additional information on wetlands impacts.

4.5.3 Impact of the Preferred Rail Corridor on Land Use

Construction and operation of the preferred rail corridor will be limited to the existing 100-ft wide ROW. No impact to land use is expected due to construction and operation of the rail line as the corridor has been maintained as a railroad ROW controlled by CSX. However, areas along the corridor have become overgrown with vegetation since the railroad was decommissioned approximately 30 years ago. Clearing of these and other forested areas will occur within 30-feet of the centerline of the corridor (60-foot total width) to allow for construction of the new rail bed.

Approximately 18.5 acres of wetlands are located along the existing, decommissioned rail bed. Using typical cross sections, construction will require developing the rail bed to a maximum base-width of 38-feet; however, 18- to 20-feet of fill material presently exists for the decommissioned rail bed. The additional 9- to 10-feet of fill material (on either side of the existing rail-bed) is anticipated to impact approximately 4.49 acres of the 18.5 acres of wetlands; and clearing activities (11 feet on either side of the maximum base-width, to achieve

60-foot total width for fill and clearing) are estimated to impact an additional 4.90 acres of forested wetlands located within the rail corridor. Total impacts to land cover, based on re-development of the rail corridor including clearing activities in non-wetland areas, will be approximately 31 acres. These activities will require mitigation as part of the over-all wetland mitigation plan/program at the site. Refer to Section 4.3.1 for further information on wetlands impacts and permits.

4.6 Cultural Resources

The 1983 EA documented 103 cultural resource sites found on the study property, including 38 prehistoric archaeological sites, 33 historic archaeological sites, 9 homesteads, 16 tobacco barns, and 7 pack-houses. These cultural resources were identified as the result of an intensive survey of the property and represent, what is believed to be, a reasonable site density for the area.

The 1983 EA included six sites, located outside of the 1983 proposed construction footprint, that were potentially eligible for the National Register of Historic Places (NRHP) and recommended that those sites be preserved in place. Two archaeological sites, identified as potentially eligible for the NRHP, are located within the potential impact zone of the current site development plans. In 2006 MACTEC re-submitted the cultural resources studies from the 1983 EA report to the SHPO, with a recommendation that these eight potential NRHP sites be preserved in place.

Santee Cooper received recommendations from the SHPO in a letter dated July 31, 2006 (Appendix L). The following table shows the SHPO recommendations and the plan of action to address these comments.

Table 4-10: SHPO Recommendations and Plan of Action

SHPO Recommendation	Plan of Action
A revisit of the entire project area, with sites (including structures that have been demolished since the original survey) to be relocated and re-evaluated with the possible exception of areas where no ground disturbance activities will take place. Such areas could be avoided by means of covenants and agreement documents.	• Revisit the previously recorded sites. • Relocate the 91 sites that could be impacted from the construction footprint. • Excavation of shovel tests at closely spaced intervals (5-10 m) to a depth of 80 cm below surface.
Preparation of a new, comprehensive report that provides all the information that is needed to comply with current SHPO guidelines for carrying out the Section 106 process.	• Prepare report to provide detailed information about findings, in general accordance with SHPO requirements. • Report will include results of background research, a discussion of the cultural history of the area, field and laboratory methodology, descriptions of all re-visited sites and artifacts recovered, and the National Register eligibility recommendation for each site. • Site maps, project maps, photographs of each site and an artifact database will also be included with the report.
Background research, including relevant research from the past 20 years and a reassessment of conditions on the property.	• Review technical report of previous cultural resources study (Commonwealth Associates, 1984). • Review NRHP listings in Florence County, SC. • Review South Carolina archaeological site files at the South Carolina Institute of Archaeology and Anthropology (SCIAA) in Columbia, SC. • Review the National Archaeological Database Bibliography. • Review historic maps and aerial photographs of the study area. • Review the chain of title for available tracts within the study area, at the Florence County courthouse. • Consult the SHPO as appropriate. • Consult local historians and land owners as available. • Consult Mr. John S. Cable and Mr. Chuck Cantley, currently of Palmetto Research Associates, Inc., and Field Directors for the previous cultural resources investigation of the study area.
A synthesis of all the findings and an analysis of trends and patterns in the data.	• Processing and recording of recovered materials according to requirement set forth by SHPO. • Analysis of artifacts focusing on identifying temporally and culturally diagnostic artifacts, as required for the preparation of state site forms. • Upon completion of the analysis and preparation of the final report, artifacts, field notes, maps, and photographs pertaining to this investigation will be prepared for curation in keeping with 36 CFR Part 79.

Source: Marcil, 2006.

In order to verify the location and condition of these sites, a Phase I Archaeological Survey is being completed for the Pee Dee Tract, in general accordance with State Historic Preservation Office (SHPO) guidelines for Section 106 compliance. Upon completion of the Phase I

Archaeological Survey, Santee Cooper will avoid and minimize impacts to NRHP-eligible resources on the subject property. Impacts that cannot be avoided will be mitigated according to SHPO requirements, including data recovery. NRHP-eligible or listed resources avoided by construction activities will be subject to active preservation by deed-restriction or other suitable method to be determined by the SHPO, Santee Cooper and other consulting parties. Phase I Archaeological Surveys have been completed for the transmission and rail corridors and will be submitted to the SHPO along with the Phase I study results from the Pee Dee Tract.

A Phase I archaeological survey and a historic structures survey was performed in July and August 2006, on the 11.94-mile preferred transmission corridor that will link the Pee Dee Station to the existing Friendfield-Lake City ROW. These surveys revealed no previously recorded archaeological resources within the proposed transmission corridor and no NRHP-listed or -eligible properties within 0.5 miles of the transmission corridor. Seventeen historic structures and/or complexes were identified during the field survey. Of these, fourteen are considered ineligible for the NRHP (because of alterations and/or the commonness of their types), and no further architectural survey work is recommended. Three structures/complexes are recommended eligible for the NRHP; however, due to distance and the existing presence of ineligible structures in the view-shed, the change in setting created by construction of the line will not adversely affect the architectural qualities of the structures that make them eligible for the NRHP. Based on these findings within the preferred transmission corridor, the transmission line as proposed will not have an adverse impact on significant archaeological resources, and no mitigation will be required.

In July and August 2006, a separate Phase I archaeological survey and historic structures survey was performed on the 4.14-mile preferred rail corridor. These surveys revealed no previously recorded archaeological resources within the rail corridor and no NRHP-listed or -eligible properties within 0.5 miles of the rail corridor. One previously recorded archaeological site is located on a small rise outside of the project area and is not considered to be eligible for the NRHP. Four historic structures and/or complexes were identified during the field survey, including one previously identified structure and the existing decommissioned rail corridor. All four are considered ineligible for the NRHP due to loss of integrity from alterations and/or the commonness of their types. No further architectural survey work is recommended, and there will be no effect on the resources created by the development of the rail corridor. Based on these findings within the preferred rail corridor, the rail corridor as proposed will have no effect on any significant archaeological resources, and no mitigation will be required.

4.7 Socioeconomic Impacts

Potential socioeconomic impacts that may occur as a result of this project were assessed for Florence and Marion Counties. The most significant impact areas include demography, economy, infrastructure, employment and income. These topics are discussed below.

4.7.1 Demography

Population increases to the project area as a result of construction and operation of the proposed Pee Dee Station are expected to be relatively small. The largest influx of persons to the area is approximately 1,500 when Unit 1 has become operational, and construction activities are occurring on Unit 2 (Jackson, 2006). During this time, both construction workers and operational personnel will be at the Pee Dee site.

According to the population projections presented in Section 3.7, the project area (Florence and Marion counties) population is expected to increase by approximately 27,993 persons between 2000 and 2030. Santee Cooper estimates that 100 workers will be required to operate Unit 1. It is estimated that approximately 20% of this operating work force will be hired from outside the local area, which leads to 20 new plant workers moving to the area. Approximately 1400 construction workers will also be on site at this time, with an estimated 10% originating from outside the area, leading to an increase of 140 new construction workers in the area. If three family members move to the area with each worker, the population increase to the local area would be 540 people, which amounts to less than two percent of the expected growth for the area. The direct population increase resulting from construction and operation of the facility should be insignificant relative to the population growth projected for the project area. The increase of people due to construction activities will be temporary. Santee Cooper estimates that 200 workers will be required for the operation of both units (Jackson, 2006). It is anticipated that these workers, and potential families, will become permanent residents of the area, yet they represent an insignificant increase to total population growth.

4.7.2 Economy

Economic impacts of a power station are dependent on several factors, including: 1) the size of the project itself; 2) the size of the labor force required for construction and operation; 3) the number of people added to the local populace as a result of the station; 4) the project's schedule; and 5) the natural and cultural characteristics of the project area. Because a schedule for construction and operation of the plant has not yet been established, this analysis assumes impacts based on 2000 economic conditions, the most recent, readily-available community information.

The most significant impacts to the economy occur as a result of induced employment, increased income, and increased housing units. The project's potential impacts to these areas are described below.

Employment: The employment estimates are based on typical work force requirements for the construction of two 600 MW coal-fired generating units. Estimated construction worker influx assumes that at least 10% of the workers will originate from outside the regional area. The majority of operational workers will originate from the local labor centers of Florence, Marion and Mullins. Some may even commute from as far way as Myrtle Beach or Georgetown. Based on experience at previous Santee Cooper power projects and the knowledge of the local labor force, it is expected that the majority of the construction workers will be from the regional area, and most will commute daily to the site (1983 EA). The largest influx of workers to the area is anticipated to occur during the periods of power unit completion and the beginning of subsequent power unit construction.

Santee Cooper estimates that approximately 100 individuals will be required for operation of each unit (Jackson, 2006). The total number of operating personnel when both units are in operation is estimated to be 200. It is estimated that approximately 20 percent of the operating work force will be hired from outside the area.

Construction and operational "multipliers" were developed by Santee Cooper to determine the number of indirect jobs that would occur for each direct job that is generated. Based on the construction of a similar generating station, the multipliers are estimated at 2.8 for construction employment and 2.08 for operational employment (1983 EA). Therefore, each direct construction job and operating job can potentially generate 1.8 and 1.08 additional indirect jobs, respectively. Applying these figures to the projected Pee Dee Station construction and operational work force provides estimated induced employment figures for the project area. During peak construction, up to 2,628 jobs will be created. Following construction, the two units would offer the potential for approximately 216 additional jobs in the community. In most cases, indirect jobs will occur in the "services" category which will be required to support the direct construction and operational employment.

Income: The initial analysis of construction work force composition and wages was based on 1981 data (1983 EA). Since then, inflation has occurred between 2.1 and 6.5 percent average rate per year (U.S. Department of Labor, 2006). Based on a total inflation factor of 2.23 from 1981 to 2006, total direct construction worker income is estimated at $639,216,280 (2006 dollars).

Indirect income for the local community will also be generated from construction of the proposed project, primarily from increased local demand for goods and services. By incorporating the U.S. Department of Commerce income multiplier of 2.01, the potential direct and indirect income combined is estimated at $1,284,824,760 (2006 dollars). This means that an additional indirect income of $645,608,480 can be generated as a result of construction.

Income generated from the station operation is estimated based on an average worker income of $50,000 (2006 dollars) (Jackson, 2006). Approximately 200 workers are required to operate the two units; therefore, direct income is estimated at $10,000,000 per year. Using a U.S. Department of Commerce income multiplier of 1.9 for operation of an electric utility (1983 EA), it is estimated that income related to operating workers (direct and indirect) would total approximately $19,000,000 annually (2006 dollars). Therefore, additional indirect income of an estimated $9,000,000 per year will be generated as a result of facility operation.

Housing: The greatest worker influx will occur when both construction and operational workers will be at the site. It is estimated that approximately 160 workers could be relocated to the local area during operation of Unit 1 and construction of Unit 2. Assuming a ratio of one worker per housing unit would generate the need for 160 additional housing units. Worker preferences, availability of housing, and services will be the primary influences in determining where workers will relocate. Some will choose to locate to rural areas near the site. Others will select the small nearby communities of Hemingway, Johnsonville, and Pamplico, or the larger cities of Conway, Lake City, Marion, and Mullins. The largest communities, Florence, Georgetown, and Myrtle Beach, will likely attract the most relocating workers because of available housing, services, and amenities. The demand for 160 additional housing units in the project area will have minimal impact on anticipated total vacant housing units.

4.7.3 Infrastructure

Peak influx of permanent workers is estimated to occur when up to 200 employees are operating the plant. However, with an estimated 20 percent of these employees being hired from outside the local area, the population influx would be an estimated 40 workers. Based on a 65 percent marriage rate and an average household size of 3.12, approximately 30 children would be part of the total in-migration figure. As outlined below, significant adverse impacts are not expected to the local infrastructure.

Education: Throughout the Florence region, school enrollments have remained relatively constant, with small increases and decreases. Assuming all new children associated with plant workers are of school age, it is anticipated that local area school districts would be able to absorb the enrollment increase with no adverse impacts to the districts.

Health Care: The influx of population associated with the construction and operation of this project would only slightly decrease the ratio of physicians to population. Similar minor changes would occur to ratios relating to dentists, pharmacists, and registered nurses. The addition of 40 permanent employees to the project area is not expected to pose any serious problems to existing area hospitals, medical facilities, and the medical care community.

Santee Cooper will prepare an emergency services plan and will coordinate with local emergency officials to address the unlikely event of a catastrophic release at the facility, prior to operation.

Law Enforcement: Given the various well-staffed and trained state, county, and municipal law enforcement agencies throughout the project area, adequate law enforcement is expected during construction and operation of the proposed Pee Dee Station. In addition, Santee Cooper will provide site security during both the construction phase and during operation.

Fire Departments: Over 19 staffed and operating fire departments will provide adequate fire protection throughout the project area. No adverse impacts are expected to the level of fire protection as a result of the influx of construction and operational workers. Appropriate fire protection during construction and operation at the proposed facility will be provided by Santee Cooper.

Santee Cooper will prepare an emergency services plan and will coordinate with local emergency officials to address the unlikely event of a catastrophic release at the facility, prior to operation.

4.8 Noise

The 1983 EA presented results of an acoustical study that was conducted at the Pee Dee site assuming four coal-fired units, totaling 2,200 MW, would be constructed. In 1983 there were no federal, state, or local noise regulations applicable to the site. The study was conducted using several professionally accepted noise indicators that formed the basis of the evaluation.

Conclusions in the 1983 study noted there were several residential areas that could be impacted, depending upon the noise modeling methodology. Only one area, four residences located at the terminus of Ashley Road and two residences located along Duli Road (Figure 3-12), remained with the potential for noise impacts from either the normal continuous operation of all units or the intermediate stages combining unit construction and operation. The somewhat varied judgments for this residential area were due to the varying terminology and criteria of the different methodologies used in the 1983 study. In this area, Santee Cooper purchased additional lands to provide for supplementary noise attenuation and a transmission line corridor.

Current changes from the original site layout that affect the predicted noise levels include:

- Technology changes resulting in removing areas once designated for solid waste area operations
- Downsizing the baseload generation - from 2,200 MW (two 500 MW units and two 600 MW units) to 1,200 MW (two 600 MW units)

These two changes would account for some reduction in continuous noise from operations typical of the original layout.

The HUD noise program regulation[7] specifies Site Acceptability Standards in terms of "Acceptable," "Normally Unacceptable," or "Unacceptable" based on Day-Night average sound levels (in decibels). The data collected in 2006 indicate levels not exceeding 65 dB are acceptable and there are no special approvals and requirements applicable. This finding is in agreement with the conclusions stated in the 1983 document.

Boaters and other recreational users on the river will be impacted by the increased noise levels in the area once the units are in operation. Minor increases in noise levels may also impact residences located adjacent or near to the site. As noted in the 1983 study, residences located along Ashley and Duli Roads will be most affected.

It is noted that the worst case scenarios are at the residences located at the terminus of Ashley Road, which are closest to the generating facility. Noise levels at locations further away from the generating facility will inherently be less than the levels above, as generally indicated in much greater detail in the 1983 EA. Aside from reporting the anticipated noise levels, the 1983 study also noted there are additional engineering solutions for reduction of the generated sound if the impact at the residences in the area of Ashley and Duli Roads is found to be serious and residents are unable to accept sudden onsets of noise. However, the 1983 EA did not provide details related to the proposed engineering solutions.

[7] See 24 CFR §51.103.

Since the 1983 EA, Florence County has developed a noise ordinance (Florence County Code, Chapter 18). This ordinance generally prohibits the creation of any unreasonably loud, disturbing or unnecessary noise of such character, intensity or duration as to be detrimental to the life or health of any individual or such noise as to disturb the quiet and peace of any citizen in the county. The ordinance makes exceptions for the conduct of manufacturing operations as defined by the South Carolina Tax Commission. Therefore, the ordinance does not prohibit or regulate noises from construction or operation of electrical generating facilities.

The largest increase in noise levels will occur when Unit 1 is in operation and Unit 2 is in construction. During this time, approximately 1500 workers will be traveling to and from the site daily. Construction vehicles entering and exiting the site could potentially add an additional 1,000 vehicles a day. This additional roadway traffic could potentially increase the noise levels for residences along the roadways surrounding the site. However, this additional roadway traffic will occur during the daytime hours and will have a minimal impact on the residential noise levels, as residential noise levels are most affected by nighttime noise increases.

Construction of new generating units will occur only as there is a demand for electricity. Therefore, it is anticipated the build-out of the entire station facilities will occur over many years once the first unit is constructed. Santee Cooper will ensure any potential concerns for excessive noise levels associated with the operation of the facility will be addressed appropriately in accordance with applicable regulations in effect at the time.

4.8.1 Preferred Transmission Corridor Noise

This section specifically addresses noise issues associated with transmission lines. The preferred transmission corridor will traverse approximately 11.94-miles westward from the site to the existing Friendfield-Lake City 69 kV transmission line. The World Health Organization (WHO) recognizes that, "noise in the form of a buzzing or humming sound may be heard around electrical transformers or high voltage power lines" (WHO, 2006). Since no structures or buildings are allowed within the transmission line ROW it is unlikely that residents in adjacent properties will hear the noise, there should be no significant adverse impact to residences related to this noise.

4.8.2 Preferred Rail Corridor Noise

This section specifically addresses the rail access component of the proposed project. The desired rail corridor was identified in the 1983 EA and consists of an estimated 4.34 mile (100-foot wide ROW) from the southeastern site boundary to the existing main line in Poston. This rail route includes an existing rail-bed that is not currently in service, but has not been abandoned. CSX still owns this rail ROW virtually in its entirety.

The Railway Noise Worksheet D was completed according to HUD Noise Assessment Guidelines for the proposed re-development of the railway spur to the Pee Dee site (Appendix I). This worksheet provides calculations of the day-night average sound level (DNL) for the railway.

DNL calculations for the railway are within the acceptable range defined by HUD at a distance of 180 feet and beyond from the centerline of the existing rail-bed. DNL calculations for the railway are within the normally unacceptable range between 40 and 180 feet from the centerline of the railway and within the unacceptable range up to 40 feet from the centerline of the railway (Figure 3-12).

Seven buildings lie within the "normally unacceptable range", one church and six residences (Figure 3-12). The closest building to the railway is a residence located near the junction of the currently decommissioned rail-bed and the operational CSX railway. This residence is situated approximately 45 feet from the rail-bed proposed for re-development and approximately 280 feet from the operational CSX railway. Assuming no additional operations on the existing CSX railway, the combined DNL for this closest residence would be 74 DNL ("normally unacceptable"; Appendix I).

The church on S-791 (Chinaberry Road) is situated approximately 150 feet from the centerline of the existing rail-bed. DNL calculations for this church are 66.1 (outdoor A-weighted sound level), within the "normally unacceptable" range, when the train passes by the church and is required to use whistles/horns at the road crossing. With an outdoor A-weighted sound level of 66.1, the indoor sound levels would then be approximately 54. However, if the use of the whistles/horns at the road crossing could be eliminated, possibly through the use of automatic crossing guards at this location, DNL calculations are 57.4, which is within the acceptable range.

4.9 Solid Waste and Hazardous Materials

The Pee Dee Station will require the use and storage of significant amounts of raw materials and chemicals. These materials and chemicals include coal, fuel oil, limestone, pet coke, anhydrous ammonia, sulfuric acid, sodium hypochlorite and to a lesser degree, other chemicals listed in Table 2-2. Once development of the transmission and rail corridors are complete, operations along these corridors are not expected to generate solid or hazardous waste or materials.

Production of electricity and the corresponding pollution controls will inherently generate waste material (Table 4-11). The majority of the solid waste generated will be in the form of bottom ash, fly ash and Flue Gas Desulfurization (FGD) system waste. Following temporary on-site storage of these wastes, much of these materials will be sold as raw materials for various industries. Remaining material that cannot be sold may be disposed of on-site.

There will be two types of waste disposal areas on the plant site. One will be for bottom ash in ash ponds and the other for fly ash and scrubber sludge in the solid waste disposal areas. Current plant designs include two approximate 100-acre ash ponds and three solid waste landfill areas ranging from 35 to 158 acres and totaling 313 acres. Although these areas have been set aside for the purpose of solid waste disposal, they will only be developed on an as-needed basis. The landfill design capacity exceeds the expected need (table 4-11) in that using conservative assumptions about amount of by-product sold, Landfill #1 would meet all landfill needs for the first 20 years of operation. In reality, it is anticipated that less of the by-product will need to be landfilled as markets are developed and technologies improve. The handling of bottom ash requires the use of settling basins which will be lined and solid waste will be disposed of by depositing it onto the existing ground surface after removal and stockpiling of top soil or an alternative Resource Conservation and Recovery Act (RCRA) compliant method.

Table 4-11: Plant Solid Waste Analysis

	Single Unit	**Two Units**
Plant Capacity Factor for Waste Analysis	80.00 %	80.00 %
Fly Ash Collected	85.00 % 32,191 lb/hr 140,997 Tons/yr 56.06 Lb/net-MWh	85.00 % 64,382 lb/hr 281,994 Tons/ yr 112.11 Lb/net-MWh
Fly Ash Sold	50.00 %	50.00 %
Fly Ash Storage – Height	60.00 feet	60.00 feet
Fly Ash Storage – No. of years	20.00 years	20.00 years
Fly Ash Storage – Area	**22.66 acres**	**45.32 acres**
Flyash Density	50.00 lb/cu ft	50.00 lb/cu ft
Limestone Consumption / Feed Rate	31,603 lb/hr 16 Tons/hr	63,206 lb/hr 32 Tons/hr
Limestone Feed Rate per Day	379 Tons/24-hrs	758 Tons/24-hrs
Limestone Feed Rate per Year	138,421 Tons/yr	276,843 Tons/yr
FGD Gypsum Generated	12.69 lb/mmbtu 57,212 lb/hr 250,587 Tons/yr 99.63 lb/net-MWh	25.38 lb/mmbtu 114,423 lb/hr 501,174 Tons/yr 99.63 lb/net-MWh
FGD Gypsum Storage – Height	60.00 feet	60.00 feet
FGD Gypsum Storage – No. of years	20.00 years	20.00 years
FGD Gypsum Storage – Area	**36.61 acres**	**73.22 acres**
Gypsum Density	110.00 lb/cu ft	110.00 lb/cu ft
Total Solid Waste	89,403 lb/hr 391,584 Tons/yr 155.68 lb/net-MWh	178,806 lb/hr 783,168 Tons/yr 311.36 lb/net-MWh
Total Solid Waste – Height	60.00 feet	60.00 feet
Total Solid Waste – No. of years	20.00 years	20.00 years
Total Solid Waste – Area	**59.27 acres**	**118.53 acres**
	Years of Storage with 2 Units Operating	
Solid Waste Landfill Area 1 Total for Solid Landfill Area 1 and Future Areas	120 acres 313 acres	**20.00 years** **52.17 years**

Source: Santee Cooper

Assumptions / Byproduct Storage Area Calculations:

Fuel – 2.5% Sulfur, 12,500 Btu/lb HHV, 10% Ash
80% Capacity Factor
50% Fly Ash Sales
Angle of Repose is 45 Deg., results in increase in
Increase of 5% in acreage

Plant operations will require the transportation and storage of several hazardous chemicals, including anhydrous ammonia. During operation, the facility will be required to comply with federal, state and local laws and safety guidelines pertaining to hazardous materials and waste transportation, storage and handling.

A related, potential issue for consideration is the possible human health effects of extremely low frequency electromagnetic fields (ELF EMF) from overhead transmission lines. The National Institute of Environmental Health Sciences (NIEHS) Electric and Magnetic Fields Research and Public Information Dissemination Program (EMF RAPID) found that there was "weak evidence that short term human exposure to ELF EMF causes changes in heart-rate variability, sleep disturbance, or suppression of melatonin," and "no evidence that such exposure has other effects on the biological end-points studied in the laboratory" (NIEHS, 2002). From the limited credible evidence suggesting that exposure to ELF fields may cause cancer, the NIEHS international panel concluded that ELF EMF should be considered as a "possible human carcinogen" (World Health Organization, 2006). The World Health Organization (WHO) has also concluded that, "since current scientific information is only weakly suggestive and does not establish that exposure to ELF fields at levels normally encountered in our living environment might cause adverse health effects, there is no need for any specific protective measures for members of the general public" (WHO, 2006). The location of the preferred transmission corridor was specifically routed to avoid residences. ELF EMF is not expected to be a health concern affecting the location of the preferred transmission corridor.

4.10 Traffic, Transportation and Parking

Construction workers will most likely commute to the plant site from the surrounding communities, with the majority expected to commute from Florence. The primary access road from Florence to the plant site is along SC 51. Commuters from Marion County, southeast of the site, will use U.S. Routes 501 and 378. Georgetown is south of the facility and commuters from that area are linked to the site by South Carolina Routes 41 and 51. Based on the vehicle traffic discussed in Section 3.10, the existing transportation facilities are expected to be able to accommodate the increased traffic volume from the construction work force. Construction of the proposed facility will cause increased traffic volumes in the site vicinity with traffic congestion decreasing in proportion to the distance from the work site. During periods of peak activity, average daily traffic on S-57 (Old River Road) will more than double from current conditions. The majority of the increase will probably occur during normal business hours, affecting commuter traffic at two peak periods per day. Increases in traffic flow may be an inconvenience to some local residents. In the immediate area of the Pee Dee site, traffic along US 378 and SC 51 will increase; however, these routes can accommodate the higher volume of traffic. Due to the level of service and safety issues, Santee Cooper will install turn lanes and traffic control devices on S-57 at the plant entrance and future crossings for waste disposal, as approved by the Highway Department.

Primary access to the proposed facility during the construction and operational phase will be from S-57 (Old River Road). Currently, S-66 travels through the site and terminates at S-57. With local assent, S-66 will be closed to the public at the site boundary. This will also close the unpaved road to the north of the highway. The closure of this road may be an inconvenience to some local residents. However, access to S-57 can be gained from Secondary Routes 1129 (Cash Road) and 791 (Chinaberry Road).

Construction materials and major plant components will be delivered to the site via existing roads and rail. The existing decommissioned rail ROW along the southwestern site boundary will likely be under construction by CSX for a new permanent spur. The beginning point of new construction is in Poston, approximately four miles southeast of the site. Construction of the new spur will require redevelopment of crossings at S-44 (Poston Road), S-791 (Chinaberry Road), S-57 (Old River Road) and US 378, at Kingsburg (See Figure 3-4, Rail Sheets). Re-development of the rail line will have short-term impact on vehicular traffic using these roads and long-term moderate impacts on traffic when coal trains travel to/from the plant site, which is discussed more fully below. At-grade crossings are anticipated for all road crossings at this time.

A permanent rail line will be installed to accommodate delivery requirements for station development and operation. Other construction materials will be transported to the site by truck and will use the same entrance road as the construction work force.

Construction of the makeup and discharge water pipelines may result in temporary disruption of traffic patterns at the crossing of S-57, which will remain open throughout construction and operation of the facility. This impact is likely to be temporary and of short duration, and is not expected to significantly affect traffic flow patterns.

Minor impacts to local vehicular traffic may also occur because of delivery of scrubber raw materials that could include limestone for use in flue gas desulfurization. The materials will be stored on-site and will be delivered by trucks. Average weekly delivery will be by approximately 100 thirty-ton trucks. Rail delivery will also be considered for these materials. It has not been determined at this time how waste materials that will be sold commercially (gypsum) will be transported to the buyer.

During operation, some disruption to local and regional traffic will occur because of coal trains bringing fuel into the site. The average length of each train will be 100 cars, or approximately 1 mile. The speed of the trains will be slowed at the site boundary to four to six miles per hour. No more than one train is expected per 24-hour period (see Section 2.4.3.1). The area of greatest disruption to traffic flow will be at the junction of US 378, SC 41, and S-57 at Kingsburg. Minor impacts may also occur at the Refuge Outreach Ministry, which is located on the southwest border of the site adjacent to the proposed rail line. At-grade crossings are planned for all roads.

The preferred transmission corridor will cross US 378 twice (one new crossing), as well as 11 crossings of state routes (Corridor #2, Figure 1-11). Minor impacts to local vehicular traffic may occur during construction of the transmission line. The transmission line crossings will be permitted with SCDOT and will be designed to allow proper clearance for traffic, resulting in no impacts to traffic during operation.

Construction of the proposed facility is unlikely to cause any severe impacts to the transportation system in Florence County or with projects that are in the current transportation plan (SCDOT, 2006). However, the at-grade crossings for the rail line at US 378, which is a hurricane evacuation route, will cause moderate traffic impacts. These impacts from coal trains stopping traffic on US 378 will occur over the life of the facility. Modifications to the existing road network associated with the rail line extension, including contingency planning for hurricane evacuations, will need to be coordinated with and reviewed by the appropriate state and local highway and public works authorities.

4.11 Potential for Generating Controversy

Numerous articles referencing the proposed project have recently been published (Appendix K). Local news coverage for this project during the site identification phase has been generally positive.

Agencies and local groups interested in Great Pee Dee River issues, particularly water quality, will likely be active participants in the public process associated with this project. Their concerns will likely be focused on the adequacy of measures to protect water quality, both ground and surface. Water quantity and air emission issues may receive attention from these parties as well.

4.12 Federal Compliance

The analysis and recommendations in this EA support the conclusion that the proposed project will be in compliance with Federal Regulations as long as the appropriate mitigation measures are implemented (Table 4-12).

Table 4-12: Compliance with Federal Regulations

Regulation	Subject	Project Compliance Issues
EO 11988	Floodplain Management	Approximately 308 acres of the Pee Dee Tract and 28.45 acres of the preferred transmission corridor lie in the 100-year floodplain. Project objectives and plans can be accomplished with avoidance and/or minimization of impacts to the regulatory floodplain. Water withdrawal activities will be designed for compliance with appropriate floodplain ordinances.
EO 11990	Protection of Wetlands	Appropriate Section 404 permits will need to be obtained from the USACE. Wetlands protection will include: avoid impacts; minimize impacts; and mitigation.
EO 11987	Exotic Organisms	Non-native / invasive species are present at the site. The plans for the site should utilize native species whenever possible and should not introduce any invasive species.
42 USC §§ 7401 *et seq* (1970) 40 CFR Parts 50-99	Clean Air	An air permit application has been submitted and is under review by SCDHEC and the public for compliance with NSR/PSD guidelines.
EO 12898	Environmental Justice	Although minority and disadvantaged populations are located in Florence and Marion Counties, no disproportionate impact on this population is expected as a result of this proposed project.
33 USC 1323, Section 313; 40 CFR 122	Clean Water	Stormwater discharges will be covered under the state's general permit in compliance with the SW3P. BMPs for construction and operation phases associated with protection of surface- and ground-water are discussed in the report. The project will require a National Pollutant Discharge and Elimination System (NPDES) permit for the sanitary sewer and thermal and treatment plant discharges, the conditions for which will require compliance with various SDHEC standards as well as the New Source Performance Standards for Steam Electric Generating Stations.
33 USC 1251 *et seq* Section 316(b), Subpart I, Track I	Clean Water	Design, construction, and capacity of cooling water intake must meet updated (2001) requirements to minimize impingement and entrainment of fish and shellfish.
33 USC §§ 1251 *et seq* CWA of 1972 Section 311	Oil Spill Prevention	Oil pollution prevention regulations must be complied with during construction of intake and outfall structures in the Pee Dee River and when transmission corridor crosses the Lynches River.
33 USC 403, Section 10	Rivers and Harbors	The preferred transmission corridor crosses Lynches River, a navigable waterway. This crossing will require a Section 10 permit from the ACOE. Installation of the intake and discharge structures may qualify as channel modifications in the Great Pee Dee River. If so, a hydromodification permit may be required.

Table 4-12: Compliance with Federal Regulations

Regulation	Subject	Project Compliance Issues
PL 93-205	Endangered Species	No incidental "take" of federally-listed species are expected as a result of project development. Additional coordination and/or consultation with the USFWS is recommended.
16 USC 1274 *et seq*	Wild and Scenic Rivers	The Great Pee Dee River does not have federal designation as a Wild and Scenic River. The Lynches River and the Great Pee Dee River are designated as state scenic rivers upstream and downstream, respectively, of the project interface, but at the project area itself.
Noise Control Act of 1972	Noise Control	Compliance with federal noise standards is expected during construction and operation.
PL 93-523	Safe Drinking Water	BMPs for construction and operation of the power plant as they relate to groundwater protection are discussed in the report. An on-site potable water system (e.g. groundwater well or other) will be constructed in accordance with applicable regulations.
PL 97-348	Coastal Barriers	Florence County is not a regulated coastal county.
16 USC 1451*et seq*, Amended by PL 101-508	Coastal Zone Management	Florence County is not a regulated coastal county.
40 CFR 230 §§ 404(b)(1) 33 CFR 323	Discharge of Dredge or Fill Material	Santee Cooper will apply for a USACE Section 404 dredge and fill permit with this EA.
PL 94-580 (RCRA)	Solid Waste Disposal	Handling and disposal of hazardous and non-hazardous wastes will need to be permitted under RCRA per the program administered for USEPA by SCDHEC
40 CFR 117	Reportable Quantities of Hazardous Substances	Reportable quantities of hazardous substances are not yet known from the site. Hazardous substances will need to be stored on site and reported per federal and state regulations.
EPCRA SARA Title III	Emergency Planning and Toxic Release Inventories	TRI reports and Emergency Response Plans will be required.
40 CFR 761	PCB Issues	PCBs are not expected to be used at the site.
14 CFR 77	Objects Affecting Navigable Airspace	Construction greater than 200 feet in height above the ground level at the site will require the notification of the FAA by submitting the Notice of Proposed Construction or Alteration Form (FAA Form 7460-1) to the FAA Regional Air Traffic Division office at least 30 days prior to the date of proposed construction.
36 CFR 800	Historic Preservation	SHPO consultation and Section 106 compliance are necessary. SHPO coordination is ongoing for this project.

4.13 Cumulative Effects

This section contains a general assessment of the anticipated cumulative effects associated with the construction and operation of two pulverized coal-fired steam generating units on a 2,709-acre tract on the Great Pee Dee River in Florence County, South Carolina, as well as the preferred transmission and rail corridors. In the assessment of these cumulative effects, the terms and limits of the necessary permits and general site conditions are considered.

Water Quality

The Great Pee Dee River is impaired with respect to mercury in fish, and the facility discharge will result in a small, incremental increase in mercury in the river; however, current water quality criteria will be met. Additional mercury reduction strategies/requirements may be necessary to meet waste load allocation reductions anticipated through the TMDL process.

The Pee Dee Station, as a new coal-burning source of NO_x and SO_2, as well as the NO_x emissions from locomotives, may contribute new sources of anions which, when combined with atmospheric vapor, may contribute new hydrogen ions directly to surface waters. Because the soils in the downwind areas are primarily sandy and poorly buffered, there is a high probability that these hydrogen ions passing through terrestrial systems on their way to surface waters may contribute further to acidification of surface waters. Although no energy source is perfectly clean, today's new plants are a significant improvement over older plants with older technologies, and this may mitigate this cumulative impact.

Fossil fuel combustion results in the production of carbon dioxide gas. Elevated levels of atmospheric CO_2 have been linked to climate change. Coal burning at the new facility will be a new point source of CO_2. The CO_2 outputs will be minimized through use of best available technologies, which include fuel-efficiency technologies.

Air Quality

This new coal-burning source of PM, sulfur dioxide, NO_x emissions, and CO_2 discharges, as well as the additional PM and NO_x emissions from the locomotives used to deliver the coal, may contribute to regional smog, acidification, and climate modification. Downwind ecosystems may also experience adverse impacts as a result of long-term exposure to permitted air emissions, e.g. acid fog and/or particulate damage to conifers, etc. These cumulative impacts may result in long-term changes in forest health. These effects are minimized by the proposed mitigative measures including; use of best available technology for air pollution control, a more fuel efficient technology, operating monitoring and compliance.

Protected species

The red cockaded woodpecker was observed to be nesting on the site in the early 1980's. As a result, a habitat enhancement and management program was instituted to help recover this listed species. Follow-up studies performed in the late 1980s and early 1990s indicated that RCW no longer utilized habitat at the site. Although suitable habitat is currently available on site, habitat quality will likely be diminished due to construction and operation of the facility. Thus, it is unlikely that RCW will return to the site in the future.

Shortnose sturgeon have historically been reported near the site. Therefore, water quality impacts will be subject to stringent review, and efforts to avoid cumulative impacts will be emphasized for general and industrial stormwater discharge and water withdrawals

Socioeconomics

The construction and operation of the Pee Dee Station will have positive impacts on the local economy. This facility will create employment opportunities for construction, operation, and maintenance workers. Development of this site will also benefit the surrounding communities by improving the local economic base, which is affected by employment, tax revenues, community services, and property values.

Wetlands

Permanently filled wetlands result in the permanent loss of aquatic resource functions and values. Functions and values which may be lost on the site and in the surrounding area as a result of wetland loss at the site include: alteration of natural drainage patterns; erosion control through substrate stabilization; stormwater and flood water storage; groundwater discharge and recharge; biological diversity; and wildlife habitat. The Pee Dee Tract has a relatively low percentage of wetlands considering the large size of the site. The highest functioning alluvial systems will generally be avoided and compliant mitigation will be implemented to reduce cumulative impacts.

Land Use

Construction on this site will change a significant portion of the site's land use from natural to developed and alter the character of the area via loss of open space. Forested areas along the preferred transmission corridor will loose their potential for any future forestry operations due to clearing and maintenance of the transmission line. A 60-ft ROW will also be re-developed for the preferred rail corridor. However, significant areas of the site will remain undeveloped and certain off-site lands will be acquired and managed for wetlands and wildlife as part of the mitigation plan. The project will bring increased development pressure to this rural area. Local and county planning departments may need to consider development and zoning restrictions that promote the conservation of open space.

Recreation

Development of this site will lead to a decrease in hunting and other outdoor recreation opportunities currently available on the site. During construction and operation of the facility, most of the site will be closed to wildlife management area (WMA) activities. Certain areas outside of the operational areas and buffers may be re-opened for hunting activities in the future. During construction of the intake and discharge structures, the Bostick Landing may be temporarily closed. Proposed improvements to this landing include re-grading the cement of the boat ramp, re-paving the parking lot, and periodic patrols of the boat ramp and parking area by Santee Cooper security personnel.

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CHAPTER 9
ALTERNATIVES TO THE PROPOSED ACTION

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
ac.	acre
AC	air conditioning
ACC	acid copper chromate
ACSR	aluminum conductor steel reinforced
AE	Account Executive
AEC	Advanced Energy Corporation; Atomic Energy Commission
AP1000	Westinghouse Electric Company, LLC's AP1000 Reactor
APE	area of potential effects
APWRA	Altamont Pass Wind Resource Area
BAT	Best Available Technology
BMP	best management practice
BTU	British thermal units
CAAA	Clean Air Act Amendment
CBD	Center for Biological Diversity
CCA	chromated copper arsenate
CCS	carbon capture and storage
CEC	California Energy Commission
CF	counterflow
CFR	Code of Federal Regulations
CIG	Commercial Industrial and Governmental
cm	centimeter

ACRONYMS AND ABBREVIATIONS (CONTINUED)

CT	combustion turbine
m^3/sec	cubic meters per second
CO	carbon monoxide
CO_2	carbon dioxide
COL	Combined License
COLA	Combined License Application
CP&L	Carolina Power & Light Company
CWA	Clean Water Act
CWIS	cooling water intake structure
CWS	circulating water system
DENR	Department of Environment and Natural Resources
DIT	Design Information Transmittal
DSM	demand-side management
EAB	exclusion area boundary
EERE	Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
ELPC	Environmental Law and Policy Center
EPACT	Energy Policy Act of 2005
ER	Environmental Report
ESRP	Environmental Standard Review Plan
FBC	fluidized bed combustor
FERC	Federal Energy Regulatory Commission
FSAR	Final Safety Analysis Report

ACRONYMS AND ABBREVIATIONS (CONTINUED)

FWPCA	Federal Water Pollution Control Act
ft.	foot
ft^3/sec	cubic feet per second
gCO_2eq/kWh	grams of carbon dioxide equivalent kilowatt-hour
gpm	gallon per minute
gpm/ft^2	gallon per minute feet squared
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants
GEO	Geothermal Education Office
G.S.	General Statute
GTG	gas turbine generator
ha	hectare
HAR	proposed Shearon Harris Nuclear Power Plant Units 2 and 3
HAR 2	proposed Shearon Harris Nuclear Power Plant Unit 2
HAR 3	proposed Shearon Harris Nuclear Power Plant Unit 3
HgA	heat generating assembly
HEIP	Home Energy Improvement Program
HNP	existing Shearon Harris Nuclear Power Plant Unit 1
HVAC	heating, ventilation, air conditioning, and cooling
IGCC	Integrated Gasification Combined Cycle
in.	inch
IRP	Integrated Resource Plan
kcmil	thousand circular mils

ACRONYMS AND ABBREVIATIONS (CONTINUED)

km	kilometer
km^2	square kilometer
kV	kilovolt
kWe	kilowatts of energy
kWh	kilowatt-hour
L	liter
$l/(s/m^2)$	liters per second meter squared
LIAP	Low-Income Assistance Program
m	meter
m^2	square meter
m^3/s	cubic meters per second
mi.	mile
$mi.^2$	square mile
MSW	municipal solid waste
MW	Megawatt
MWe	Megawatt electric
MWh	Megawatt hour
MWt	Megawatt thermal
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCDWQ	North Carolina Division of Water Quality
NCSC	North Carolina Solar Center

ACRONYMS AND ABBREVIATIONS (CONTINUED)

NCUC	North Carolina Utilities Commission
NEPA	National Environmental Policy Act
NGG	Nuclear Generation Group
NGVD29	National Geodetic Vertical Datum
NERC	North American Electric Reliability Corporation
NETL	National Energy Technology Laboratory
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
OUC	Orlando Utilities Commission
PEC	Progress Energy Carolinas, Inc.
PM	particulate matter
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
POST	Parliamentary Office of Science and Technology
ppsm	people per square mile
PURPA	Public Utility Regulatory Policies Act of 1978
PV	photovoltaic
RO	reverse osmosis
ROI	region of interest
ROW	right-of-way

ACRONYMS AND ABBREVIATIONS (CONTINUED)

RTO	Regional Transmission Organization
S&L	Sargent & Lundy, LLC
SEER	Seasonal Energy Efficiency Ratio
SEGS	Solar Electric Generating System
SEO	State Energy Office
SERC	Southeastern Electric Reliability Council
SHPO	State Historic Preservation Officer
SO_2	sulphur dioxide
SO_x	oxides of sulphur
SRS	Savannah River Site
SS	Siemens Solar
USACE	U.S. Army Corps of Engineers
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
$W(hr)/m^2/day$	watt hours per square meter per day
Westinghouse	Westinghouse Electric Company, LLC
XF	crossflow

9.0 ALTERNATIVES TO THE PROPOSED ACTION

This chapter identifies alternatives to the proposed action in four ways: (1) it identifies the impact of the no-action alternative; (2) reviews possible energy resources that could be used as alternatives to the proposed action; (3) identifies alternative sites; and (4) evaluates alternative plant and transmission systems for heat dissipation, circulating water, and power transmission at the proposed Shearon Harris Nuclear Power Plant Units 2 and 3 (HAR 2 and HAR 3).

For the purposes of this discussion and consistent with the information presented in the other chapters of this Environmental Report (ER), the following terms are used:

- **Plant Site**. The plant site is the area within the fence line (Figure 4.0-2). This area includes the footprint of HAR 2 and HAR 3 (HAR), including the reactor buildings and generating facilities.

- **HAR Site**. The HAR site is an irregularly shaped area comprised of the following site components: the plant site (area within the fence line), Harris Reservoir, Harris Reservoir perimeter, the dam at Harris Reservoir, the pipeline corridor, and the intake structure and pumphouse (Figure 2.0-2). The HAR site is located within Wake and Chatham counties.

- **Exclusion Zone**. The area with the exclusion area boundary (EAB). The exclusion zone is represented by two circles, each with a radius of 1245 meters (m) (4085 feet [ft.]), centered on the reactor building of each unit (Figure 4.0-3).

- **Pipeline Corridor**. The pipeline corridor includes the Harris Lake makeup water system pipeline and corridor connecting the Harris Reservoir and the Cape Fear River. The pipeline components will transport makeup water from the Cape Fear River to the Harris Reservoir (Figure 4.0-4).

- **Intake Structure and Pumphouse**. The Harris Lake makeup water system intake structure and pumphouse will be constructed on the Cape Fear River (Figure 4.0-5).

- **Harris Lake**. Harris Lake includes both the Harris Reservoir and the Auxiliary Reservoir.

- **Harris Reservoir**. The Harris Reservoir is also known as the Main Reservoir. It does not include the affiliated Auxiliary Reservoir.

- **Harris Reservoir Perimeter**. The Harris Reservoir perimeter describes the area impacted by the 6 m (20 ft.) change in the reservoir's water level.

- **Transmission Corridors and Off-Site Areas**. Transmission corridors and off-site areas describe areas outside the site boundary that may fall within the footprint of new or existing transmission lines.
- **Vicinity**. The vicinity is a band or belt 9.7 kilometers (km) (6 miles [mi.]) wide surrounding the HAR site (Figure 2.0-6). The vicinity includes a much larger tract of land than the HAR site. The vicinity is located within four counties: Wake, Chatham, Harnett, and Lee.
- **Region**. The region applies to the area within an 80-km (50-mi.) radius from the center point of the HAR power block footprint, excluding the site and vicinity (Figure 4.0-6). The following counties are located entirely within the region: Chatham, Durham, Harnett, Lee, Orange, and Wake. The following counties are located partially within the region: Alamance, Caswell, Cumberland, Franklin, Granville, Guilford, Hoke, Johnston, Montgomery, Moore, Nash, Person, Randolph, Richmond, Robeson, Sampson, Scotland, Vance, Wayne, and Wilson. The region includes the economic centers of Raleigh, Durham, Fayetteville, Cary, and Chapel Hill.

9.1 NO-ACTION ALTERNATIVE

The no-action alternative is a scenario under which the U.S. Nuclear Regulatory Commission (NRC) denies the application and HAR 2 and HAR 3 (HAR), as described in ER Chapter 2, is not constructed and no other generating station, either nuclear or non-nuclear, is constructed and operated. As stated in NUREG-1555, *Standard Review Plans for Environmental Reviews of Nuclear Power Plants*:

> The no-action alternative would result in the facility not being built, and no other facility would be built or other strategy implemented to take its place. This would mean that the electrical capacity to be provided by the project would not become available.

The most significant effect of the no-action alternative would be the loss of the potential 2000 megawatts electric (MWe) of energy, which could lead to a reduced ability of existing power suppliers to maintain reserve margins and supply lower-cost power to customers. ER Chapter 8 describes the evaluation of the need for power and discusses a 2-percent annual increase in electricity demand in North Carolina over the next 10 years. The no-action alternative would restrict the ability of Progress Energy Carolinas, Inc. (PEC) to provide safe, reliable baseload power within North Carolina and South Carolina to meet the projected demand obligations of approximately 900 megawatts (MW) additional baseload every 4 years as discussed in ER Section 8.4. Under the no-action alternative, PEC would not be able to satisfy the concerns about climate change and greenhouse gas reductions in North Carolina and the southeastern United States. As discussed in Chapter 8 and Subsection 9.2.1, because this area of the country already imports a portion of its electricity, the ability to import additional resources in a cost-effective manner is limited.

The options outlined above are not optimal from the standpoint of the cost of operation or the cost of supplied power. PEC's fuel supply within the Region of Interest (ROI) could become increasingly dependent on fossil-fuel generation and other alternatives. Without additional capacity, the region would not only remain heavily dependent on fossil fuel generation, it would not recognize the role of fuel diversity in the overall reliability of the State's power system, as discussed in Section 8.4. If PEC took no action at all to meet growth demands, the ability to supply low-cost, reliable power to their customers would be impaired. PEC would not be able to support national goals, as established in the Energy Policy Act (EPACT) of 2005, to advance the use of nuclear energy.

In addition to the benefits in ER Section 10.4, additional benefits of the construction and operation of the HAR include economic and tax impacts to the surrounding region that are described in ER Subsections 4.4.2, 4.4.3, 5.8.2.1, and 5.8.2.2. Under the no-action alternative, none of the benefits of the proposed project as described in this ER would be realized.

Under the no-action alternative, the predicted impacts from the project would not occur at the site. Impacts would result primarily from the construction of the facilities, increasing the operating level of Harris Reservoir and the withdrawal of water from the Cape Fear River. The impacts from construction of the HAR include impacts to land use, water-related impacts, ecological impacts, and socioeconomic impacts as summarized in Table 4.6-1. Impacts resulting from operation are summarized in Table 5.10-1. The benefits of implementing the no-action alternative would include avoiding the impacts resulting from the project as described in the sections referenced above; however, none of the project objectives would be realized.

9.2 ENERGY ALTERNATIVES

This section examines the potential environmental impacts associated with electricity-generating sources other than the HAR. The energy alternatives considered include the following:

- Purchasing electric power from other sources to replace power that would have been generated by the HAR.
- Combining new generating capacity and conservation measures.
- Resorting to other electricity generating alternatives that were deemed not to be viable replacements for the HAR.

The decision to develop a nuclear power plant on land adjacent to the existing Shearon Harris Nuclear Power Plant Unit 1 (HNP) was primarily based on factors such as the proximity to an already licensed station, the ability to incorporate existing environmental permits in the operation and plant parameters, property ownership, proximity to a substation and transmission grid, historic assessments of multiple plants at the HNP site and other location features conducive to the plant's intended generating objective.

Alternatives that do not require new generating capacity were evaluated. These include passive measures such as energy conservation and demand-side management (DSM).

Alternative energy supplies such as wind, geothermal, oil, natural gas, hydropower, municipal solid wastes (MSW), coal, photovoltaic (PV) cells, solar power, wood waste/biomass, energy crops, as well as any reasonable combination of these alternatives were also analyzed.

Alternatives that do not require new generating capacity are discussed in Subsection 9.2.1. Alternative energy supplies are discussed in Subsection 9.2.2. In Subsection 9.2.2, some of the alternatives that require new generating capacity were eliminated from further consideration and discussion based on availability in the region, overall feasibility, and environmental consequences. In Subsection 9.2.3, the alternatives that were not eliminated based on these factors are investigated in further detail relative to specific criteria such as environmental impacts, reliability, and economic costs.

9.2.1 ALTERNATIVES THAT DO NOT REQUIRE NEW GENERATING CAPACITY

This subsection is intended to provide an assessment of the economic and technical feasibility of supplying the demand for energy without constructing new generating capacity. Other alternatives considered include the following:

- Initiating conservation measures (including implementing DSM actions).
- Reactivating or extending the service life of existing plants within the power system.
- Purchasing power from other utilities or power generators.

Refer to ER Chapter 8 for descriptions and assessments of the regional power systems and assessments of alternatives for supply.

9.2.1.1 Initiating Conservation Measures

DSM programs consist of planning, implementing, and monitoring activities of electric utilities to encourage consumers to modify their level and pattern of electricity usage. This can reduce customers' demand for energy through conservation, efficiency, and load management so that the need for additional generation capacity is eliminated or reduced. Those environmental impacts that result from the construction of the proposed facility are avoided if DSM were sufficient to reduce the need for additional power.

These programs are in response to the rising cost of energy and the rising cost of building new electric generating units. A wide variety of conservation technologies are considered as alternatives to generating electricity at current nuclear plants. These technologies include hardware, such as more efficient motors in consumer appliances, commercial establishments, or manufacturing processes; more energy-efficient light bulbs; and improved heating, ventilation, and air conditioning (HVAC) systems. Structures consume less energy when weatherized with better insulation, weather stripping, and storm windows. Conservation measures on the utility side include the installation of more efficient equipment, as it retrofits its power plants and improves distribution and transmission technologies.

Conservation technologies and measures have proven to be popular with some utilities, public utility commissions, and members of the public. Energy conservation is viewed as a way of providing economical service while reducing the need to construct more electric generating facilities. Using integrated planning processes such as PEC's conservation technologies and measures are considered as potential new resources in the utility's portfolio of capabilities.

Under EPACT 2005, a rebate program was established for dwellings and small businesses that install energy efficient systems in their buildings. The rebate was set at $3000 or 25 percent of the expenses, depending on which was less. EPACT 2005 authorized $150 million for 2006 and up to $250 million in 2010. According to the act, renewable energy sources included geothermal, biomass, solar, wind, or any other renewable energy used to heat, cool, or produce electricity for a dwelling (Reference 9.2-001). This new act was established to encourage homeowners and small businesses to become more aware of energy efficient technologies, which could lead to decreased energy usage in the future.

Historically, state regulatory agencies have required regulated utilities to institute programs designed to reduce demand for electricity. DSM has shown great potential in reducing peak-load usage. In 2005, peak-load usage was reduced by approximately 25,710 megawatt electric (MWe), an increase of 9.3 percent from the previous year (Reference 9.2-002); however, DSM costs increased by 23.4 percent. Overall, nominal DSM costs have decreased over the past 10 years (Reference 9.2-003).

The following are additional programs that can be used to directly reduce summer or winter peak loads when needed but will not significantly reduce baseload demand:

- **Large Load Curtailment** — This program provides a source of load that may be curtailed at the company's request to meet system load requirements. Customers who participate in this program receive a credit on their bill.

- **Voltage Control** — This procedure involves reducing distribution voltage by up to 5 percent during periods of capacity constraints. This level of reduction does not adversely affect customer equipment or operations (Reference 9.2-004).

The impact of DSM and conservation programs implemented by PEC on peak and baseload power generation requirements is integrated into the Integrated Resource Plan (IRP) process. As discussed in Subsection 8.3.1, IRP Table 8.1-2 identifies an increase of 2803 MWe under the heading of Generation Additions as "Undesignated". PEC's historical data and future projections indicate that baseload generation is a significant portion of the power needs in the ROI, with peaking generation making up a smaller percentage of generation needs. To meet future generation requirements, PEC will require more than 2500 MWe of new capacity to be in service by 2017. While a portion of the peak load requirements may be deferred by the new DSM programs, which are projected to yield approximately 1000 MWe of peak load reductions, DSM and conservation programs will not eliminate the need for additional baseload generation.

9.2.1.1.1 Conservation Programs

PGN presents the conservation programs currently implemented and under consideration in PEC's DSM Plan (Reference 9.2-004). Based on review of these programs, PEC concludes the following: (1) the benefits and impacts of these additional programs would lower peak demand and possibly slow the need to construct new peaking facilities, but they would result in a minor increase in baseload demand, and (2) the assessment of these potential programs is not yet complete. The final portfolio of DSM programs may include some or all of the above potential initiatives, as well as others being considered but not yet analyzed. PEC will develop more specific proposals and obtain any required regulatory approvals for those programs determined to be cost effective. When this process is complete, the energy and load impacts of the programs will be incorporated into PEC's ongoing resource planning process. The programs discussed above will encourage energy efficiency and reduce peak demand but will not eliminate the need for additional baseload demand generation, as discussed in ER Chapter 8.

9.2.1.2 Reactivating or Extending Service Life of Existing Plants

Retired fossil plants and fossil plants slated for retirement tend to be ones that are old enough to have difficulty in economically meeting today's restrictions on air contaminant emissions. In the face of increasingly stringent environmental restrictions, delaying retirement or reactivating plants to compensate for the closure of a large baseloaded plant would require major construction to upgrade or replace plant components. Currently PEC does not plan to retire any baseload generation plants between now and 2025, which is projected as the sixth year of commercial operation of HAR 3. PEC plans to retire the 12- to 18-MW Combustion Turbine (CT) #1 in Roxboro, North Carolina. The Roxboro CT #1 facility is used only for peak demand and does not provide baseload generation. The retirement of the Roxboro CT #1 facility is discussed in Chapter 8 and has been factored into PEC's current power analysis.

PEC does not have any retired plants that would be suitable for reactivation. PEC has retired the Cape Fear Unit 3 and Unit 4 coal plants, which were rated at approximately 65 MW total. The retired Cape Fear coal plants do not provide a suitable alternative to the construction of a new nuclear power generating plant at HAR because these plants could not be refurbished to meet today's environmental standards. PEC has other retired plants, but none are larger than 20 MW or provide a suitable alternative for construction of a new nuclear power generating plant. PEC does not plan to retire any existing power generation plants between now and 2025.

Upgrading existing plants would be costly and, at the same time, power generation would remain the same. A new baseline facility would allow for the generation of needed power within the ROI. A new 157-MW CT facility (Wayne County Plant) in Goldsboro, North Carolina, is proposed to be online in June 2009 and a new 600-MW combined cycle facility in Richmond County, North Carolina, is proposed to be online in 2011, as identified in Table 8.1-3.

9.2.1.3 Purchasing Power from Other Utilities or Power Generators

As discussed in ER Chapter 8, PEC sells electric energy to supplement small production facilities in the ROI. Under the Public Utility Regulatory Policies Act of 1978 (PURPA), electric utilities are required to offer purchase of electric energy from any small production facilities or cogeneration plants that qualify under PURPA. In addition, North Carolina General Statute (G.S.) 62-156 requires the North Carolina Utilities Commission (NCUC) to determine the rates and contract terms to be observed by electric utilities in purchasing power from small power producers as defined in G.S. § 62-3(27a). The rates established pursuant to G.S. § 62-156 shall not exceed, over the term of the purchase power contract, the incremental cost to the electric utility of the electric energy which, but for the purchase from a small power producer, the utility would generate or purchase from another source. (Reference 9.2-005) Due to the limited number of small production facilities or cogeneration plants and the limitations on output from those facilities, the purchase of electricity from these sources is not a viable alternative for additional baseload capacity.

A list of wholesale purchase power commitments is provided in Table 9.2-1. In addition, PEC is currently negotiating a 150-MWe purchase power contract for the 2010–2019 timeframe. This method is not competitive and would not meet the needs that the 2000-MWe HAR facility would meet (see ER Chapter 8). Because there is not enough electricity to import from nearby states, purchasing power from other utilities or power generators is a less attractive option than the construction of new nuclear units at HAR.

9.2.2 ALTERNATIVES THAT REQUIRE NEW GENERATING CAPACITY

While many methods are available for generating electricity and combinations of those methods can be assimilated to meet system needs, such an expansive approach would be too unwieldy to thoroughly examine each in depth, given the purposes of the alternatives analysis. In keeping with the NRC's evaluation of alternatives to license renewal, a reasonable set of alternatives should be limited to analysis of single discrete electrical generation sources and those electricity generation technologies that are technically reasonable and commercially viable.

The following alternative energies were considered:

- Wind.
- Geothermal.
- Hydropower.
- Solar Power.
  - Concentrating Solar Power Systems.
  - PV Cells.
- Wood Waste (and other Biomass).
- Municipal Solid Waste.
- Energy Crops.
- Petroleum Liquids (Oil).
- Fuel Cells.
- Coal.
- Natural Gas.

Each of these alternatives will be further discussed in other sections, with an emphasis on coal, solar, natural gas, and wind energy. As a renewable resource, solar and wind energies, alone or in combination with one another, have gained increasing popularity over the years because these alternative energy sources have decreased greenhouse gas emissions. Also, air pollutant emissions from solar and wind facilities are much less than fossil fuel air emissions. Although the use of coal and natural gas has become less popular, it is still one of the most widely used fuels for producing electricity. However, based on the installed capacity of 2000 MWe that the HAR facility will produce, not all of the alternative energies discussed in this report will be competitive or viable.

The current mix of power generation options in North Carolina is one indicator of the feasible choices for electricity generation technology within the State. PEC evaluated North Carolina electricity generation capacity and utilization characteristics. "Capacity" is the categorization of the various installed technology choices in terms of its potential output. "Utilization" is the degree to which each choice is actually used.

This subsection identifies alternatives that PEC has determined are not reasonable and the basis for this determination. This Combined License Application (COLA) is premised on the installation of a facility that would serve as a baseload resource and that any feasible alternative would also need to be able to generate baseload power. In performing this evaluation, PEC relied heavily on NRC's Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants.

The GEIS made is useful for analyzing alternative energy sources because the NRC has determinations regarding these potential alternative technologies for the agency to consider the relative environmental consequences of an action given the environmental consequences of other activities that also meet the purpose of the proposed action. To generate the reasonable set of alternatives used in the GEIS, the NRC included common generation technologies and consulted various state energy plans to identify the alternative energy sources typically being considered by state authorities across the country. From this review, the NRC had established a reasonable set of energy source alternatives to be examined. These energy source alternatives include wind energy, PV cells, solar thermal energy, hydroelectricity, geothermal energy, incineration of wood waste and municipal solid waste, energy crops, coal, natural gas, oil, and delayed retirement of existing non-nuclear plants. The NRC has considered these alternatives pursuant to its statutory responsibility under the National Environmental Policy Act (NEPA). Although the GEIS is for license renewal, the alternatives analysis in the GEIS can be compared with the proposed action to determine if the alternative represents a reasonable alternative to the proposed action.

Each alternative is analyzed in the subsequent sections based on the following criteria:

- Is the alternative energy conversion technology mature, proven, and will it be available in the region of interest within the life of the COL?
- Does the alternative energy source provide baseload-generating capacity equivalent to the capacity and to the same level as HAR?
- Do the costs of an alternative energy source exceed the costs that make it economically impractical?

- Is the alternative energy source environmentally preferable to HAR?

Each of the potential alternative technologies considered in this analysis are consistent with national policy goals for energy use and are not prohibited by federal, state, or local regulations. These criteria were not factors in evaluating alternative technologies.

Combined heat and power systems geographically dispersed and located near customers are another source of heat and electrical power. PEC continues to be involved in research and demonstration of the viability of promising new technologies. PEC is currently researching the potential application of fuel cells to deliver electrical energy in operating distributed generation on or near a customer's property. The assessment of this and other potential distributed energy generation programs of fuel cell technology is years away. PEC will continue with research and development through active pilots and demonstrations to help to accelerate the process. Distributed energy generation was not seen as a competitive or viable alternative and was not further examined.

Based on one or more of these criteria, several of the alternative energy sources were considered technically or economically infeasible after a preliminary review and were not considered further. Alternatives that were considered to be technically and economically feasible are further discussed in Subsection 9.2.3.

9.2.2.1 Wind

In general, areas identified as Class 4 and above are regarded as potentially economical for wind energy production with current technology. Wind energy resource classifications are defined by the Department of Energy for the United States.

As a result of technological advances and the current level of financial incentive support, other areas with a slightly lower wind resource (Class 3+) could be suitable for wind development; however, they would operate at an even lower annual capacity factor and output than used by National Renewable Energy Laboratory (NREL) for Class 4 sites.

North Carolina has the potential to produce 7 percent of its electricity through suitable Class 3 and higher sites. This could produce approximately 8 million megawatt hours (MWh). Class 5 and 6 sites are abundant in the western mountains of North Carolina or ROI; however, because of the Mountain Ridge Protection Act of 1983, constructing structures taller than 10.7 m (35 [feet [ft.]) is prohibited in elevations above 915 m (3000 ft.). There are also Class 3 and 4 sites in the western mountains and along the eastern seaboard (Reference 9.2-006).

In any wind facility, the land use could be significant. Wind turbines must be sufficiently spaced to maximize capture of the available wind energy. If the turbines are too close together, one turbine can affect the efficiency of another turbine. A turbine with a generating capacity of 1.5 MWe would require approximately 10.8 hectares (ha) (26.7 acres [ac.]) of dedicated land for the actual placement of the wind turbine. For illustrative purposes, if all of the resources in Classes 3+ and 4 sites were developed using 2-MWe turbines, with each turbine occupying 0.10 ha (0.25 ac.), 9000 MWe of installed capacity would use 455 ha (1125 ac.) just for the placement of the wind turbines alone. Based on the North American Electric Reliability Corporation (NERC) capacity factor, his project would have an average output of 1530 MWe (approximately 0.30 ha [0.73 ac.]/MWe). This is a conservative assumption because Class 3+ sites will have a lower percentage of average annual output.

If a Class 3+ site was available and developed using 2-MWe turbines within the ROI, the equivalent of 12,800 MWe of installed capacity would be needed to produce 2000 MWe of full-time output, due to wind variability. This would encompass a footprint of approximately 648 ha (1600 ac.), which is more than twice the land area needed for HAR. This does not include supporting infrastructure for wind farms, such as access roads, which would require more area. Even if there was enough land area to develop wind turbines, the HNP site is a Class 1 site; therefore, it would not be feasible to construct a wind power facility at the site (Reference 9.2-007).

Although wind technology is considered mature, technological advances could make wind power a more economic choice for developers than other renewables (Reference 9.2-008). Technological improvements in wind turbines have helped reduce capital and operating costs. In 2000, wind power was produced in a range of $0.03 to $0.06/kWh (depending on wind speeds), but by 2020 wind power generating costs are projected to fall to $0.03 to $0.04/kWh) (Reference 9.2-009).

The EIA's *Annual Energy Outlook 2004* can provide the following limitations on the ability of the wind resource to provide baseload (Reference 9.2-010):

- In addition to the construction and operating and maintenance costs for wind farms, there are costs for connection to the transmission grid. Any wind project would have to be located where the project would produce economical generation and that location may be far removed from the nearest possible connection to the transmission system. A location far removed from the power transmission grid might not be economical, as new transmission lines will be required to connect the wind farm to the distribution system. Existing transmission infrastructure might need to be upgraded to handle the additional supply. Soil conditions and the terrain must be suitable for the construction of the towers' foundations. Finally, the choice of a location might be limited by land use regulations and the ability to obtain the required permits from local, regional, and national authorities. The farther a wind energy development project is from transmission lines, the higher the cost of connection to the transmission and distribution system.

- The distance from transmission lines at which a wind developer can profitably build depends on the cost of the specific project. Consider, for example, the cost of construction and interconnection for a 115-kilovolt (kV) transmission line that would connect a 50-MWe wind farm with an existing transmission and distribution network. The EIA estimated, in 1995, the cost of building a 115-kV line to be $130,000 per mile, excluding right-of-way (ROW) costs (Reference 9.2-011). This amount includes the cost of the transmission line itself and the supporting towers. It also assumes relatively ideal terrain conditions, including fairly level and flat land with no major obstacles or mountains (more difficult terrain would raise the cost of erecting the transmission line). In 1993, the cost of constructing a new substation for a 115-kV transmission line was estimated at $1.08 million and the cost of connecting a 115-kV transmission line with a substation was estimated to be $360,000 (Reference 9.2-012).

Another consideration on the integration of the wind capacity into the electric utility system is the variability of wind energy generation. Wind-driven electricity-generating facilities must be located at sites with specific characteristics to maximize the amount of wind energy captured and electricity generated. In addition, for transmission purposes, wind generation is not considered "dispatchable," meaning that the generator cannot control output to match load and economic requirements. Because the resource is intermittent, wind, by itself, is not considered a firm source of baseload capacity. The inability of wind alone to be a dispatchable, baseload producer of electricity is inconsistent with the objectives for the HAR facility.

Wind has environmental impacts in addition to the land requirements posed by large facilities:

- Some consider large-scale commercial wind farms to be an aesthetic problem. Local residents near the wind farms might lose what they consider their pristine scenic view of the area.
- High-speed wind turbine blades can be noisy, although technological advancements continue to lessen this problem.
- Wind facilities sited in areas of high bird use can expect to have fatality rates higher than those expected if the wind facility were not there.

The Center for Biological Diversity (CBD) recently voiced mixed reviews regarding wind farms along migratory bird routes. The CBD supports wind energy as an alternative energy source that would reduce environmental degradation. However, wind power facilities, such as the Altamont Pass Wind Resource Area (APWRA) in California, are increasing mortality rates in raptor populations as a result of turbine collisions and electrocution on power lines. The APWRA kills about 881 to 1300 birds of prey each year. Birds that have been affected to the greatest extent include golden eagles, red-tailed hawks, burrowing owls, great horned owls, American kestrels, ferruginous hawks, and barn owls (Reference 9.2-013).

With the inability of wind power to generate baseload power, the projected land use impacts of development of Class 3+ and Class 4 sites, the cost factors in construction and operation, along with the impacts associated with development, and cost of additional transmission facilities to connect all of these turbines to the transmission system, wind by itself is not a feasible alternative to the new plant. Because off-shore wind farms are non-competitive and not viable with a nuclear reactor at the HAR site, they are not discussed further in this report. The technical constraints associated with siting and construction of off-shore wind turbines are more significant than on-shore wind farms, making off-shore wind power not a feasible alternative to the new plant. Marine environments present a more corrosive setting and may lead to reliability problems with conventional on-shore turbine designs. The length of required transmission corridors associated with off-shore wind farms also presents significant challenges.

Wind power systems produce power intermittently, depending upon when the wind is blowing at sufficient velocity and duration. Despite advances in technology and reliability, capacity factors for wind power systems remain relatively low (25 to 45 percent) compared to 90 to 95 percent industry average for a baseload plant such as a nuclear plant.

Many renewable resources are intermittent, or are not consistently available. Wind is an example of this type of renewable resource. Storing energy from the renewable source allows supply to more closely match demand. An example would be a wind turbine with a storage system could capture energy on a continuous basis. Energy could then be dispatched during periods of peak demand (e.g., midday market) (Reference 9.2-014).

Based on availability of land and wind resources, a wind-powered facility is a less attractive option than the construction of new nuclear units at the HAR site.

9.2.2.2 Geothermal

As shown on Figure 8.4 in the GEIS, geothermal plants could be located in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent; however, meaningful geothermal resources do not exist in North Carolina.

Based on the hottest known geothermal regions of the United States, North Carolina is not a candidate for geothermal energy and could not produce the proposed 2000 MWe of baseload energy (Reference 9.2-015). North Carolina does not have sufficient resources to use geothermal technologies (Reference 9.2-016). Therefore, geothermal energy is not available in the ROI and is a non-competitive alternative to a new nuclear unit at the HNP site. Based on the geographic limitations associated with geothermal technologies, it is a less attractive option than the construction new nuclear units at the HAR site.

9.2.2.3 Hydropower

The GEIS estimates land use of 4144 square kilometers (km^2) (1600 square miles [$mi.^2$]) or approximately 1 million acres per 1000 MWe generated by hydropower. Based on this estimate, hydropower would require flooding more than 9034 km^2 (3488 $mi.^2$) or approximately 2.2 million ac. to produce a baseload capacity of 2000 MWe, resulting in a large commitment of land. Further, operation of a hydroelectric facility would alter aquatic habitats above and below the dam, which would affect existing aquatic species.

The Federal Energy Regulatory Commission (FERC) is required to take environmental issues into consideration when renewing or granting licenses for hydropower. Many environmentalists oppose hydropower dams because of the constraints these dams put on migrating fish species in the area. Also, new dams face opposition from local communities that might be displaced by flooding the new reservoir or use the current river system for recreational activities.

Currently, North Carolina supplies 3.5 percent of the states electricity through hydroelectric supplies. North Carolina has the potential to produce approximately 7 percent of its electricity (8 million MWh) through hydroelectric generation. According to a study performed by the Idaho National Engineering and Environmental Laboratory, North Carolina has 93 undeveloped sites with a 508-MWe generating capacity. Only one site had the potential generating capacity of more than 76 MWe. Furthermore, even if the remaining undeveloped sites were developed, baseload capacity would still not be met. Droughts that have occurred in the past decade could be the most significant hurdle to use of hydropower in North Carolina (Reference 9.2-006). As a result, hydropower is a less attractive option than the construction of new nuclear units at HAR.

9.2.2.4 Solar Power

Solar energy is dependent on the availability and strength of sunlight (strength is measured as kWh/m^2). Solar power is considered an intermittent source of energy. Solar power combined with fossil fuels is a viable power production alternative. However, solar facilities combined with fossil fuel facilities would have equivalent or greater environmental impacts relating to a new nuclear facility at the HNP site. Similarly, solar facilities combined with fossil fuel facilities would have higher costs than a new nuclear facility at the HNP site along with additional construction impacts and only moderately less significant environmental impacts compared to fossil fuel alternatives. A discussion of solar facilities combined with other alternatives is provided in Subsection 9.2.3.3.1.

All technologies provide a fuel-saving companion to a baseload source. These technologies can be divided into two groups. The first group concentrates the sun's energy to drive a heat engine (concentrating solar power systems). The other group of solar power technologies directly converts solar radiation into electricity through the photoelectric effect by using PV cells. Some solar thermal systems can also be equipped with a thermal storage tank to store heated transfer fluid. These solar thermal plants can then dispatch electric power on demand using this stored heat.

Construction of solar power generating facilities has substantial impacts on natural resources (such as wildlife habitat, land use, and aesthetics). As stated in the GEIS for License Renewal, land requirements are high — 141 km^2 (54.5 $mi.^2$) or 34,880 ac. per 1000 MWe for PV and approximately 60 km^2 (23.2 $mi.^2$) or 14,848 ac. per 1000 MWe for solar thermal systems The footprint needed to produce a 2000-MWe baseload capacity would be too large to construct at the proposed plant site.

To look at the availability of solar resources in North Carolina, two collector types must be considered: concentrating collectors and flat-plate collectors. Concentrating collectors are mounted to a tracker, which allows them to face the sun at all times of the day. In North Carolina, approximately 4000 to 4500 watt hours per square meter per day (W[hr.]/m^2/day) can be collected using concentrating collectors. Flat-plate collectors are usually fixed in a tilted position to best capture direct rays from the sun and also to collect reflected light from clouds or off the ground. In North Carolina, approximately 4500 to 5000 W(hr.)/m^2/day can be collected using flat-plate collectors (Reference 9.2-016).

9.2.2.4.1 Concentrating Solar Power Systems

Concentrating solar power plants only perform efficiently in high-intensity sunlight locations, specifically the arid and semi-arid regions of the world (Reference 9.2-017). This does not include North Carolina.

Concentrating solar power plants produce electricity by converting the sun's energy into high-temperature heat using various mirror configurations. The heat is then channeled through a conventional generator through an intermediate medium (e.g., water or salt). Concentrating solar power plants consist of two parts: one that collects the solar energy and converts it to heat and another that converts heat energy to electricity.

There are three kinds of concentrating solar power systems — troughs, dish/engines, and power towers — classified by how they collect solar energy (Reference 9.2-018).

While concentrating solar power technologies currently offer the lowest-cost solar electricity for large-scale electricity generation, these technologies are still in the demonstration phase of development and cannot be considered competitive with fossil- or nuclear-based technologies (Reference 9.2-008).

9.2.2.4.2 "Flat-Plate" Photovoltaic Cells

The second main method for capturing the sun's energy is through the use of PV cells. A typical PV or solar cell might be a square that measures about 10 centimeters (cm) (4 inches [in.]) on a side. A cell can produce about 1 watt of power, which is more than enough to power a watch, but not enough to run a radio.

Available PV cell conversion efficiencies are in the range of approximately 15 percent (Reference 9.2-019). In North Carolina, solar energy can produce an average of 4- to 4.5 kWh/m^2/day and even slightly higher in the summer. This value is highly dependent on the time of year, weather conditions, and obstacles that might block the sun (Reference 9.2-020).

Currently, PV solar power is not competitive with other methods of producing electricity for the open wholesale electricity market. PV solar power will not be a viable alternative because it will not meet the baseload capacity necessary for HAR. When determining the cost of solar systems, the totality of the system must be examined. There is the price per watt of the solar cell, price per watt of the module (whole panel), and the price per watt of the entire system. Systems vary in quality and size, which make it challenging to determine an average price. The average price for modules (dollars per peak watt) increased 9 percent, from $3.42 in 2001 to $3.74 in 2002. For cells, the average price decreased 14 percent, from $2.46 in 2001 to $2.12 in 2002 (Reference 9.2-021). However, the module price does not include the design costs, land, support structure, batteries, an inverter, wiring, and lights or appliances. With all of these included, a full system can cost anywhere from $7 to $20 per watt (Reference 9.2-022). Costs of PV cells in the future could be expected to decrease with improvements in technology and increased production. Optimistic estimates are that costs of grid-connected PV systems could drop to $2275 per kWe ($0.15 per kWh) by 2020 (Reference 9.2-009). These costs would still be significantly more than the costs of power from a new nuclear plant. Therefore, use of PV cells is a less attractive option than the construction of new nuclear units at HAR.

Environmental impacts of solar power systems can vary based on the technology used and the site-specific conditions. Environmental impacts of solar power systems include the following:

- Land use and aesthetics are the primary environmental impacts of solar power.
- Land requirements for each of the individual solar energy technologies are large compared with the land required for a new nuclear plant. The land required for the solar-generating technologies could require up to 6 ha (14.8 ac.)/MWe compared with 0.09 ha (0.23 ac.) per MWe for a nuclear plant. In addition, this land use is pre-emptive; land used for solar facilities would not be available for other uses such as agriculture.

- Depending on the solar technology used, there could be thermal discharge impacts. These impacts would be minor (Subsection 9.2.3). During operation, PV and solar thermal technologies produce no air pollution, little or no noise, and require no transportable fuels.

- There are environmental impacts of PV cells related to manufacture and disposal. The process to manufacture PV cells is similar to that for producing a semiconductor chip. Chemicals used to manufacture PV cells include cadmium and lead. There are potential human health risks from manufacturing and deploying PV systems because there is a risk of exposure to heavy metals, such as selenium and cadmium, during use and disposal. (Reference 9.2-023) There is some concern that landfills could leach cadmium, mercury, and lead into the environment in the long term. Generally, PV cells are sealed and the risk of release is considered slight. However, the long-term impact of these chemicals in the environment is unknown. Another environmental consideration with solar technologies is the lead-acid batteries that are used with some systems. However, the impact of these lead batteries is lessening as batteries become more recyclable, batteries of improved quality are produced, and better quality solar systems that enhance battery lifetimes are created (Reference 9.2-024).

Concentrating solar power systems provide a viable energy source for small power-generating facilities; however, concentrating solar power systems are still in the demonstration phase of development and are not competitive with nuclear-based technologies. PV cell technologies are becoming more popular as costs gradually decrease. However, a supplemental energy source would be needed to meet the HAR facility baseload capacity and the large estimate of land required would make this alternative infeasible. Like wind, capacity factors are too low to meet baseload requirements.

Based on the lack of information regarding large-scale systems able to produce the proposed 2000-MWe baseload capacity and the large land area footprint needed for construction, concentrating solar power systems and "flat-plate" PV cells are less attractive options than the construction of new nuclear units at HAR.

9.2.2.5 Wood Waste (and Other Biomass)

The use of wood waste to generate electricity is mostly limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries, which consume wood and wood waste for energy, benefiting from the use of waste materials that could otherwise represent a disposal problem. However, the largest wood waste power plants are 40 to 50 MWe in size, which would not meet the proposed 2000-MWe baseload capacity.

Nearly all of the wood-energy-using electricity generation facilities in the United States use steam turbine conversion technology. The technology is relatively simple to operate and it can accept a wide variety of biomass fuels. However, at the scale appropriate for biomass, the technology is expensive and inefficient. Therefore, the technology is relegated to applications where there is a readily available supply of low, zero, or negative cost delivered feedstocks.

Construction of a wood-fired plant would have an environmental impact that would be similar to that for a coal-fired plant, although facilities using wood waste for fuel would be built on smaller scales. Like coal-fired plants, wood waste plants require large areas for fuel storage, processing, and waste disposal (i.e., ash). Additionally, operation of wood-fired plants has environmental impacts, including impacts on the aquatic environment and air.

Currently, the capacity for wood waste production in North Carolina from wood waste power plants is 330 MWe. According to a 1993 study performed by Research Triangle Institute for the North Carolina Division of Forest Resources, the potential for wood energy production in North Carolina including captive generation is 1017 MWe (Reference 9.2-025).

Biomass fuel can be used to co-fire with a coal-fueled power plant, decreasing cost from $0.023/kWh to $0.021/kWh. This is only cost effective if biomass fuels are obtained at prices equal to or less than coal prices. In today's direct-fired biomass power plants, generation costs are about $0.09/kWh (Reference 9.2-026).

Construction of a biomass-fired plant would have an environmental impact that would be similar to that for a coal-fired plant, although facilities using wood waste and agricultural residues for fuel would be built on smaller scales. Like coal-fired plants, biomass-fired plants require areas for fuel storage, processing, and waste (i.e., ash) disposal. In addition, operation of biomass-fired plants has environmental impacts, including potential impacts on the aquatic environment and air. Due to the small scale of biomass generating plants, high cost, and lack of an obvious environmental advantage, biomass energy is not a reasonable alternative for baseload power.

9.2.2.6 Municipal Solid Waste

The initial capital costs for MSW plants are greater than for comparable steam turbine technology at wood waste facilities. This difference in cost is caused by the need for specialized waste separation and handling equipment required for MSW plants.

The decision to burn MSW to generate energy is usually driven by the need for an alternative to landfills, rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of the numerous obstacles and factors that could limit the growth in MSW power generation, most of which are environmental regulations and public opposition to siting MSW facilities. The conversion of waste to energy is not a viable option because there is a lack of MSW available in the area.

Estimates suggest that the overall level of construction impacts from an MSW-fired power generation plant should be approximately the same as that for a coal-fired plant. Additionally, MSW-fired power generation plants have the same or greater operational impacts, including impacts on the aquatic environment, air, and waste disposal. Some of these impacts would be MODERATE (see Subsection 9.2.3), but more significant than those from the proposed action.

From 2004 to 2005, 9,112,403 metric tons (10,044,705 tons) of MSW was disposed of in North Carolina. This total includes approximately 108,138 metric tons (119,202 tons) or 1.2 percent from other states. At a population of 8,541,263, this produced a per capita disposal rate of 1.29, which was a 21-percent increase from 1991 to 1992 (Reference 9.2-027). As an MSW reduction method, incineration can be implemented to generate energy and reduce the amount of waste by up to 90 percent in volume and 75 percent in weight (Reference 9.2-028).

There have been cases where coal-fired power plants have mixed pulverized MSW to create a waste consisting of 10 percent MSW and 90 percent coal. Currently, the city of Wilmington, North Carolina, has an MSW direct-combustion system containing 100 percent MSW. This system is able to produce over 7.5 MWe. However, North Carolina currently transports most of its MSW to landfills. From an environmental standpoint, the burning of MSW to create an energy source is the least environmentally favorable option because of particulate and gas emissions, which contradict the State's cleaner smokestack initiative (Reference 9.2-006).

The United States has about 89 operational MSW-fired power generation plants, generating approximately 2500 MWe, or about 0.3 percent of total national power generation. This comes to approximately 28 MWe per MSW-fired power generation plant. This would not meet the proposed 2000-MWe baseload capacity. However, economic factors have limited new construction. Burning MSW produces nitrogen oxides and sulphur dioxide as well as trace amounts of toxic pollutants, such as mercury compounds and dioxins. MSW-fired power generation plants, much like fossil fuel power plants, require land for equipment and fuel storage. The non-hazardous ash residue from the burning of MSW is typically deposited in landfills (Reference 9.2-029). Therefore, MSW-fired power generation is a less attractive option than the construction of new nuclear units at HAR.

9.2.2.7 Energy Crops

In addition to wood and MSW fuels, there are several other concepts for fueling electric generators, including burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive), and gasifying energy crops (including wood waste). None of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload capacity of 2000 MWe.

The National Research Council has evaluated other biomass-derived fuels for the purposes of alternative energy source analysis. These include burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). The National Research Council concluded that none of these technologies had progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant. The other biomass-derived fuels do not represent an acceptable alternative to the proposed project.

Estimates suggest that the overall level of construction impacts from a crop-fired plant should be approximately the same as that for a wood-fired plant. Additionally, crop-fired plants would have similar operational impacts, including impacts on the aquatic environment and air. In addition, these systems have significant impacts on land use because of the acreage needed to grow the energy crops.

Ethanol is perhaps the best known energy crop. It is estimated that 769 ha (1900 ac.) of corn is needed to produce 3,785,412 liters (L) (1 million gallons) of ethanol, and in 2001, North Carolina produced approximately 287,327 ha (710,000 ac.) of corn. Currently in North Carolina, more corn is used for livestock feed than for any other purpose. If ethanol were to be proposed as an energy crop, North Carolina would have to supplement its corn production from nearby states (Reference 9.2-006). Surrounding states also use corn for grain products and do not have the resources to supplement ethanol-based fuel facilities. Therefore, use of energy crops as an alternative source of energy is a less attractive option than the construction of new nuclear units at HAR.

9.2.2.8 Petroleum Liquids (Oil)

From 2002 to 2005, petroleum costs almost doubled, increasing by 92.8 percent. The period from 2004 to 2005 alone produced an average petroleum increase of more than 50 percent (Reference 9.2-030). As a result, from 2005 to 2006, production of electricity by petroleum-fired plants dropped by about 15 percent in North Carolina (Reference 9.2-031). In the GEIS for License Renewal, the staff estimated that construction of a 1000-MWe oil-fired plant would require about 49 ha (120 ac.). Operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant. Based on this, oil-fired power generation is not considered a reasonable alternative to a new nuclear unit at the HNP site.

Oil-fired plants have one of the largest carbon footprints of all the electricity-generating systems analyzed. Conventional oil-fired plants result in emissions of greater than 650 grams of carbon dioxide (CO_2) equivalent/kilowatt-hour (gCO_2eq/kWh). This is approximately 130 times higher than the carbon footprint of a nuclear power generation facility (about 5 gCO_2eq/kWh). Future developments, such as carbon capture and storage (CCS) and co-firing with biomass, have the potential to reduce the carbon footprint of oil-fired electricity generation (Reference 9.2-032).

The economics, apart from fuel price, of oil-fired power generation are similar to those of natural gas-fired power generation. Distillate oil can be used to run gas turbines in a combined-cycle system; however, the cost of distillate oil usually makes this combined-cycle system much less competitive where gas is available. Oil-fired power generation has experienced a significant decline since the early 1970s. Increases in world oil prices have forced utilities to use less expensive fuels; however, certain regions of the United States still depend on oil-fired power generation (Reference 9.2-032). An oil-fired power generation plant as an alternative energy source is not a reasonable or viable alternative.

9.2.2.9 Fuel Cells

Phosphoric acid fuel cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications but progress has been slow. Today, the most widely marketed fuel cells cost about $4500 per kWh of installed capacity. By contrast, a diesel generator costs $800 to $1500 per kWh of installed capacity, and a natural gas turbine can cost even less. DOE has launched an initiative, the Solid State Energy Conversion Alliance, to significantly reduce fuel cell cost. DOE's goal is to cut costs to as low as $400 per kWh of installed capacity by the end of this decade, which would make fuel cells competitive for virtually every type of power application (Reference 9.2-033).

As market acceptance and manufacturing capacity increase, natural-gas-fueled fuel-cell plants in the 50- to 100-MWe range are projected to become available. This will not meet the proposed 2000-MWe baseload capacity. Currently, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation and, therefore, are a less attractive option than the construction of new nuclear units at the HAR.

9.2.2.10 Coal

Coal-fired steam electric plants provide most of the electricity-generating capacity in the United States, accounting for about 52 percent of the electric utility industry's total generation, including co-generation, in 2000 (Reference 9.2-034). Conventional coal-fired plants generally include two or more generating units and have total capacities of 100 MWe to more than 2000 MWe. Coal is likely to continue to be a reliable energy source in the future assuming environmental constraints do not cause the gradual substitution of other fuels (Reference 9.2-035). Concerns over CO_2 emissions and other greenhouse gases and costs have resulted in recent courts, regulatory commissions, state officials, and local and national environmental groups blocking or challenging coal-fired power plants proposed for Kansas, Florida, Illinois, Montana, Colorado, Utah, Nevada, South Dakota, and Texas.

The United States has abundant low-cost coal reserves, and the price of coal for electricity generation is likely to increase at a relatively slow rate. Even with recent environmental legislation, new coal capacity is expected to be an affordable technology for reliable, near-term development and for potential use as a replacement technology for nuclear power plants.

The environmental impacts of constructing a typical coal-fired steam plant are well known because coal is the most prevalent type of power generating technology in the United States. The impacts of constructing a 1000-MWe coal plant on a location that has not previously been developed for any use (i.e., a greenfield site) can be substantial, particularly if it is sited in a rural area with considerable natural habitat. An estimated 688 ha (1729 ac.) would be needed, and this could amount to the loss of about 7.77 km^2 (3 $mi.^2$) or 1920 acres of natural habitat and/or agricultural land for the coal-fired plant site alone, excluding land required for mining and other fuel cycle impacts.

Currently, PEC has eight utility-owned, coal-fired power plants in the ROI. Combustion of coal, particularly in older power plants, is increasingly becoming an issue from an emission standpoint. Recently, the North Carolina legislature passed the Smokestacks Bill which reduced emissions of sulphur dioxide and nitrogen oxides from coal-fired plants by 50 percent by 2009 and 75 percent by 2013 (Reference 9.2-006).

A coal-fueled power plant usually averages about $0.023/kWh. However, co-firing with inexpensive biomass fuel can decrease the cost to $0.021/kWh. This is only cost effective if biomass fuels are obtained at prices equal to or less than coal prices (Reference 9.2-026). Coal is a reasonable alternative energy source and is further discussed in Subsection 9.2.3.

9.2.2.11 Natural Gas

The electric utility sector in North Carolina historically used very little natural gas; however, this has begun to change. According to U.S. Energy Information Administration's North Carolina Profile, gas-fired utility generation increased by an annual growth rate of 22.5 percent (1 percent in 1990 to 7.3 percent in 1999). There are currently 14 natural gas-fired plants being considered for North Carolina. Together, they would be able to generate over 9000 MWe of energy (Reference 9.2-006).

Most environmental impacts of constructing natural gas-fired power generation plants will be similar to those of other large power generating stations. Land use requirements for gas-fired plants are 45 ha (110 ac.) for a 1000 MWe plant; thus land-dependent ecological, aesthetic, erosion, and cultural impacts should be minimal. Siting at a greenfield location would require new transmission lines and increased land-related impacts; whereas, co-locating the gas-fired plant with an existing nuclear plant would help reduce land-related impacts. Also, gas-fired plants, particularly combined cycle and gas turbine, take significantly less time to construct than other plants.

Based on well-known technology, fuel availability, and known environmental impacts associated with constructing and operating a natural gas-fired power generation plant, this source of energy is considered a competitive alternative and is further discussed in Subsection 9.2.3.

9.2.2.12 Integrated Gasification Combined Cycle

Integrated Gasification Combined Cycle (IGCC) is an emerging, advanced technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. The technology is substantially cleaner than conventional pulverized coal plants because major pollutants can be removed from the gas stream before combustion.

The IGCC alternative generates substantially less solid waste than the pulverized coal-fired alternative. The largest solid waste stream produced by IGCC installations is slag, which is a black, glassy, sand-like material that could be a marketable byproduct. Slag production is a function of ash content. The other large-volume byproduct produced by IGCC plants is sulphur, which is extracted during the gasification process and can be marketed rather than placed in a landfill. IGCC units do not produce ash or scrubber wastes.

IGCC technology still has insufficient operating experience for widespread expansion into commercial-scale utility applications. Each major component of IGCC has been broadly used in industrial and power generation applications. However, the integration of coal gasification with a combined cycle power block to produce commercial electricity as a primary output is relatively new and has been demonstrated at only a handful of facilities around the world, including five in the United States.

System reliability is still relatively lower than conventional pulverized coal-fired power plants. There are also problems with integrating gasification and power production. For example, a problem with gas cleaning resulting in uncleaned gas can cause damage to the gas turbine (Reference 9.2-036).

To advance the technology, Southern Company and the Orlando Utilities Commission (OUC) are building a $557 million advanced IGCC facility in Central Florida as part of the U.S. Department of Energy (DOE) Clean Coal Power Initiative. The 285-MWe plant will be built at OUC's Stanton Energy Center near Orlando and will gasify coal using state-of-the-art emissions controls. DOE will contribute $235 million and OUC and Southern Company will contribute $322 million (Reference 9.2-037).

IGCC plants are about 15 to 20 percent more expensive than comparably sized pulverized coal plants partly because of the need for coal gasifier and other specialized equipment. Recent estimates indicate that overnight capital costs for coal-fired IGCC power plants range from $1400 to $1800 per kilowatt (Reference 9.2-038). The production cost of electricity from a coal-based IGCC power plant is about $0.033 to $0.045 per kWh.

Because IGCC technology is currently not cost effective, requires further research to achieve an acceptable level of reliability, and is not a proven technology for baseload generation, an IGCC facility is a less attractive option than the construction of new nuclear units at the HAR.

9.2.3 ASSESSMENT OF REASONABLE ALTERNATIVE ENERGY SOURCES AND SYSTEMS

PEC has identified the significance of the impacts associated with each issue as SMALL, MODERATE, or LARGE. This characterization is consistent with the criteria that NRC established in 10 Code of Federal Regulations (CFR) 51, Appendix B, Table B-1, Footnote 3 as follows:

- SMALL — Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
- MODERATE — Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
- LARGE — Environmental effects are clearly noticeable and are sufficient to destabilize any important attributes of the resource.

Table 9.2-2 presents the impacts associated with various impact categories.

9.2.3.1 Coal-Fired Power Generation

NRC evaluated environmental impacts from coal-fired power generation alternatives in the GEIS and concluded that construction impacts could be substantial partly because of the large land area required for the plant site alone (688 ha [1700 ac.] for a 1000-MWe plant) and the large workforce needed to construct and operate a coal-fired power generation plant. According to NRC, siting a new coal-fired power generation plant where an existing nuclear plant is located would reduce many construction impacts. NRC identified major adverse impacts from operations as human health concerns associated with air emissions, waste generation, and losses of aquatic biota resulting from cooling water withdrawals and discharges.

Operating impacts of new coal plants would be substantial for several reasons. Concerns over adverse human health effects from coal combustion have led to important federal legislation in recent years, such as the Clean Air Act Amendments (CAAA). While emissions from coal-fired power plants are continually improving (i.e., decreasing), these type of facilities emit particulates and chemicals of concern which remain a concern for human health. Air quality would be affected by the release of regulated pollutants, and radionuclides. Public health risks such as cancer and emphysema are considered likely results. Sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) have been identified with acid rain. Substantial solid waste, particularly fly ash and scrubber sludge, would be produced and require constant management. Losses to aquatic biota would occur through impingement and entrainment, and discharge of cooling water to natural water bodies. Socioeconomic benefits can be considerable for surrounding communities in the form of several hundred jobs, substantial tax revenues, and plant spending.

9.2.3.1.1 Air Quality

The air quality impacts of coal-fired power generation are considerably different from those of nuclear power. A coal-fired power plant emits sulphur dioxide (SO_2, as oxides of sulphur [SO_x] surrogate), NO_x, particulate matter (PM), and carbon monoxide (CO), all of which are regulated pollutants. Air quality impacts from fugitive dust, water quality impacts from acidic runoff, and aesthetic and cultural resources impacts are all potential adverse consequences of coal mining.

Air emissions were estimated for a coal-fired power generation facility based on the emission factors contained in U.S. Environmental Protection Agency (USEPA) document, AP-42, Fifth Edition, as posted in the Technology Transfer Network, Clearinghouse for Inventories and Emission Factors (Reference 9.2-039). The emissions from this facility are based on a power generation capacity of 2000 MWe.

The coal-fired power generation facility assumes the use of bituminous coal fired in a circulating fluidized bed combustor (FBC). The sulphur content of the coal was assumed to be 2 percent by weight. Emissions control included the use of lime in the combustor unit, a wet scrubber system to control acid gas emissions, selective catalytic reduction to minimize NO_x emissions and a baghouse to control PM. Table 9.2-3 summarizes the air emissions produced by a 2000-MWe coal-fired power generation facility.

Coal burning power systems have the largest carbon footprint of all the electricity generation systems analyzed. Conventional coal systems result in emissions of greater than 1000 gCO_2eq/kWh. This is approximately 200 times higher than the carbon footprint of a nuclear power generation facility (about 5 gCO_2eq/kWh). Lower emissions can be achieved using new gasification plants (less than 800 gCO_2eq/kWh), but this is still an emerging technology and is not as widespread as proven combustion technologies. Future developments, such as

CCS and co-firing with biomass, have the potential to reduce the carbon footprint of coal-fired power generation (Reference 9.2-032).

According to the NRC, air emission impacts from fossil fuel power generation are greater than nuclear plant air emission impacts; human health effects from coal combustion are also greater, and acid rain is one potential impact. Therefore, air impacts from coal combustion power generation would be considered MODERATE to LARGE.

9.2.3.1.2 Waste Management

Substantial solid waste, especially fly ash and scrubber sludge, would be produced and would require constant management.

With proper placement of the HAR facility, coupled with current waste management and monitoring practices, waste disposal would not destabilize any resources.

An estimated 8900 ha (22,000 ac.) for mining the coal and disposing of the waste could be committed to supporting a coal plant during its operational life (Table 9.2-2).

Based on these factors, waste management impacts would be MODERATE.

9.2.3.1.3 Economic Comparison

DOE has estimated the cost of generating electricity from a coal facility to be approximately $0.043 to $0.049 per kWh. The projected cost associated with operating a new nuclear facility similar to the HNP facility is in the range of $0.031 to $0.046 per kWh (Reference 9.2-040).

9.2.3.1.4 Other Impacts

Construction of a coal facility could affect as much as 700 ha (17,000 ac.) of land for a 1000 MWe and associated terrestrial habitat, and additional land would be needed for waste disposal. As a result, land use impacts would be MODERATE.

Impacts on aquatic resources and water quality would be minimized and could be construed as SMALL.

New power plant structures and tall stacks, potentially visible for 64 km (40 mi.) in a relatively non-industrialized area, would need to be constructed along with a possible cooling tower and associated plumes. As a result, aesthetic impacts would be LARGE.

Cultural resources, ecological resources, and threatened and endangered species impacts would be SMALL as a result of an already disturbed HNP site.

Socioeconomic impacts would result from the approximately 250 people needed to operate the coal-fired facility, and would include several hundred mining jobs and additional tax revenues associated with the coal mining. As a result, socioeconomic impacts would be MODERATE (beneficial). Adverse impacts for socioeconomics would be SMALL.

As a result of increased safety technologies, accident impacts would be SMALL.

As a result of increased air emissions and public health risks, human health impacts would be MODERATE.

9.2.3.1.5 Summary

A coal-fired plant is not environmentally preferable when compared to a nuclear plant. Also, if a coal-fired plant was constructed on the HNP site it would need to generate power in excess of 2000 MWe. The nuclear plant requires a dry land footprint of 78 ha (192 ac.) and an additional 1497 ha (3700 ac.) of inundated footprint; whereas, the coal-fired plant would require dry land and a footprint of 688 ha (1700 ac.) and a similar amount of inundated footprint as a nuclear plant. Therefore, a 2000-MWe coal-fired power generation plant would not be an environmentally preferable alternative with the land area currently available.

9.2.3.2 Natural Gas Power Generation

Most environmental impacts of constructing natural gas-fired plants should be approximately the same for steam, gas-turbine and combined-cycle plants. These impacts might be similar to those of other large power generating stations. The environmental impacts of operating natural gas-fired plants are generally less than those of other fossil fuel technologies of equal power generation capacity. Consumptive water use is about the same for steam plants as for other technologies. Water consumption is likely to be less for gas-turbine plants.

9.2.3.2.1 Air Quality

Natural gas is a relatively clean-burning fossil fuel. Also, because the heat recovery steam generator does not receive supplemental fuel, the combined-cycle operation is highly efficient (56 percent versus 33 percent for the coal-fired alternative). Therefore, the gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Control technology for gas-fired turbines focuses on the reduction of NO_x emissions.

Generally, air quality impacts for all natural gas technologies are less than for other fossil fuel technologies because fewer pollutants are emitted and SO_2, a contributor to acid precipitation, is not emitted at all.

Air emissions were estimated for a natural gas-fired power generation facility based on the emission factors contained in USEPA document, AP-42, Fifth Edition as posted in the Technology Transfer Network, Clearinghouse for

Inventories and Emission Factors (Reference 9.2-039). The emissions from this facility are based on a power generation capacity of 2000 MWe.

Current gas-powered electricity generation has a carbon footprint that is about half that of coal (about 500 gCO_2eq/kWh), because gas has a lower carbon content than coal. This is approximately 100 times higher than the carbon footprint of a nuclear power generation facility (about 5 gCO_2eq/kWh). Like coal-fired plants, gas plants could co-fire biomass to reduce carbon emissions in the future (Reference 9.2-032).

The natural gas-fired power generation facility assumes the use of a combined cycle gas turbine generator (GTG). Water injection is used to control nitrogen oxides emissions. Table 9.2-3 summarizes the air emissions produced by a 2000-MWe natural gas-fired power generation facility. Based on emissions generated from a natural gas-fired power generation facility, air quality impacts would be MODERATE.

9.2.3.2.2 Waste Management

Gas-fired power generation would result in almost no waste generation, producing minor (if any) impacts; therefore, impacts associated with waste management would be SMALL.

9.2.3.2.3 Other Impacts

Construction of the power block would disturb approximately 24 ha (60 ac.) of land and associated terrestrial habitat, and 4 ha (10 ac.) of land would be needed for pipeline construction. Inundated land requirements would be similar to a proposed nuclear plant. As a result, land use impacts would be SMALL to MODERATE.

Consumptive water use is about the same for steam plants as for other technologies. There are potential impacts on aquatic biota through impingement and entrainment, and increased water temperatures in receiving water bodies. Water consumption is likely to be less for gas-turbine plants. Water quality impacts would be SMALL.

Structures to support gas-fired power generation would not be significantly different from that proposed for the HAR site. As a result, aesthetic impacts would be SMALL.

Cultural resources, ecological resources, and threatened and endangered species impacts would be SMALL as a result of an already disturbed HNP site.

Socioeconomic impacts would result from the approximately 150 people needed to operate the gas-fired power generation facility, as estimated in the GEIS. As a result, socioeconomic impacts would be SMALL.

As a result of increased safety technologies, accidents and human health impacts would be SMALL.

9.2.3.2.4 Summary

The gas-fired alternative defined by PEC in Subsection 9.2.2.11 would be located at the HNP site. The natural gas generation alternative at the HNP site would require less land area than the coal-fired plant but more land area than the nuclear plant. The gas-fired alternative alone would require 45 ha (110 ac.) for a 1000-MWe generating capacity. An additional 1457 ha (3600 ac.) of land would be required for wells, collection stations, and pipelines to bring the natural gas to the generating facility. Therefore, constructing a natural gas generation plant would not be an environmentally preferable alternative for the HNP site.

9.2.3.3 Combination of Alternatives

The HAR facility will have a baseline capacity of approximately 2000 MWe. Any alternative or combination of alternatives would be required to generate the same baseline capacity.

Because of the intermittent nature of the resource and the large land requirements, wind and solar energies are not sufficient on their own to generate the equivalent baseload capacity or output of the HAR facility, as discussed in Subsections 9.2.2.1 and 9.2.2.4. The large land requirements and other limitations, such as the proven reliability of large-scale operations, result in a combined wind-solar powered facility as a less attractive option than new nuclear units at the HAR site. As discussed in Subsections 9.2.3.1 and 9.2.3.2, fossil-fired power generation could meet baseload capacity but its environmental impacts are greater than those of a nuclear facility.

Alternatives may be combined, but such combinations should be sufficiently complete, competitive and environmentally preferable for NRC to appropriately compare them with the proposed nuclear plant.

9.2.3.3.1 Determination of Viability of Hybrid Alternatives

Many possible combinations of alternatives could theoretically satisfy the baseload capacity requirements of the HAR. Some combinations can include renewable sources, such as wind and solar. Wind and solar do not, by themselves, provide a reasonable alternative energy source to match the baseload power to be produced by the HAR. However, wind and solar, combined with fossil fuel-fired power plant(s), could generate baseload power to be considered a reasonable alternative to nuclear energy produced by the HAR. However, as noted in Subsection 9.2.3.3 and discussed in detail in the sections below, environmental impacts, such as land requirements and aesthetics and lack of guaranteed reliability of wind and solar, make this not a viable combination of alternatives.

The ability to generate baseload power in a consistent, predictable manner meets the business objective of the HAR. Therefore, when assessing combinations of alternatives to the HAR, their ability to generate baseload power must be the determining feature when analyzing their effectiveness. This subsection reviews the ability of the combination alternative to have the capacity to generate baseload power equivalent to the HAR.

When examining a combination of alternatives that would meet the business objectives similar to that of the HAR, any combination that includes a renewable power source (either all or part of the capacity of the HAR) must be combined with a fossil-fuel power generation facility equivalent to the generating capacity of the HAR. This combination would allow the fossil-fueled portion of the combination alternative to produce the needed power if the renewable resource is unavailable and to be displaced when the renewable resource is available. For example, if the renewable portion is some amount of potential wind generation and that resource became available, then the output of the fossil-fuel power generation portion of the combination alternative could be lowered to offset the increased power generation from the renewable portion. This facility, or facilities, would satisfy business objectives similar to those of the HAR in that it would be capable of supporting fossil-fuel baseload power.

CO_2 is the principal greenhouse gas from power-generating facilities that combust solid or liquid fuels. If the source of the carbon is biomass or derived from biomass (ethanol), then the impact is carbon neutral. If the source of the carbon is fossil fuel, then there is a net increase in atmospheric CO_2 concentrations and global climate change unless the carbon emissions are offset or sequestered.

Coal- and gas-fired power generation has been examined as having environmental impacts that are equivalent to or greater than the impacts of HAR. Based on the comparative impacts of these two technologies, as shown in Table 9.2-2, it can be concluded that a gas-fired power generation facility would have less of an environmental impact than a comparably sized coal-fired power generation facility. In addition, the operating characteristics of gas-fired power generation are more amenable to the type of load changes that could result from including renewable generation such that the baseload generation output of 2000 MWe is maintained. "Clean coal" power plant technology could decrease the air pollution impacts associated with burning coal for power. Demonstration projects show that clean coal programs reduce NO_x, SO_x, and particulate emissions. However, clean coal technology is not a proven technology for baseload generation and environmental impacts are still greater than the impacts from natural gas (Reference 9.2-041). Therefore, for the purpose of examining the impacts from a combination of alternatives to the HAR, a facility equivalent to that will be used in the environmental analysis of combination alternatives. The analysis accounts for the reduction in environmental impacts from a gas-fired facility when power generation from the facility is displaced by the renewable resource. Use of renewable in conjunction with fossil only marginally reduces fossil-fuel use and environmental impacts by the renewable's capacity factor.

Additionally, the renewable portion of the combination alternative would be any combination of renewable technologies that could produce power equal to or less than the HAR at a point when the resource was available. This combination of renewable energy and natural gas-fired power generation represents a viable mix of non-nuclear alternative energy sources.

Many types of alternatives can be used to supplement wind energy, such as solar power. PV cells are another source of solar power that would complement wind power by using the sun to produce energy while wind turbines use windy and stormy conditions to generate power. Wind and solar facilities combined with fossil fuel facilities (coal, petroleum) could also be used to generate baseload power, but depend on capacity factors and would result in construction impacts associated with building two facilities. Therefore, wind and solar facilities combined with fossil fuel facilities would have equivalent or greater environmental impacts compared with those of a new nuclear facility at the HNP site. Similarly, wind and solar facilities combined with fossil fuel facilities would cost more than a new nuclear facility at the HNP site. Therefore, wind and solar facilities combined with fossil fuel facilities are a less attractive option than the construction of new nuclear units at HAR.

9.2.3.3.2 Environmental Impacts

The environmental impacts associated with a gas-fired power generation facility sized to produce power equivalent to the HAR have already been analyzed. Depending on the level of potential renewable output included in the combination alternative, the level of impact of the gas-fired portion will be comparably lower. If the renewable portion of the combination alternative were not enough to displace the power produced by the fossil-fuel power generation facility, then there would be some level of impact associated with the fossil-fuel power generation facility. Consequently, if the renewable portion of the combination alternative were sufficient to displace the output of the gas-fired power generation facility, then, when the renewable resource is available, the output of the fossil-fuel power generation facility could be eliminated; thereby, eliminating its operational impacts. Types of environmental impacts from these hybrid plants or combination of facilities can be determined by studying impacts from similar projects.

For instance, in 1984, Luz International, Ltd. built the Solar Electric Generating System (SEGS) plant in the California Mojave Desert. The SEGS technology consists of modular parabolic-trough solar collector systems, which use oil as a heat transfer medium. The Luz technology uses a natural-gas-fired boiler as an oil heater to supplement the thermal energy from the solar field or to operate the plant independently during evening hours. SEGS I was installed at a total cost of $62 million (about $4500/kW) and generates power at $0.24/kWh (in 1988 real levelized dollars). The improvements incorporated into the SEGS III-VI plants (about $3400/kW) reduced generation costs to about $0.12/kWh, and the third-generation technology, embodied in the 80-MWe design at an installed cost of $2875/kW, further reduced power costs to $0.08 to $0.10/kWh. Because solar energy is not a concentrated source, the dedicated land requirement for the Luz plants is large compared with conventional plants, on the order of 5 ac/MWe (2 ha/MWe), compared with 0.23 ac/MWe for a nuclear plant (Reference 9.2-042).

Parabolic-trough solar power plants require a significant amount of land; typically the use is pre-emptive because parabolic troughs require the land to be graded level. According to a California Energy Commission (CEC) report, 5 to 10 ac/MWe is necessary for concentrating solar power technologies such as trough systems (Reference 9.2-023).

The environmental impacts associated with a solar and a wind facility equivalent to the HAR has already been analyzed. It is reasonable to expect that the impacts associated with an individual unit of a smaller size would be similarly scaled. It is anticipated that the renewable portion of the combination alternative would not generate power equivalent to that of the HAR due to capacity factors and the combination alternative would have to rely on the gas-fired portion to meet the equivalent capacity of the HAR. Consequently, if the renewable portion of the combination alternative has a potential output that is equal to that of the HAR, then the impacts associated with the gas-fired portion of the combination alternative would be somewhat lower in terms of operation but the impacts associated with the renewable portion would be greater. The gas-fired power generation facility alone has impacts that are greater than those of the HAR; some environmental impacts of renewables are also greater than or equal to those of the HAR. The combination of a gas-fired power plant and wind or solar power facilities would have environmental impacts that are equal to or greater than those of a nuclear facility:

- Environmental impacts of a new nuclear plant at the HNP and environmental impacts from a gas-fired power plant are SMALL, except for air quality impacts from a gas-fired power generation facility, which are MODERATE. Impacts from wind and/or solar power generation facilities combined with a gas-fired power generation facility would be SMALL and, therefore, would be equivalent to the air quality impacts from a nuclear facility.

- Environmental impacts of a new nuclear plant at the HNP and environmental impacts from wind and solar power generation facilities are SMALL, except for land use and aesthetic impacts from wind and solar power generation facilities, which range from MODERATE to LARGE. Use of a gas-fired power generation facility combined with wind and solar facilities would reduce the land use and aesthetic impacts from the wind and solar power generation facilities. However, at best, those impacts would be SMALL and, therefore, would be equivalent to the land use and aesthetic impacts from a nuclear facility.

Based on these findings, the combination of wind, solar, and gas-fired power generation facilities is not environmentally preferable to the HAR.

9.2.3.3.3 Summary

Wind and solar power generation facilities combined with fossil fuel power plants could be used to generate baseload power and would serve the purpose of the HAR facility. However, wind and solar power generation facilities combined with fossil fuel facilities would have equivalent or greater environmental impacts compared with those of a new nuclear facility at the HNP site. Similarly, wind and solar power generation facilities combined with fossil fuel facilities would cost more and require more land than a new nuclear facility at the HNP site. Therefore, wind and solar power generation facilities combined with fossil fuel facilities are not environmentally preferable to a new facility at HNP site.

9.2.4 CONCLUSION

Based on environmental impacts, PEC has determined that neither a coal-fired, nor a gas-fired power generation facility, nor a combination of alternatives, including wind and solar power generation facilities, would provide an appreciable reduction in overall environmental impacts relative to a nuclear plant. Furthermore, each of these types of alternatives, with the possible exception of the combination alternative, would entail a significantly greater environmental impact on air quality than would a nuclear plant. To achieve the SMALL air quality impact in the combination alternative, a MODERATE to LARGE impact on land use would be needed. Therefore, PEC concludes that neither a coal-fired, nor a gas-fired power generation facility, nor a combination of alternatives would be environmentally preferable to a nuclear plant.

9.2.5 REFERENCES

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Table 9.2-1
Wholesale Purchase Power Commitments

Purchase	In-Service Date	Contract End Date	Summer Rating MWe	Winter Rating MWe
SEPA	various	perpetual	95	95
NUG–Cogeneration	various	various	179	179
NUG–Renewables	various	various	4	4
AEP/Rockport #2	01/01/90	12/31/09	250	250
Broad River CTs #1-5	2001-2002	2021-2022	816	841

Source: Reference 8.0-002

Table 9.2-2 (Sheet 1 of 2)
Impacts Comparison Table

Impact Category	Proposed Action (HAR)	Coal-Fired Power Generation	Gas-Fired Power Generation	Combinations of Alternatives
Air Quality	**SMALL**	**MODERATE to LARGE** SO_2 = 565 (623) NO_2 = 1000 (1102) CO = 6000 (6610)	**MODERATE** SO_2 = 24 (26) NO_2 = 900 (993) CO = 208 (229)	**SMALL to LARGE**
Waste Management	**SMALL**	**MODERATE** Substantial amount of scrubber sludge and fly ash produced	**SMALL**	**SMALL to MODERATE**
Land Use	**SMALL to MODERATE**	**MODERATE** Waste disposal 243 ha (600 ac.) Coal storage and power block area 121 ha (300 ac.)	**SMALL to MODERATE**	**SMALL to LARGE**
Water Quality	**SMALL**	**SMALL**	**SMALL**	**SMALL**
Aesthetics	**SMALL**	**LARGE** Plant structures and tall stacks potentially visible for 64 km (40 mi.) in a relatively non-industrialized area	**SMALL**	**SMALL to LARGE**
Cultural Resources	**SMALL**	**SMALL**	**SMALL**	**SMALL**
Ecological Resources	**SMALL**	**SMALL**	**SMALL**	**SMALL**
Threatened & Endangered Resources	**SMALL**	**SMALL**	**SMALL**	**SMALL**
Socioeconomics	**SMALL (Adverse) and MODERATE (Beneficial)**	**SMALL (Adverse) and MODERATE (Beneficial)** 250 people needed to operate facility, several hundred mining jobs, and additional tax revenues	**SMALL**	**SMALL (Adverse) and MODERATE (Beneficial)**

Table 9.2-2 (Sheet 2 of 2)
Impacts Comparison Table

Impact Category	Proposed Action (HAR)	Coal-Fired Power Generation	Gas-Fired Power Generation	Combinations of Alternatives
Accidents	**SMALL**	**SMALL**	**SMALL**	**SMALL**
Human Health	**SMALL**	**MODERATE** (See Air Quality)	**SMALL**	**SMALL to MODERATE**

Notes:
SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE - Environmental effects are sufficient to alter noticeably, but not destabilize, any important attribute of the resource.

LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Table 9.2-3
Air Emissions from Alternative Power Generation Facilities

Fuel	Coal[(a)]	Natural Gas[(b)]
Combustion Facility	Circulating FBC	Combined Cycle GTG
Generation Capacity	2000 MWe	2000 MWe
Air Pollutant Emissions (metric tons (tons) per year)		
Sulphur Dioxide (SO_2)	565 (623)	24 (26)
Nitrogen Dioxide (NO_2)	1000 (1102)	900 (993)
Carbon Monoxide (CO)	6000 (6610)	208 (229)
Particulate Matter (PM)	28 (31)	45 (50)
PM. Less than 10 um (PM_{10})	21 (23)	33 (36)
Carbon Dioxide, equiv. (CO_2e)	2,357,900 (2,599,141)	769,800 (848,553)

Notes:
a) AP-42 Section 1.1, Tables 1.1-3, 1.1-4 and 1.1-20.

b) AP-42 Section 3.1, Table 3.1-1 and 3.2-2a.

9.3 ALTERNATIVE SITES

In accordance with NUREG-1555, Section 9.3, this section identifies and evaluates a set of alternatives to the HAR, which will be co-located with existing HNP. The objective of this evaluation is to verify that there are no "obviously superior" sites for the eventual construction and operation of the HAR facilities.

9.3.1 SITE COMPARISON AND SELECTION PROCESS

The site comparison and selection process focuses on identifying and evaluating locations that represent a range of reasonable alternative sites for the proposed project. The primary objective of the site selection process is to determine if any alternative site is "obviously superior" to the preferred site for eventual construction and operation of the proposed reactor units.

The components of the site-comparison process as defined in the Environmental Standard Review Plan (ESRP) include the ROI, candidate areas, potential sites, candidate sites, and preferred site. The components are defined as follows:

- The ROI is the largest area considered, and is the geographic area within which sites suitable for the size and type of nuclear power plant proposed by the applicant are evaluated. The basis for an ROI can be the state in which the proposed site is located, or the relevant service area for the proposed plant.

- Candidate areas are areas located within the ROI containing desirable sites. Areas of the ROI that are unacceptable in terms of safety considerations, prohibited areas, geographic or engineering restrictions, and environmental restrictors are omitted from the site selection process. These can initially be determined with reconnaissance level information.

- Potential sites are locations within candidate areas. Whether or not a potential site is evaluated further depends on criteria such as general safety issues, environmental criteria, transmission capability, and market analysis.

- Candidate sites are those sites that are within the ROI and that are considered in the comparative evaluation of sites to be among the best that can reasonably be considered for the siting of a nuclear power plant. These are sites that would be expected to be granted construction permits and operating licenses. Candidate sites are chosen from the list of potential sites using a defined site selection methodology. To be considered as candidate sites, a location must meet the following criteria as outlined in NUREG-1555, Environmental Standard Review Plan (ESRP), Section 9.3(III)(4c):

- Consumptive use of water should not cause significant adverse effects on other users.

- There should not be any further endangerment of federal, state, regional, local, and affected Native American tribal listed threatened, endangered, or candidate species.
- There should not be any potential significant impacts to spawning grounds or nursery areas of populations of important aquatic species on federal, state, regional, local, and affected Native American tribal lists.
- Discharges of effluents into waterways should be in accordance with federal, state, regional, local, and affected Native American tribal regulations and would not adversely affect efforts to meet water quality objectives.
- There would be no preemption of or adverse effects on land specially designated for environmental, recreational, or other special purposes.
- There would not be any potential significant impact on terrestrial and aquatic ecosystems, including wetlands, which are unique to the resource area.
- Population density and numbers conform to 10 CFR 100.
- There are no other significant issues that affect costs by more than 5 percent or that preclude the use of the site.
- The proposed (or preferred) site is the candidate site that is submitted to the NRC by the applicant as the proposed location for a nuclear power plant. The alternative sites are those candidate sites that are further evaluated to determine if there is an obviously superior site for the location of the new nuclear power plant.

The site comparison process, as defined in the ESRP, first evaluates the ROI (ER Chapter 8) and identifies candidate areas. Within the candidate areas, potential sites are chosen. From the potential sites, candidate sites are chosen and evaluated. Finally, a preferred site is selected from among the candidate sites. The preferred site is compared with the candidate sites to determine if any are environmentally preferable. The basic constraints and limitations of the site selection process are the currently implemented rules, regulations, and laws within the federal, state, and local agency levels. These provide a comprehensive basis and an objective rationale under which this selection process is performed.

The review of alternative sites consists of a two-part sequential test for whether a site is "obviously superior" to the ESRP preferred site. The first part of the test determines whether there are "environmentally preferred" sites among the candidate sites. The standard is one of "reasonableness," considering whether the applicant has performed the following:

- Identified reasonable alternative sites.
- Evaluated the likely environmental impacts of construction and operation at these sites.
- Used a logical means of comparing sites that lead to the applicant's selection of the proposed site.

If one or more alternative sites are environmentally preferable, the estimated "costs" of the new plant at the proposed site and the alternative sites are compared (e.g., environmental, socioeconomic, cost, construction time, and others identified in NUREG-1555). To find an obviously superior alternative site, the applicant may determine the following:

- One or more important aspects, either individually or in combination, of a reasonably available alternative site are obviously superior to the corresponding aspects of the applicant's proposed site.
- The alternative site does not have offsetting deficiencies in other important areas.

Siting new units at existing nuclear sites has provided another option in the way alternatives are reviewed and selected. Existing sites offer decades of environmental and operational information about the effect of a nuclear plant on the environment. The NRC recognizes (in NUREG-1555, ESRP, Section 9.3[III][8]) the following regarding proposed sites:

> Recognize that there will be special cases in which the proposed site was not selected on the basis of a systematic site-selection process. Examples include plants proposed to be constructed on the site of an existing nuclear power plant previously found acceptable on the basis of a National Environmental Policy Act (NEPA) review and/or demonstrated to be environmentally satisfactory on the basis of operating experience, and sites assigned or allocated to an applicant by a state government from a list of state-approved power plant sites. For such cases, the reviewer should analyze the applicant's site-selection process only as it applies to candidate sites other than the proposed site, and the site comparison process may be restricted to a site-by-site comparison of these candidates with the proposed site. As a corollary, all nuclear power plant sites within the identified region of interest having an operating nuclear power plant or a construction permit issued by the NRC should be compared with the applicant's proposed site.

In addition to meeting all applicable regulations and guidelines, the following factors, based on the applicant's preference, influenced the decision to review sites:

- The selected site must be suitable for the design parameters for the new plant design.
- The location must be compatible with the applicant's current system and transmission capabilities.
- The selected site's expected licensing and regulatory potential must minimize the schedule and financial risk for establishing new baseload generation.

A greenfield site is a location that has not been previously developed for any use. For the purposes of this site analysis, PEC reviewed potential effects of developing a greenfield site. PEC assumed that the greenfield site would be located in an area that met the siting criteria of 10 CFR 100. As a result, the characteristics of the site could be largely rural. For the purposes of this analysis, PEC further assumed that the site would be near a supply of cooling water. PEC assumed that the site would consist of at least 200 to 400 hectares (ha) (500 to 1000 acres [ac.]) to accommodate construction and operation needs. PEC assumed that the general environmental considerations associated with construction and operation at a greenfield site would be similar to those discussed in NUREG-1555 and ER Chapters 4 and 5.

9.3.1.1 PEC's Site Selection Process

This subsection describes processes and criteria used to identify and evaluate alternative sites and select a proposed site as the geographic location for the PEC COLA. The information in this subsection is consistent with the special case noted in NUREG-1555, ESRP, Section 9.3(III)(8). The overall objective of the site selection process was to verify that no site is "environmentally preferable," (and thus no site is "obviously superior") for the siting of a new nuclear plant and to identify a nuclear power plant site that 1) meets PEC's business objectives for the COL project, 2) satisfies applicable NRC site suitability requirements, and 3) is compliant with NEPA requirements regarding the consideration of alternative sites.

The PEC Nuclear Power Plant Siting Study Report (Reference 9.3-001) was used to determine whether or not any ESRP alternative sites are environmentally preferable to the ESRP proposed site. As discussed in the PEC siting study, site selection evaluation was conducted in accordance with the overall process outlined in the industry standard EPRI *Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application* (*Siting Guide*), March 2002.

The EPRI Siting Guide, as adopted for the PEC siting study, provides four steps in the site selection process whereby the ROI is initially subjected to exclusionary considerations. The EPRI Siting Guide does not identify candidate areas. The ESRP guidance recommends the evaluation of candidate areas. The ROI is conservative and includes all potential candidate areas. Therefore, a separate evaluation of candidate areas as recommended by the ESRP is not required. The identification of "potential sites" resulting from the site selection process within the ROI is further analyzed against avoidance considerations that are reduced to a small number of "candidate sites." To identify EPRI alternative sites, EPRI candidate sites are evaluated based on 10 criteria that are consistent with the ESRP siting criteria. EPRI alternative sites are further evaluated with a more stringent process that includes 26 siting criteria, which are more stringent than the ESRP criteria in some cases. The terminology used to describe sites considered under the EPRI and ESRP criteria are similar but have slight differences. The discussion that follows defines which criteria (i.e., EPRI or ESRP) are applicable to the site terminology.

A suitability evaluation of specific criteria then determines the highest ranked EPRI "alternative sites" best suited for a nuclear plant. These sites are finally subjected to business strategy considerations to determine the EPRI "preferred site." The four-step evaluation and selection process is summarized below:

Step 1 — Exclusionary considerations for the potential sites in the ROI:

- Lack of Water.
- Population Restrictions.
- Federal or State Parks.
- Geologic Features.

Step 2 — Avoidance considerations for the candidate sites:

- Water Use Moratoriums.
- Cultural or Historical Limitations.
- State or Local Governmental Restrictions.
- Presence of Wetlands.

Step 3 — Application of Suitability Criteria to score and rank alternative sites:

- Health and Safety Criteria.
- Environmental Criteria.
- Socioeconomic Criteria.
- Engineering and Cost-Related Criteria.

Step 4 — Verification and confirmation whereby site differentiation draws conclusion to the preferred site for PEC:

- Business Strategic Considerations.
- Transmission Modeling and Analysis.

Sites were evaluated based on the assumption that a twin-unit plant, AP1000 design will be built and operated. This assumption provided a realistic, consistent basis for evaluation of site conditions against site requirements for a nuclear power plant design.

During the evaluation process for locating an optimal site for building and operating an advanced reactor type for new nuclear baseload generation, certain key assumptions and/or criteria were used as "bounding conditions" to aid in the evaluation process. By invoking these key assumptions and/or criteria, the relative values for a particular attribute of the various siting locations were determined.

- The new nuclear baseload generation must reach commercial in-service status by mid-2015.
- The new nuclear plant siting location must be suitable to envelope the range of specific design parameters contemplated for deployment of a standard plant design as certified by the NRC.
- The location must be compatible with PEC's System Operation and Transmission Delivery capabilities.
- The recommended site's expected licensing path and regulatory outlook must reduce PEC's schedule and financial risk for establishing new nuclear baseload generation.
- The cost of the new nuclear generation as affected by the location must be reasonable and fair, and methods to ensure greater certainty of the cost/schedule during the licensing, design engineering, and construction phases of the project must be included.
- Evaluation criteria and methodology established as part of the EPRI Early Site Permit Demonstration Program will be employed in the nuclear plant site selection process. Specifically, the EPRI Siting Guide: *Site Selection and Evaluation Criteria for an Early Site Permit Application*, dated March 2002, will be utilized.
- The evaluation and selection process will include "greenfield" (e.g., locations with no current generation facilities), existing nuclear generation plant locations, and other sites previously characterized by PEC.
- Compliance with current NRC regulations and NRC guidance (as of November 2005), including 10 CFR Part 50–"Domestic Licensing of Production and Utilization Facilities," 10 CFR Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants," SECY-05-0139, "Semi-annual Update of the Status of New Reactors Licensing Activities and Future Planning for New Reactors," dated August 4, 2005.
- Compliance with NEPA of 1996 requirements.

The site selection process typically involves sequential application of exclusionary, avoidance, and suitability criteria evaluation (includes site reconnaissance, topographic data collection), and technical screening by application of scoring and associated weighting factors applied to the suitability criteria. The exclusionary, avoidance, and suitability criteria address a full range of considerations important in nuclear power facility siting, including health and safety, environmental, socioeconomic and land use, and engineering and cost aspects.

The evaluation and selection process involves a series of activities starting with identification of an ROI or a geographic area within which a site must be located. For the Carolinas, the ROI became the PEC service territory. This geographic area was derived from PEC fundamental business decisions on the economic viability of a nuclear facility, the market for the facility's output, and the general geographic area where the facility should be deployed to serve the market. ER Chapter 8 further discusses the need for power in this region.

Eleven EPRI potential sites were identified within the ROI as possible locations for the PEC COL, based on knowledge of the sites potentially available for acquisition and development as power plant sites. Locations subjected to review and evaluation included greenfield sites and locations with operating nuclear plants. Sites previously considered for a nuclear facility were also included. Potential site locations per the EPRI siting criteria were subjected to criteria such as identification of water supply, environmental impacts, sufficient land area, and available transmission lines.

The overall process for screening the 11 potential to candidate sites was comprised of the following elements: 1) develop criterion ratings for each site; 2) develop weight factors reflecting the relative importance of each criterion; and 3) develop composite site suitability ratings.

- **Criterion Ratings** — Each site was assigned a rating of 1 to 5 (1 = least suitable, 5 = most suitable) for each of the following site evaluation criteria: cooling water supply, flooding, population, hazardous land uses, ecology, wetlands, railroad access, transmission access, geology/seismic, and land acquisition. Information sources for these evaluations included publicly available data, information available from PEC files and personnel, and large-scale satellite photographs.

- **Weight Factors** — Weight factors reflecting the relative importance of the criteria were synthesized from those developed for previous nuclear power plant siting studies. The weight factors were originally derived using methodology consistent with the modified Delphi process specified in the EPRI Siting Guide. Weight factor used designated 1 as least important to 10 as most important).

- **Composite Suitability Ratings** — Ratings reflecting the overall suitability of each site were developed by multiplying criterion ratings by the criterion weight factors and summing over all criteria for each site.

In summary, the first phase of the site evaluation process involved screening the ROI using the exclusionary criteria identified above. This initial evaluation identified the sites by eliminating areas in which it is not feasible to site a nuclear facility due to regulatory, institutional, facility design impediments, or environmental constraints. Further screening was performed using avoidance criteria to eliminate feasible but less favorable areas, thus reducing the areas remaining under consideration to an adequate and reasonable number of EPRI "candidate sites" for continued screening.

The EPRI potential site list was further screened using refined exclusionary and avoidance criteria to identify optimum areas for a facility. The screening process eliminates many potential unsuitable locations before detailed, expensive, and time-consuming investigations are committed. The more favorable EPRI candidate sites undergo detailed investigations to determine both their basic engineering and environmental feasibility. The EPRI siting criteria used to evaluate candidate sites included the following: cooling water supply, flooding, population, hazardous land uses, terrestrial and aquatic ecology, wetlands, railroad access, transmission access, geology/seismic and land acquisition. resulted in reducing the EPRI candidate site list to a fewer number of alternative sites.

Based on the initial iterative screening approach, the list of 11 EPRI potential sites was reduced to four EPRI candidate sites for further evaluation: the HNP site, located in Wake County, North Carolina; the Brunswick Nuclear Power Plant, located in Brunswick County, North Carolina; and the H.B. Robinson Nuclear Power Plant, located in Darlington County, South Carolina. In addition, a greenfield site was chosen in Marion County, South Carolina.

The use of the EPRI siting criteria in the PEC Siting Study is consistent with the ESRP because PEC selected an existing nuclear site as the ESRP preferred site and identified two other nuclear sites in the ROI as two of the three alternative sites. The evaluation of the ESRP preferred site and three alternative sites in the PEC siting study represent among the best that could reasonably have been found within the ROI as required by the ESRP. The basis for screening out the seven remaining potential sites is discussed below.

Seven EPRI potential sites were evaluated by PEC but eliminated from further consideration. The site southeast of the city of Marion was eliminated because seismic criteria could not be met. The Fayetteville site was eliminated because the tract of land was not of suitable size. The "South River" site was eliminated due to soil liquefaction issues. A grouping of sites evaluated together on the Pee Dee River was eliminated because a new cooling water reservoir would have been required, as well as significant transmission line upgrades. The Savannah River Site (SRS) was eliminated because it lies outside the PEC Service Territory and the ROI. Two sites in eastern North Carolina were eliminated because they are being actively considered for new fossil plants and the location lacked sufficient off-site power voltage to support a nuclear plant. The Marion County site was the eighth non-nuclear site evaluated and was selected as an EPRI candidate site. It was the only non-nuclear site to pass the screening criteria, primarily because of the availability of suitable land and an adequate water supply.

The nuclear sites were chosen for further evaluation because they are owned by PEC (with ready access to the site and other information), are located relatively near the HNP site, and are within the applicant's candidate areas. Other sites within the North and South Carolina candidate area were not evaluated further because they are not owned by PEC or its partners. Purchase of or access to a competitor's site would be cost prohibitive and, therefore, would not be viable options for siting of a new reactor by the applicant. The applicant conducted an initial review of all potential sites.

Table 9.3-1 provides a list of the EPRI potential sites identified, results of the analysis of these sites against exclusionary criteria and PEC's business objectives, and the disposition of each site.

The next component of the site selection process was to further evaluate the four EPRI alternative sites and select a EPRI proposed site (i.e., ESRP preferred site) for the PEC COL. PEC undertook a site-by-site comparison of EPRI alternative sites and the ESRP preferred site in the ER to "determine if there are any alternative sites that are environmentally preferable to the proposed site." The review process involved the two-part sequential test outlined in NUREG-1555. The first stage of the review uses reconnaissance-level information to determine whether there are environmentally preferable sites among the alternatives. If environmentally preferable sites are identified, the second stage of the review considers economics, technology, and institutional factors for the environmentally preferred sites to determine if any are obviously superior to the proposed site.

PEC used the following two-phase, three-step process for reviewing the candidate sites:

- Step 1 – *Identify the candidate sites.* The proposed site is co-located with an existing nuclear facility (HNP). Therefore, PEC chose other nuclear sites over which it had control in the candidate areas (North and South Carolina), as well as a greenfield site.

- Step 2a – *Consider sites without existing nuclear facilities.* The initial step was to evaluate undeveloped greenfield and brownfield/non-nuclear sites. PEC assumed that the environmental impacts of building on a greenfield site could be greater than those of building at an existing site with a nuclear facility (disturbing land that had not previously been disturbed). PEC identified a greenfield site in Marion County, South Carolina, for evaluation.

- Step 2b – *Consider sites with existing nuclear facilities.* The next step was to evaluate sites with an existing nuclear facility to determine if the sites met the land requirements specified in this ER. If additional land would be required, PEC assumed that the environmental impacts of developing a new nuclear facility would be similar to the impacts for developing a previously undeveloped site, and concluded that the impact would be MODERATE to LARGE. Initially, PEC relied on NUREG-1437 as a basis of defining land requirements for building a new nuclear unit at candidate sites and used these land requirements as one basis for initial review. PEC reviewed land use and other land requirements to identify their initial environmental impacts on the alternatives and the proposed site.

- Step 3 – *Compare alternative sites with HAR for environmental preferability and "obvious superiority."* The environmental impacts of siting a new nuclear unit at alternative sites were compared with the impacts for siting a new unit at the proposed site, using the candidate site criteria identified in NUREG-1555 as the general standard. "Reconnaissance level" information made publicly available and site reviews conducted for other projects were also used to identify site-specific information. The comparisons made using the candidate site criteria and reconnaissance level information did not indicate that the alternative sites were environmentally preferable as noted in Subsection 9.3.2. PEC did not identify any environmentally preferable alternative site in its evaluation process because the effects of the reference plant on the alternative sites was considered greater than or equal to the effects predicted for HAR. As a result, PEC did not compare any alternative sites with the HAR site for "obvious superiority."

General siting criteria used to evaluate the four candidate sites were derived from those presented in the PEC siting study (Reference 9.3-001). The criteria were tailored to reflect issues applicable to, and data available for, the PEC sites.

The overall process for applying the general site criteria to evaluate the four EPRI alternative sites was analogous to that which was used in the evaluation of the 11 ROI sites described earlier. The evaluation process for the four EPRI alternative sites was comprised of the following elements: develop criterion ratings for each site and develop weight factors reflecting the relative importance of each criterion.

- **Criterion Ratings** – Each site was assigned a rating of 1 to 5 (1 = least suitable, 5 = most suitable) for each of the potential site evaluation criteria. Information sources for these evaluations included publicly available data, information available from PEC files and personnel, and U.S. Geological Survey (USGS) topographic maps.

- **Weight Factors** – Weight factors reflecting the relative importance of these criteria were synthesized from those developed for previous nuclear power plant siting studies. The weight factors were originally derived using methodology consistent with the modified Delphi process specified in the EPRI Siting Guide. Weight factors used factors of 1 as least important, through 10 as most important).

From the application of these exclusionary and avoidance features, alternative sites were identified as discrete parcels of land approximately the size of an actual nuclear site, thus eliminating large tracts of land that do not exhibit conditions suitable to a nuclear facility site. The process then becomes one of comparing the small number of alternative sites, and identifying a site that possesses the most favorable set of conditions for siting a nuclear power facility. The evaluation technique to this point ensures that the remaining alternative sites have no fatal flaws that could result in extended licensing delays and increased costs.

The remaining alternative sites were evaluated against suitability criteria, resulting in a transition from the elimination approach to an evaluation approach of the suitable sites. The objective of evaluation against suitability criteria is to rank the small number of alternative sites for determination of the preferred site(s).

The suitability criteria are grouped into four categories: Health and Safety, Environmental, Land Use/Socioeconomics, and Engineering/Cost-related, with features in each category relevant to the specific aspects of facility development that are weighted and scored to provide a relative comparison of the candidate sites. The multiple features of the suitability criteria are combined into one composite value for each of the alternative sites.

Next, the technically acceptable and ranked alternative sites then undergo a final technical evaluation process and a verification process as a second step to ensure compliance and compatibility with PEC's business strategic considerations, transmission deliverability, and population considerations. This analysis allows the decision of site selection to consider tradeoffs in business requirements and identification of a basis for differentiation among sites, thereby ensuring the optimal site is chosen. The components of PEC's business strategic considerations include the following:

- Existing nuclear site advantages: Sharing of existing resources and facilities associated with security, maintenance, training, warehousing, and emergency planning.

- Proximity to load: Location to load center to ensure transmission delivery capabilities and system operations.

- NRC considerations: Preference of existing nuclear facility sites facilitating the COLA review process.

- Local and state government support: Incentives and support associated with infrastructure improvements, rate base impact, emergency planning and employment training.

- Business planning: The selected site must promote assurance of satisfying schedule and budget for COL approval.
- Public support: General public desire for safe and efficient nuclear power generation and avoidance of nonproductive intervention.
- Land utilization: Leverage of PEC land for potential applications of public benefit.

Finally, each of the four EPRI alternative sites were evaluated on transmission deliverability/system direct connect and upgrade costs and on population considerations.

The results of the evaluation of the four EPRI alternative sites concluded that the HAR site is the "preferred site" since it received the highest scoring in the following evaluation areas: Technical Evaluation, PEC Strategic Considerations, and Transmission System Compatibility.

The HAR site was considered the best in regard to technical evaluation criteria which address licensing and design technical requirements to construct and operate a new nuclear plant. The HAR is superior to Robinson regarding the lake cooling water and availability of PEC-owned property. While Brunswick has access to more than adequate river water for cooling, the transmission system upgrades required are significant. The Marion County site had the largest land area, but also the largest percentage of wetland acreage, and less than desirable geotechnical features. The HAR site has the least wetland acreage, and the benefit of being a solid rock site as compared to deep soil of the alternative locations.

In regards to PEC's strategic considerations, the HAR site also ranks the highest. The NRC indicates preference to existing nuclear plant sites based on licensing reviews and detailed site characterization already completed to support the existing nuclear plant, which places the Marion County site at a disadvantage. The existing nuclear plant locations further provide an advantage due to the ability to leverage existing site facilities and resources, such as warehousing, security, and operator training. HAR demonstrated an advantage over Brunswick and Robinson due to larger acreage of PEC-owned property, and the clear ability to accommodate additional future generation capacity.

Transmission deliverability analysis has further concluded the HAR site was best suited to the existing transmission system requirements. The HAR site has minimal transmission impact costs for the installation of an 1100 megawatt (MW) nuclear unit. All other sites evaluated had considerable overloads identified with the addition of a 1100-MW nuclear unit (during various contingency scenarios), and required significant transmission system upgrades as compared to the HAR. Brunswick required the most extensive transmission system upgrades to remedy current overloads, estimated to be more than $300 million in cost.

The HAR site had a higher population than the other three EPRI alternative sites. However, there are a number of beneficial factors associated with the HAR site as compared to other acceptable locations. These include transmission deliverability and proximity to load, available land area, adequate water supply for multiple units and minimal environmental impact.

In summary, the evaluation of the four EPRI alternative sites indicated that all three of the nuclear sites are suitable for a new nuclear power plant; the Marion County site (greenfield site) ranks significantly lower than the existing sites, as a result of high transmission costs and seismic, land acquisition and wetlands issues. Of the existing nuclear sites, HAR rated highest followed by Robinson and Brunswick. Robinson rated somewhat lower, primarily due to potential cooling water supply operational limitations and a lower rating in the geology/seismic category. Brunswick rated lower primarily due to transmission challenges as well as being slightly less favorable with respect to ecology and nearby hazardous land uses. Based on these rating results and other applicable considerations related to PEC's business plans, HAR was selected as the proposed site for the PEC COL. In addition to its advantages as an existing nuclear power plant site, HAR ranked highest or equal-highest in 26 of the general site criteria and was rated as being more suitable in both the screening-level and general site criteria composite ratings. A summary of the information used to evaluate the EPRI candidate sites and EPRI alternatives that support the selection of the EPRI preferred site (i.e., ESRP proposed site) location are presented in Subsection 9.3.2.

9.3.2 PROPOSED AND ALTERNATIVE SITE EVALUATION

The ESRP alternative sites are those ESRP candidate sites that are specifically compared with the proposed site to determine if there is an obviously superior site for the location of the new nuclear power plant. The ESRP proposed (or EPRI preferred) site is the ESRP alternative site that is submitted to the NRC by the applicant as the proposed location for a nuclear power plant. The remaining ESRP alternative sites chosen from within the ROI are compared with HAR.

The ESRP alternative sites that are compared with the HAR site (the ESRP proposed site) include Brunswick Nuclear Power Plant, located in Brunswick County, North Carolina; the H.B. Robinson Nuclear Power Plant, located in Darlington County, South Carolina; and a greenfield site located in Marion County, South Carolina. According to Regulatory Guide 4.2, the applicant is not expected to conduct detailed environmental studies at alternative sites; only preliminary reconnaissance-type investigations need be conducted. The alternatives sites were compared with HAR based on information about the existing nuclear plants and the surrounding area, as well as existing environmental studies and final environmental impact statements issued by the Atomic Energy Commission (AEC) and/or NRC. In Subsection 9.3.2, PEC's siting study (Reference 9.3-001) was used to determine whether or not any alternative sites are environmentally preferable to the proposed site.

To analyze the effects of building a new nuclear plant at each of the alternative site locations, PEC assumed the construction and operation practices described in ER Chapters 4 and 5 would generally be applied to each site; thereby, allowing for a consistent description of the impacts on each site.

In Subsection 9.3.2, environmental impacts of the alternatives are assessed using the NRC three-level standard of significance: SMALL, MODERATE, or LARGE. This standard of significance was developed using the following Council on Environmental Quality guidelines set forth in the footnotes to Table B-1 of Title 10 CFR Part 51, Subpart A, Appendix B:

- **SMALL**. Environmental effects are not detectable or are so minor they will neither destabilize nor noticeably alter any important attribute of the resource.
- **MODERATE**. Environmental effects are sufficient to alter noticeably but not to destabilize important attributes of the resource.
- **LARGE**. Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the GEIS, NUREG-1437, Volumes 1 and 2.

Based on the conclusion of PEC's siting study (Reference 9.3-001), the ESRP proposed site is co-location of the new reactor units at the existing HNP site. Siting a new reactor at an existing nuclear facility offers a number of benefits. By co-locating nuclear reactors, the total number of nuclear power generating sites is reduced. No additional land acquisitions are necessary, and the applicant can readily obtain control of the property. This reduces both initial costs to the applicant and the degree of effect on the surrounding anthropogenic and ecological communities. Site characteristics, including geologic/seismic suitability, are known, and the site has already undergone substantial review through the NEPA process during the original selection procedure. No new analysis of site appropriateness is necessary, which can reduce start-up costs. In addition, the environmental impacts of constructing and operating the existing unit are known. It can be expected that the effects of a new unit should be comparable to those of the operating nuclear plant. Furthermore, co-located sites can share existing infrastructure, reducing both development costs and environmental effects associated with construction of new access roads, waste disposal areas, and other supporting facilities and structures. Construction of new transmission corridors could be eliminated because of the potential use and/or expansion of existing corridors. Finally, existing nuclear plants have nearby markets, the support of the local community, and the availability of experienced personnel.

A summary of the information contained in the PEC's siting study (Reference 9.3-001) is presented in the following subsections.

9.3.2.1 The Marion County, South Carolina, Greenfield Site

The greenfield site chosen for analysis is the Marion County site, located between the towns of Florence and Marion, South Carolina. A nuclear power facility could be constructed and operated at this site; however, several significant issues make this location less desirable than co-location. The environmental impacts from constructing and operating a nuclear power plant at this site would range from MODERATE TO LARGE, but would be similar to or greater than those at the preferred site.

9.3.2.1.1 Land Use

The Marion County site is not currently owned by PEC. The site is a greenfield site that is located in a low-lying area surrounded by wetlands and swamps. Previous site investigations indicate that soil is at least 6.1 meters (m) (20 feet [ft.]) deep with groundwater encountered at 2.7 to 4.9 m (9 to 16 ft.) below the existing ground surface .The site is generally low in elevation, with considerable on-site and surrounding swamp land. Site elevations appear to be at or even slightly below that of the 100-year floodplain (a probable maximum flood [PMF] elevation has not been determined, but it is assumed that it would be higher than the 100-year floodplain and site grade could be below PMF). This presents the need to address environmental effects on floodplains as well as the possibility that engineered flood protection features will be required to protect the plant. These factors, combined with the surrounding known swamps and shallow depth to groundwater, also indicate the potential for construction dewatering problems (Reference 9.3-001).

No current or future regulatory land use restrictions were identified that are incompatible with locating nuclear power generation plants on the Marion County site. However, based on the need to acquire and commit land that is currently greenspace to a new nuclear power generating station, coupled with the potential for construction dewatering problems, impacts are anticipated to be MODERATE to LARGE.

9.3.2.1.2 Air Quality

Potential adverse impacts caused by drift from cooling towers on surrounding plants, including crops and ornamental vegetation, natural plant communities, and soils, is expected to be SMALL. This potential impact can be minimized with the use of drift eliminators on the cooling towers.

Based on the new reactor design and the actions that will be taken to comply with permit requirements for emissions, it is expected that siting the unit at this location would have a SMALL impact on air quality.

9.3.2.1.3 Water

The water metric evaluated for the Marion County site is the ability of a primary water source to provide adequate cooling water for a two-unit plant with cooling towers without significant permitting issues or operational restrictions. PEC indicated that the Pee Dee River 7-day and 10-year low flow at the site is 41 cubic meters per second (m^3/s) (1450 cubic feet per second [ft^3/s]) or 650,805 gallons per minute (gpm) (Reference 9.3-001). The closed-cycle cooling system, cooling water supply requirements for the proposed two-unit plant is approximately 2.65 m^3/s (93.58 ft^3/s) or 42,000 gpm. Adequate cooling water is available to support a two-unit plant for any of the designs under consideration. However, there are potential concerns regarding adequate flow during extreme drought conditions because the water source is not on a reservoir or lake. The Marion County site would likely require the construction of a reservoir (size not known at this time), and pumping distances could be longer at that site, depending on reservoir siting (Reference 9.3-001). Based on the concerns associated with the supply of adequate cooling water and the potential commitment of a significant area to a new cooling water reservoir, water resource impacts would likely be LARGE.

9.3.2.1.4 Terrestrial Ecology

Both on and near the Marion County site, there are approximately 518 ha (1280 ac.) of freshwater forested wetlands, forested/shrub wetlands, and freshwater emergent wetlands. Much of this wetland area is semi-permanently flooded, consistent with the low-lying land in this area. These wetlands are jurisdictional wetlands and a permit from USACE would be needed before conducting land disturbance activities. Based on the low-lying nature of the land in this area, dewatering of the site would be necessary, which would most likely affect wetlands (Reference 9.3-001). There are no terrestrial species in the immediate site vicinity that are included on federal or state lists of endangered or threatened species (Reference 9.3-001). Table 9.3-2 presents the rare, threatened, and endangered terrestrial species status list for Marion County, South Carolina. Based on the extensive amount of wetlands on the site, impacts would likely be MODERATE.

9.3.2.1.5 Aquatic Ecology

There are no aquatic species in the immediate site vicinity that are included on federal or state lists of endangered or threatened species (Reference 9.3-001). Table 9.3-3 presents the rare, threatened, and endangered aquatic species status list for Marion County, South Carolina.

The Marion County site was evaluated with respect to potential for entrainment and impingement impacts on the closed-cycle cooling water system. Proposed facilities at the site would likely include cooling towers that will reduce the amount of cooling water withdrawal required for plant operation. Proper design of the water intake structure would also minimize potential adverse impacts. With cooling towers and appropriate intake design, potential adverse impacts from entrainment or impingement of aquatic organism would be minor and would not significantly disrupt existing populations. Assuming a two-unit closed-cycle plant at the site, and 100 percent of the local plankton passing through the plant, there would be no discernible effect on the plankton population in the Pee Dee River at the site because of the very small volume of water used by the plant compared with the total volume in the river. Because of the low-flow velocities of a closed-cycle plant at the site, impingement of adult fish would be expected to be minimal. Use of a deepwater intake would have a minimal effect on entrainment of larval fish. Impacts on aquatic species from the construction of a reservoir include loss of habitat, temporary displacement, temporary turbidity, and water quality impacts during construction. Because of the potential to disrupt aquatic species associated with wetland, impacts are expected to be SMALL to MODERATE.

9.3.2.1.6 Socioeconomics

Marion County has a 2006 population estimate of 34,684, which is a 2.2 percent decrease from the 2000 population (Reference 9.3-002). The median household income is $26,593 per year. Approximately 22.5 percent of the county's population lives below the poverty level. The mean value of owner-occupied housing units was $63,500. There were 1898 firms doing business in the county in 2002 (Reference 9.3-002). The largest towns near the proposed greenfield site are the towns of Marion (7042) and Florence (30,248) (Reference 9.3-001).

The impact on area employment from construction and operation of the two new units would be low because Marion County is in close proximity to two population centers with high population density (Darlington and Florence counties) (Reference 9.3-001). It is expected that the impact on housing and community services would be negligible. The site appears to have sufficient population centers within commuting distance such that its public services sector would be able to absorb the population in-migration associated with plant construction and operation with minimal impact. Therefore, the effect of the proposed facility on the population and demographics of Marion County, South Carolina, is expected to be SMALL.

9.3.2.1.7 Transportation

The proposed Marion County site is located on the east side of the Great Pee Dee River. No limiting climate or terrain conditions were identified (Reference 9.3-001). The Marion County site is served by several primary access roads; however, site access will need to be constructed. About 1.6 to 3.2 km (1 to 2 mi.) of additional access roads will be needed to develop the Marion County site (Reference 9.3-001).

There are several airports nearby including the Florence City-County airport, the Marion County Airport the Dillon County Airport, and a landing strip in Latta, South Carolina. The proposed site is in the vicinity of the existing Seaboard rail line. (Reference 9.3-001).

There are several ways to mitigate the potential transportation impacts during construction such as developing a construction traffic management plan before construction to address potential impacts on local roadways. If necessary, coordinating with local planning authorities for the upgrading of local roads, intersections, and signals to handle increased traffic loads could be considered. Schedules during workforce shift changes and for the delivery of larger pieces of equipment or structures could be coordinated to limit impacts on local roads. Use of shared (e.g., carpooling) and multi-person transportation (e.g., buses) during construction and/or operation of the facility could be encouraged. By implementing the appropriate measures, it is expected that there would be SMALL to MODERATE impacts on transportation during construction activities and SMALL impact during operation of the facility. Transportation impacts are expected to be MODERATE based on the cost of supplying to necessary rail line infrastructure.

9.3.2.1.8 Historic, Cultural, and Archeological Resources

Potentially significant cultural resources on the Marion County site that could be affected by the proposed project include a confederate naval yard and Pee Dee Indian Town. These cultural resources along with mapped archaeological sites connected with a large graveyard might limit use of certain areas of the site (Reference 9.3-001). Investigation would be required before siting a new reactor at this location. Consultation with the State Historic Preservation Officer (SHPO) would occur if any significant historic, cultural, or archeological resources were identified and any appropriate mitigation measures put in place before construction and operation. Even with the implementation of mitigation measures, the historical context and original location of historic, cultural or archaeological resources would be lost. Therefore, impacts are thought to be MODERATE to LARGE.

9.3.2.1.9 Environmental Justice

Table 9.3-4 presents demographic information for several counties surrounding the proposed Marion County site: Marion, Florence, Dillon, and Darlington counties. Given that no significant impacts on any human populations are expected to occur at the proposed Marion County site, there would not be significant disproportionate impacts on minority or low income populations. Based on actual employment experience, positive economic benefits have been shown to be available to all members of the population, without regard to income or ethnicity. In addition, if no significant health and safety impacts from construction and operation of the proposed project are identified, there would be no environmental justice concerns, regardless of the percentage of minority or low income populations found within the surrounding communities. Therefore, it is anticipated that environmental justice impacts would be SMALL.

9.3.2.1.10 Transmission Corridors

Transmission system upgrades would be required at the Marion County site to construct and operate the proposed nuclear facility. Transmission system upgrades for the addition of an 1100-megawatt electric (MWe) power generating unit would result in environmental impacts related to clearing and construction of the new lines (Reference 9.3-001). Impacts would be LARGE based on the commitment of land, construction impacts on ecological resources associated with clearing, and the permanent commitment of land.

9.3.2.2 Existing Nuclear Facilities for Comparison

Co-locating the new reactor is preferable to the greenfield alternative because the new reactor will be able to take advantage of the infrastructure that serves the existing reactor(s). Co-location negates the need for many of the preliminary analyses required for a Greenfield site because these analyses have already been performed for the existing site license. Preliminary analyses of site suitability; appropriate seismicity and geological setting; federal, state, and local regulatory restrictions; and other significant issues have already been conducted for the existing unit(s). This further reduces uncertainties associated with construction and operation of the new units. Discussion of resource commitments for HAR can be found in ER Sections 10.1, 10.2, and 10.3. The resource commitments needed for construction and operation of the new facility would be similar regardless of where the unit is co-located. Therefore, the information in Chapter 10 applies to the candidate sites described below.

9.3.2.2.1 HAR Site: The Preferred Location

HAR is the preferred site for locating the new nuclear reactors. The HAR site is in Wake County, North Carolina. The HAR site and its surroundings, as well as the impacts of its construction and operation, is further described in ER Chapters 2, 4, and 5, and summarized below.

9.3.2.2.1.1 Land Use

The HAR site is to be located on land that is already owned by PEC and is already zoned for uses that are compatible with the development of new reactor units. The existing units are integrated into the surrounding land use patterns.

No surface faulting or deformation has been identified at the site. No areas of volcanic activity, subsidence caused by withdrawal of subsurface fluids, potential unstable slope, potential collapse, mined areas, or areas subject to seismic or other induced water waves or floods occur at the site.

Because of the 30-m (100-ft.) difference in elevation between the site and the Cape Fear River, and distance to HNP, flooding from the river is not a concern because flood protection features are currently in place to protect safety-related structures on the existing nuclear facility.

To meet the new facilities' water needs during operation of the plant, the Harris Reservoir volume will need to be increased (Subsection 9.3.2.2.1.3). The inundation of the reservoir will require replacement or relocation of existing infrastructure. Long-term land use impacts are expected to be insignificant because the relocation and/or rebuilding of structures with similar infrastructure in non-affected areas nearby will occur before or after inundation. The effect of these mitigation efforts would be no net loss in resource area or associated functional value.

Land use impacts are expected to be SMALL to MODERATE based on the fact that the HNP was initially planned to be a multiple-unit facility with a larger reservoir (Subsection 9.3.2.2.1.3).

9.3.2.2.1.2 Air Quality

Potential adverse impacts caused by drift from cooling towers on surrounding plants, including crops and ornamental vegetation, natural plant communities, and soils, are expected to be minor. These potential impacts can be minimized with the use of drift eliminators on the cooling towers.

Based on the design of the new reactor and the actions that will be taken to comply with permit requirements for emissions, it is expected that siting the unit at this location would have a SMALL impact on air quality.

9.3.2.2.1.3 Water

The water metric evaluated for this site is the ability of a primary water source to provide adequate cooling water for a two-unit plant with cooling towers without significant permitting issues or operational restrictions. The water supply is Harris Lake, consisting of the Harris Reservoir on Buckhorn Creek, and the Auxiliary Reservoir located on Tom Jack Creek. The average reservoir level is at 66.8 m (219.4 ft.) NGVD29 for a one-unit operation. Buckhorn Creek has its headwaters near Holly Springs and Apex, North Carolina, and flows on a southwesterly course to its confluence with the Cape Fear River. Buckhorn Creek has five tributaries above the main dam. The conceptual design of the original reservoir system was intended to support multiple nuclear units at full development of the site with a higher lake elevation at 76.2 m (250 ft.) NGVD29. The existing nuclear facility contains one 900-MWe unit with closed-cycle cooling. At full development, the reservoir was to be recharged by pumping from the Cape Fear River in addition to the natural recharge from the watershed. Previous modeling efforts showed that for a two-unit plant, the Harris Reservoir water level would fluctuate from a minimum water level of 66.3 m (217.7 ft.) NGVD29 to a maximum level of 67.6 m (221.9 ft.) NGVD29. Analysis of a 100-year drought in both Buckhorn Creek and Cape Fear River, in connection with a hypothetical 4-unit operation at 100-percent load factor, resulted in the lowest reservoir level of 62.7 m (205.7 ft.) NGVD29 (at which point, the plant would shut down – 62.7 m [205.7 ft.] NGVD29 is the minimum operating level). During licensing of the HNP, NRC concluded that the water supply was adequate for a two-unit plant operation, including the Cape Fear River makeup system, and is also adequate in the event of a severe drought for both a one- and two-unit operation (Reference 9.3-001).

The closed-cycle cooling system, cooling water supply requirements for the proposed two-unit facility is approximately 2.65 m^3/s (93.58 ft^3/s) or 42,000 gpm (Reference 9.3-001). Adequate cooling water from the reservoir could support a two-unit plant for any of the designs under consideration. Because the HNP site is located on a large reservoir system, which would likely provide sufficient heat rejection capacity for the new units, plant operation should not have significant thermal impacts on aquatic or marine ecology and water quality. Impacts from constructing and operating the new reactor units would be SMALL as a result of adequate water supply and building the plant on an existing reservoir.

9.3.2.2.1.4 Terrestrial Ecology

There are two potentially occurring endangered or threatened species near the HAR site: the red-cockaded woodpecker (*Picoides borealis*) (federally listed as endangered) and an experimental population of Michaux's sumac (*Rhus michauxii*) (federally and state-listed as endangered) (Reference 9.3-001). PEC has procedures in place to protect endangered or threatened species if they are encountered on-site (or along the transmission corridors), and provides training for employees on these procedures (Reference 9.3-001) (see Table 4.3-2 for listed species in Wake and Chatham counties).

The forested and wetland habitats at the HAR site support a variety of wildlife species of birds, mammals, amphibians, and reptiles typically found in the Piedmont region of North Carolina. According to Subsection 5.2.1.1, approximately 47 ha (117 ac.) of wetlands exist along the perimeter of the reservoir and near the dam. These wetland areas were created or modified during the construction of the HNP. These wetlands will be inundated because of the increased water level of the reservoir. However, this inundation will also create new wetlands.

No impacts on the terrestrial ecosystems would be expected when construction of the new reactor is complete. Therefore, the impacts of construction might be MODERATE; however, the impacts of operation would be SMALL.

9.3.2.2.1.5 Aquatic Ecology

There are no aquatic species in the HAR site that are included on federal or state lists of endangered or threatened species (Reference 9.3-001) (see Table 4.3-3 for listed species in Wake and Chatham counties).

As discussed in Subsection 5.2.1, water from the Cape Fear River, in addition to the existing Harris Reservoir drainage area, will be required to fill and maintain the required pool level for normal operations. The normal rate of 2.35 m^3/s

(84 ft^3/s) or 37,248 gpm, for operation and water quality control, is approximately 3.6 percent (2.35 m^3/s / 65 m^3/s = 3.6 percent) of the average daily flow reported at the USGS gauge at Lillington (USGS02102500). The rate at which water is withdrawn would be based on a set of operational rules designed to meet the target flows at Lillington as defined by the 1992 Water Control Manual for B. Everett Jordan Lake.

The HAR site was evaluated with respect to relative potential for entrainment and impingement effects to aquatic organisms for the closed-cycle cooling water system. Proposed facilities at the site will include cooling towers that will reduce the amount of cooling water withdrawal required for plant operation. Through the use of cooling towers with an appropriate intake design, it is anticipated that potential adverse effects from entrainment or impingement of aquatic organism would be minor and would not significantly disrupt existing populations of aquatic organisms (Reference 9.3-001). Because of the low-flow velocities of a closed-cycle plant at the site, it is expected that aquatic effects would be SMALL.

9.3.2.2.1.6 Socioeconomics

Wake County has a 2006 population estimate of 786,522, which is a 25.3 percent increase from the 2000 population (Reference 9.3-003). The median household income is $57,846 per year. Approximately 9.2 percent of the county's population lives below the poverty level. The mean value of owner-occupied housing units was $162,900. There were 61,908 firms doing business in the county in 2002 (Reference 9.3-003). The towns with the highest population near the HAR site are the town of Cary (94,536), located 21 km (13 mi.) from the proposed site, and the City of Raleigh (276,093), located approximately 34.9 km (21.7 mi.) from the proposed site (Reference 9.3-001).

The HAR site had a higher population than the other three alternative sites. However, there are a number of beneficial factors associated with the HAR site as compared to other acceptable locations. These include transmission deliverability and proximity to load, available land area, adequate water supply for multiple units and minimal environmental impact.

The general population level is anticipated to be sufficiently large that the impact on area employment from construction and operation of the two new units would be low. It is expected that the impact on housing and community services would be negligible. The site area appears to have sufficient population centers within commuting distance such that its public services sector would be able to absorb the population in-migration associated with plant construction and operation with minimal impact. Therefore, the effect of the proposed facility on the population and demographics of Wake County, North Carolina, is expected to be SMALL.

9.3.2.2.1.7 Transportation

The HAR site is located on the northern side of the Harris Reservoir. U.S. Highway 1 is located immediately north of the site and provides access to the

Raleigh, North Carolina area (northeast of the site) and Interstate 40. The proposed site will not need significant, if any, highway construction to accommodate construction or operation of a new plant. The location of the site in relation to the Harris Reservoir prevents direct egress to the south. No other limiting climate or terrain conditions were identified (Reference 9.3-001). The proposed HAR site is located near the HNP. On-site railroad access is already provided in the immediate vicinity of the proposed HAR site from the Seaboard rail line. It is anticipated that approximately 0.3 km (0.2 mi.) of rail would need to be constructed to link the proposed HAR site to the existing rail line. The cost of constructing this rail line is approximately $600,000 (Reference 9.3-001).

There are several ways to mitigate the potential transportation impacts during construction such as developing a construction traffic management plan before construction to address potential impacts on local roadways. If necessary, coordinating with local planning authorities for the upgrading of local roads, intersections, and signals to handle increased traffic loads could be considered. Schedules during workforce shift changes and for the delivery of larger pieces of equipment or structures could be coordinated to limit impacts on local roads. Use of shared (e.g., carpooling) and multi-person transportation (e.g., buses) during construction and/or operation of the facility could be encouraged. By implementing the appropriate measures, it is expected that there would be SMALL to MODERATE impacts on transportation during construction activities and SMALL impact during operation of the facility.

9.3.2.2.1.8 Historic, Cultural, and Archeological Resources

As discussed in Sections 4.4 and 5.8, PEC is coordinating with the North Carolina SHPO to comply with Section 106 of the National Historic Preservation Act to construct and operate a new facility at the HNP site. Investigations will be conducted to identify the full extent of historic properties and cultural resources in the area of potential effects (APE). The APE includes all areas of direct impact for the two new reactor units, the areas of direct impact for the 5.6-km- (3.5-mi.-) long makeup water line and pumphouse, and all lands between the existing normal pool elevation of Harris Reservoir and the proposed 100-year flood elevation. Areas where potential historic properties could be affected by plant operation include the land between the existing normal pool elevation of Harris Reservoir and the proposed 100-year flood elevation and the three new transmission lines. As a result of consultation with SHPO, it is expected that the impacts of constructing and operating an additional reactor(s) at this site would be SMALL.

9.3.2.2.1.9 Environmental Justice

Table 9.3-5 presents demographic information for several counties surrounding the HAR site: Chatham, Harnett, Durham, Orange, and Wake counties. Given that no significant impacts to any human populations are expected to occur at the HAR site, there would not be significant disproportionate impacts on minority or low income populations; and based on actual employment experience, positive economic benefits have been shown to be available to all members of the population regardless of income or ethnicity. In addition, if no significant health and safety impacts are identified from reactor construction and operation, there would be no environmental justice concerns regardless of the percentage of minority or low income populations found within the surrounding communities. Furthermore, this site has been operating as a power-generating facility for many years. Therefore, it is anticipated that environmental justice impacts would be SMALL.

9.3.2.2.1.10 Transmission Corridors

The HAR site is located near the HNP. As such, transmission lines are located in the immediate vicinity of the proposed site. Transmission system upgrades are estimated to be less than $1 million for the addition of each 1100-MWe power-generating unit (Reference 9.3-001).

As stated in Subsection 3.7.1.1, three new transmission lines will be needed to connect the HAR 3 switchyard to the PEC grid. The proposed routing of the new lines for HAR 3 are being evaluated for placement adjacent to or within the existing maintained transmission corridors rights-of-way (ROWs) for the HNP. The new corridors for HAR 3 are conservatively estimated to require an additional 100 ft. of width. The corridor areas are mostly remote and pass through land that is primarily agricultural and forest land with low population densities. It is anticipated that farmlands that have corridors passing through them will generally continue to be used as farmland. Also, the longer transmission lines cross numerous state and United States highways. Use of existing corridors and ROWs would avoid critical or sensitive habitats/species as much as possible. If transmission towers that are to be inundated will pose either a permanent threat to boaters or a threat during low water events, permanent buoys and warning signs will be placed in appropriate locations. Specific monitoring requirements for new transmission lines and associated switchyards will be designed to meet conditions of permits, to minimize adverse environmental impacts, and to ensure that organisms are protected against transmission line alterations. Therefore, environmental effects from expansion efforts are anticipated to be SMALL and the effect of these corridors on land usage is expected to be minimal.

9.3.2.2.2 Brunswick Nuclear Power Plant Site

The Brunswick Nuclear Power Plant (Brunswick) site is located in Brunswick County, North Carolina.

9.3.2.2.2.1 Land Use

The Brunswick Nuclear Power Plant site is located on the Cape Fear River on the North Carolina coast at 6.1 to 7.6 m (20 to 25 ft.) NGVD29 (nominal plant grade is 6.1 m [20 ft.] NGVD29). The nominal plant grade of 6.1 m (20 ft.) NGVD29 results in 0.6 m (2 ft.) of water depth surrounding the plant during the maximum surge conditions. All safety-related structures at the current plant are waterproofed to 6.7 m (22 ft.) NGVD29 (Reference 9.3-001). The Brunswick Nuclear Power Plant site is on land already owned by PEC and is already zoned for uses compatible with the development of new units. The existing facility is integrated into the surrounding land use patterns. The impacts on land use at this site would be expected to be SMALL because the new reactor would be placed near existing nuclear facilities in an area that is currently zoned appropriately for power generation.

9.3.2.2.2.2 Air Quality

Potential adverse impacts caused by drift from cooling towers on surrounding plants, including crops and ornamental vegetation, natural plant communities, and soils, is expected to be minor. This potential impact can be minimized with the use of drift eliminators on the cooling towers.

Based on the design of the new reactor and the actions that will be taken to comply with permit requirements for emissions, it is expected that siting the unit at this location would have a SMALL impact on air quality.

9.3.2.2.2.3 Water

The Brunswick Nuclear Power Plant site is located on the Cape Fear River on the North Carolina coast. The site is 6.1 to 7.6 m (20 to 25 ft.) NGVD29. During a probable maximum hurricane, storm surge levels at the site would be 6.7 m (22 ft.) NGVD29 and the peak storm elevation of the Cape Fear River would be 7.1 m (23.3 ft.) NGVD29. In the intake canal, the stillwater level in this situation could reach 6.7 m (22 ft.) NGVD29. The nominal plant grade of 6.1 m (20 ft.) NGVD29 would result in 0.6 m (2 ft.) of water surrounding the plant during these hypothetical maximum surge conditions. However, this peak tide would not reach the site because all safety-related structures are waterproofed to an elevation 6.7 m (22 ft.) NGVD29 (Reference 9.3-001).

Because of the intake design and proximity of the site to the Atlantic Ocean, there are no flow constraints. The drainage area of Cape Fear River is 23,670 square kilometers (km^2) (9140 mi^2). In this drainage area, stream flow from about 15,540 km^2 (6000 mi^2) is continuously gauged by the USGS. The average daily freshwater discharge rate of Cape Fear River at its mouth is estimated to be 229 m^3/s to 283 m^3/s (8100 ft^3/s and 10,000 ft^3/s) or 3,629,724 gpm and 4,485,641 gpm (Reference 9.3-001). Water impacts are expected to be SMALL.

9.3.2.2.2.4 Terrestrial Ecology

According to the NRC's NUREG-1437, Supplement 25, terrestrial species that are listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) and have potential to occur in the vicinity of the Brunswick Nuclear Power Facility site or along the transmission line ROWs are presented in

Table 9.3-6. Terrestrial species listed by the State of North Carolina in the vicinity of the Brunswick Nuclear Power Facility site or along the transmission line ROWs are presented in Table 9.3-7. NRC staff conducted a review and concluded that the impacts on terrestrial endangered, threatened, proposed, or candidate species of an additional 20 years of operation and maintenance of the Brunswick Nuclear Power Plant site would be SMALL, and no additional mitigation was needed. The operation of additional units at this site would not be expected to adversely affect any federally listed terrestrial species (Reference 9.3-001).

Approximately 162.01 ha (400.33 ac.) of wetlands are known to occur in the 2428 ha (6000 ac.) site area. Of these wetlands, 33 ha (81 ac.) were found in the 162 ha (400 ac.) power block area, which would be affected by construction of the proposed facility (Reference 9.3-001). Terrestrial ecology impacts are expected to be MODERATE to LARGE.

9.3.2.2.2.5 Aquatic Ecology

According to the NRC's NUREG-1437, Supplement 25, aquatic species that are listed as threatened or endangered by the USFWS or the State of North Carolina and have potential to occur in the vicinity of the Brunswick Nuclear Power Facility are presented in Table 9.3-8. During the Brunswick Nuclear Power Plant re-licensing process, it was concluded that 1) continued operation of the plant and maintenance of the associated transmission line ROWs during the license renewal term was unlikely to adversely affect any federally listed aquatic species, and 2) any effect on threatened and endangered species during the additional 20 years of operation would be SMALL; therefore, no additional mitigation was warranted. Based on this information, it is reasonable to assume that operation of additional reactors at the Brunswick Nuclear Power Plant site would not adversely affect any federally listed aquatic species (Reference 9.3-001).

The Brunswick Nuclear Power Plant site was evaluated with respect to relative potential for entrainment and impingement impacts on the closed-cycle cooling water system. Proposed facilities at each site will include cooling towers that will reduce the amount of cooling water withdrawal required for plant operation. In addition, proper design of the water intake structure would minimize the potential adverse impacts. In NUREG-1437, NRC concludes that, with cooling towers and appropriate intake design, potential adverse impacts from entrainment or impingement of aquatic organism are minor and do not significantly disrupt existing populations. Assuming that there would be a two-unit closed-cycle plant at the site, there would be no discernible adverse effect on aquatic organisms because of the very small volume of water used by the plant compared with the total volume of available water at the site. Because of the low flow velocities of a closed-cycle plant at the site, impingement of adult fish is expected to be minimal. Use of a deep-water intake would have a minimal effect on entrainment of larval fish (Reference 9.3-001).

Thermal effluent from the Brunswick Nuclear Power Plant site discharges through two 4-m- (13-ft.-) diameter, 610 m (2000 ft.) long submerged pipes that extend into the Atlantic Ocean. Water depth at the point of discharge is approximately 3 m (10 ft.). The ocean floor near the discharge pipes is sandy, with no hard bottom outcroppings or attached vegetation that might attract fish. There is a strong westerly tidal and longshore flow in this region. Most aquatic organisms in the area, such as fish and shellfish, are highly mobile and can avoid the discharge area. Although aquatic species might use the nearshore area around the discharge location, the slight increase in temperature above ambient ocean temperature is not enough to cause heat shock (Reference 9.3-001).

The National Pollutant Discharge Elimination System (NPDES) permit for the Brunswick Nuclear Power Plant site includes a semi-annual monitoring requirement of water temperatures at the discharge location. The plant is currently able to operate at or near full power while still meeting state water temperature standards. Temperature monitoring is conducted when both reactor power levels are 85 percent or greater (Reference 9.3-001).

A newly abundant *Gracilaria spp.* species in the sounds of southeastern North Carolina has become a problem for commercial fishing and industries drawing water from the lower Cape Fear River. DNA sequence analyses have shown that this species is *Gracilaria vermiculophylla*, a taxon originally identified as native to East Asian countries. This species has wider temperature and salinity tolerance range than native species of *Gracilaria spp.* It is also presumed to not have many predators since it is an invasive species. *Gracilaria vermiculophylla* has been identified as a major fouling organism on the Brunswick Nuclear Power Plant's cooling water diversion and intake screens. Heavy accumulations of the macroalgae have been documented in the shallow waters north of the intake canal.

Operation under the NPDES permit should result in the maintenance of a balanced, indigenous population of fish, shellfish, and other aquatic organisms, both in the Cape Fear Estuary and Atlantic Ocean near the discharge structure. Based on a review of the available information regarding potential impacts of the cooling water intake system on the entrainment of fish and shellfish in early life stages and on the effectiveness of the mitigation measures already in place at the Brunswick Nuclear Power Plant site, the potential impacts are SMALL, and no additional mitigation is warranted. In addition, based on a review of the available information regarding potential impacts of the cooling water intake system on the impingement of fish and shellfish, and on the effectiveness of mitigation measures already in place at the Brunswick Nuclear Power Plant site that reduce impingement and mortality caused by impingement, the potential impacts are SMALL, and no additional mitigation is warranted (Reference 9.3-001).

9.3.2.2.2.6 Socioeconomics

Brunswick County, North Carolina, has a 2006 population estimate of approximately 94,945, which is a 29.8 percent increase from the 2000 population (Reference 9.3-004). The median household income is $39,379 per year.

Approximately 13.2 percent of the county's population lives below the poverty level. The mean value of owner-occupied housing units was $127,400. There were 8009 firms doing business in the county in 2002 (Reference 9.3-004). The largest town near the proposed site is the town of Wilmington, North Carolina (75,838), located 25.7 km (16 mi.) from the proposed site (Reference 9.3-001).

Based on the population near the plant, it is expected that most construction workers would come from within the region surrounding the site. Should a higher than expected number of construction workers come from outside the region, there could be a noticeable increase in population, but it would not be excessive. The population level is anticipated to be sufficiently high that the impact on area employment from construction and operation of the two new units would be low. It is expected that the impact on housing and community services would be negligible. The site area has sufficient population centers within commuting distance such that its public services sector would be able to absorb the population in-migration associated with plant construction and operation with minimal impact. Therefore, the effect of the proposed facility on the population and demographics of Brunswick County, North Carolina, is expected to be SMALL.

9.3.2.2.2.7 Transportation

The proposed Brunswick Nuclear Power Plant site is located near the city of Southport, North Carolina. The site is accessed by local roads. U.S. State Highways 87, 133, and 211 provide access to the Southport area, and feed into U.S. Highway 17 (Ocean Highway East). The Atlantic Ocean and Cape Fear River prevent egress to the east and the south (Reference 9.3-001). The proposed site will not need significant, if any, highway construction to accommodate construction or operation of a plant.

On-site railroad access is already provided in the immediate vicinity of the proposed site; however, an additional 0.16 km (0.1 mi.) of rail would be needed to connect to the existing rail (Reference 9.3-001). The existing units at the site are integrated into the surrounding land use patterns. The land that would be used for the new units is already owned by PEC and is currently zoned for uses compatible with the development of the new units.

Facilities within 8 km (5 mi.) of the site include Brunswick County Airport (6.4 km [4 mi.]), Cape Fear River/barge traffic (ocean-going vessels), and Sunny Point Army Terminal. The site area is generally industrial, and the closest industries are an Archer Daniels Midland (ADM) industrial plant (principal product is citric acid) and a Co-Gentrix Plant (steam and fossil fuel electricity). There is also a natural gas pipeline adjacent to the proposed site (Reference 9.3-001).

There are several ways to mitigate the potential transportation impacts during construction such as developing a construction traffic management plan before construction to address potential impacts on local roadways. If necessary, coordinating with local planning authorities for the upgrading of local roads, intersections, and signals to handle increased traffic loads could be considered. Schedules during workforce shift changes and for the delivery of larger pieces of equipment or structures could be coordinated to limit impacts on local roads. Use of shared (e.g., carpooling) and multi-person transportation (e.g., buses) during construction and/or operation of the facility could be encouraged. By implementing the appropriate measures, it is expected that there would be SMALL to MODERATE impacts on transportation during construction activities and SMALL impacts during operation of the facility.

9.3.2.2.2.8 Historic, Cultural, and Archeological Resources

Because no historic sites are known to occur at the existing Brunswick Nuclear Power Plant site, impacts on historic, cultural, and archeological resources from construction and operation of an additional reactor unit at this site would be SMALL. Investigation would be required before siting a new reactor at this location. Consultation with SHPO would occur if any significant historic, cultural, or archeological resources were identified and appropriate mitigation measures would be put in place before construction and operation. Therefore, it is expected that the impacts from constructing and operating an additional reactor at this site would be SMALL.

9.3.2.2.2.9 Environmental Justice

Table 9.3-9 presents demographic information for four counties surrounding the proposed Brunswick site: Brunswick, Columbus, New Hanover, Pender counties. Because no significant impacts on any human populations are expected to occur at the proposed Brunswick Nuclear Power Plant site, there would not be significant disproportionate impacts on minority or low income populations; and based on actual employment experience, positive economic benefits have been shown to be available to all members of the population regardless of income or ethnicity. In addition, if no significant health and safety impacts are identified from reactor construction and operation, there would be no environmental justice concerns, regardless of the percentage of minority or low income populations found within the surrounding communities. Furthermore, this site has been operating as a power generating facility for a number of years. Therefore, environmental justice impacts would be SMALL.

9.3.2.2.2.10 Transmission Corridors

The proposed site is located near the existing Brunswick Nuclear Power Plant. Required transmission system upgrades are estimated to require the significant installation of new infrastructure for the addition of an 1100-MWe generating unit (Reference 9.3-001). Additional infrastructure will be needed for a two-unit facility. However, efficiencies can be gained by using existing and proposed switchyards and corridors. If additional transmission corridors and towers are needed, they would be situated (if possible) in existing ROWs to avoid critical or sensitive habitats/species as much as possible. Specific monitoring requirements for new transmission lines and corridors, and associated switchyards will be designed to meet conditions of applicable federal, state, and local permits, to minimize adverse environmental impacts, and to ensure that organisms are protected against transmission line alterations. Transmission corridor impacts would be LARGE due to the commitment of land and construction impacts associated with the installation of new infrastructure on ecological resources. Utilization of existing transmission corridor ROWs could present opportunities to minimize impacts.

9.3.2.2.3 H.B. Robinson Nuclear Power Plant Site

The H.B. Robinson Nuclear Power Plant (Robinson) site is located in Darlington County, South Carolina. The site has an existing 710 MWe nuclear, 174 MW fossil and 15 MWe combustion turbine (Reference 9.3-001).

9.3.2.2.3.1 Land Use

The Robinson site is located on approximately 2435 ha (6020 ac.) of property in northwestern Darlington and southwestern Chesterfield counties, including the 911-ha (2250-ac.) Lake Robinson (Reference 9.3-001). The site area is rural, with light development. Facilities within 8 km (5 mi.) of the site include the Darlington County Internal Combustion Electric Plant (1.6 km [1 mi.]), Robinson Unit 1 coal-fired power plant, and the gas pipeline at Hartsville Municipal Airport (4 km [2.5 mi.]). Railroad Specialty Steel plant (Talley Metals) adjacent to the existing plant Lee County Airport lies within 24 km (15 mi.) of the site (Reference 9.3-001). Land to be used for new units is already owned by PEC and is already zoned for uses compatible with development of a new unit. The existing units are integrated into the surrounding land use patterns. Land use impacts are expected to be SMALL.

9.3.2.2.3.2 Air Quality

Potential adverse impacts caused by drift from cooling towers on surrounding plants, including crops and ornamental vegetation, natural plant communities, and soils, is expected to be minor. This potential impact can be minimized with the use of drift eliminators on the cooling towers.

Based on the design of the new reactor and the actions that will be taken to comply with permit requirements for emissions, it is expected that siting the unit at this location would have a SMALL impact on air quality.

9.3.2.2.3.3 Water

Lake Robinson, a 911-ha (2250-ac.) impoundment on Black Creek is the cooling water source for the H.B. Robinson Nuclear Power Plant. Currently, water to cool the nuclear unit is pumped at a rate of approximately 31.92 m^3/s (1127.37 ft^3/s) or 506,000 gpm and returned to the lake through the discharge canal. The site currently contains a 710-MWe nuclear, a 174-MWe fossil, and a 15-MWe combustion turbine. Based on operation of the existing unit, there have been some restrictions based on water availability and thermal effects (Reference 9.3-001).

Because Black Creek was impounded to provide cooling water to the H.B Robinson Nuclear Power plant, NRC considers the lake a "cooling pond" by definition. Units 1 and 2 share the cooling water discharge canal that extends approximately 6.4 km (4 mi.) to the north of the plant along the western edge of the lake. The canal was designed to allow the discharge water to cool before entering the lake. There are impacts from the thermal effluent on Lake Robinson near the discharge area; however, the impacts are limited and do not threaten the continued existence of a balanced and indigenous community of fish and wildlife in and around the lake. The NRC staff concluded that the potential heat shock impacts from operation of the plant's cooling water discharge system on the aquatic environment on- or near the site are SMALL, and mitigation is not warranted (Reference 9.3-001).

The proposed site is located on a 911-ha (2250-ac.) lake at an elevation of 69 m (225 ft.) NGVD29. Modeling of the PMF based on probable maximum precipitation (PMP) of 50.8 centimeters [cm] (20 inches [in.]) in 48 hours from a postulated hurricane showed a resulting flow of 850 m^3/s (30,000 ft^3/s). However, the proposed site would still be above flood elevation in this scenario. In addition, the spillway is designed to pass a flow of 1133 m^3/s (40,000 ft^3/s), which would result in a lake level of 67.57 m (221.67 ft.) NGVD29 (Reference 9.3-001).

The site appears to be challenged for water supply. In addition, operation of the coal unit at the Robinson site has historically been curtailed to avoid exceeding thermal limits for the lake (Reference 9.3-001). Therefore, SMALL to MODERATE impacts are expected based on concerns about operational limitations associated with water supply and thermal issues in Lake Robinson.

9.3.2.2.3.4 Terrestrial Ecology

According to NRC's NUREG-1437, Supplement 13, terrestrial species that are listed as threatened or endangered by the USFWS or the State of South Carolina and have potential to occur in the region surrounding the H.B. Robinson Nuclear Power Plant are presented in Table 9.3-10. No rare, threatened, or endangered species are known to occur in the immediate vicinity of the site (Reference 9.3-001).

Approximately 20.1 ha (49.7 ac.) of wetlands are located in the 162 ha (400 ac.) power block area and approximately 42.8 ha (105.8 ac.) of wetlands were found in the 2428 ha (6000 ac.) site area (Reference 9.3-001). Terrestrial ecology impacts are expected to be SMALL.

9.3.2.2.3.5 Aquatic Ecology

According to NRC's NUREG-1437, Supplement 13, aquatic species that are listed as threatened or endangered by the USFWS or the State of South Carolina and have potential to occur in the region surrounding the H.B. Robinson Nuclear Power Plant are presented in Table 9.3-11. However, none of these species are considered to exist on or near the site (Reference 9.3-001).

The Robinson site was evaluated for potential for entrainment and impingement impacts on the closed-cycle cooling water system. Proposed facilities at each site will include cooling towers that will reduce the amount of cooling water withdrawal required for plant operation. In addition, proper design of the water intake structure would minimize the potential adverse impacts. In NUREG-1437, NRC concludes that, with cooling towers and appropriate intake design, potential adverse impacts from entrainment or impingement of aquatic organism are minor and do not significantly disrupt existing populations.

Based on the results of entrainment studies and operating history of the Robinson intake, the NRC staff has reviewed the available information (in support of recent re-licensing) and concludes that the potential impacts of the cooling water intake system's entrainment on fish and shellfish in the early life stages are SMALL and, therefore, no additional mitigation is warranted. Furthermore, the H.B. Robinson Nuclear Power Plant operations will be required to comply with any future requirements imposed in its NPDES permit to ensure that entrainment impacts at the site will continue to be SMALL (Reference 9.3-001).

Based on the results of impingement studies and operating history of the Robinson intake, the NRC staff has reviewed the available information regarding potential impacts of the cooling water intake on the impingement of fish and shellfish and, based on this data, concludes that the potential impacts are SMALL, and no additional mitigation is warranted. Furthermore, the H.B. Robinson Nuclear Power Plant operations will be required to comply with any future requirements imposed in its NPDES permit to ensure that impingement impacts at the site will continue to be SMALL (Reference 9.3-001). Overall, aquatic ecology impacts are expected to be SMALL.

9.3.2.2.3.6 Socioeconomics

Darlington County, South Carolina, has a 2006 population estimate of approximately 67,551, which is a 0.2-percent increase from the 2000 population (Reference 9.3-005). The median household income is $31,982 per year. Approximately 19.9 percent of the county's population lives below the poverty level. The mean value of owner-occupied housing units was $74,100. There were 4112 firms doing business in the county in 2002 (Reference 9.3-005). The largest town near the proposed site is the town of Hartsville (7556); located 6.4 km (4 mi.) from the proposed site (Reference 9.3-001).

Based on the population near the plant, it is expected that most construction workers would come from within the region surrounding the site. Should a higher than expected number of construction workers come from outside the region, there could be a noticeable increase in population, but it would not be excessive.

The population level is anticipated to be sufficiently high that the impact on area employment from construction and operation of the two new units would be low. It is expected that the impact on housing and community services would be negligible. The site area has sufficient population centers within commuting distance such that its public services sector would be able to absorb the population in-migration associated with plant construction and operation with minimal impact. Therefore, the effect of the proposed facility on the population and demographics of Darlington County, South Carolina, is expected to be SMALL.

9.3.2.2.3.7 Transportation

The proposed Robinson site is located on the southwestern side of Lake Robinson, near the town of Pine Ridge, South Carolina. State Highway 151 provides access to the area and serves as a link to U.S. Highway 1 (northwest) or U.S. Highway 15 (southeast). The location of the site in relation to Lake Robinson prevents direct egress to the east. No other limiting climate or terrain conditions were identified (Reference 9.3-001). The proposed site would not require any highway construction to accommodate construction or operation of a plant.

On-site railroad access is already provided near the proposed site. However, an additional 0.32 km (0.2 mi.) of rail line would be needed to connect to the existing rail. (Reference 9.3-001)

There are several ways to mitigate the potential transportation impacts during construction such as developing a construction traffic management plan before construction to address potential impacts on local roadways. If necessary, coordinating with local planning authorities for the upgrading of local roads, intersections, and signals to handle increased traffic loads could be considered. Schedules during workforce shift changes and for the delivery of larger pieces of equipment or structures could be coordinated to limit impacts on local roads. Use of shared (e.g., carpooling) and multi-person transportation (e.g., buses) during construction and/or operation of the facility could be encouraged. By implementing the appropriate measures, it is expected that there would be SMALL to MODERATE impacts on transportation during construction activities and SMALL impacts during operation of the facility.

9.3.2.2.3.8 Historic, Cultural, and Archeological Resources

Because no historic sites are known to occur at the existing Robinson plant, impacts on historic, cultural, and archeological resources from construction and operation of an additional reactor unit at this site would be SMALL. Investigation would be required before siting a new reactor at this location. Consultation with SHPO would occur if any significant historic, cultural, or archeological resources were identified and any appropriate mitigation measures would be put in place before construction and operation.

9.3.2.2.3.9 Environmental Justice

Table 9.3-12 presents demographic information for several counties surrounding the proposed Robinson site: Darlington, Chesterfield, Lee, Kershaw, and Sumter counties. Because no significant impacts on any human populations are expected to occur at the proposed site, there would not be significant disproportionate impacts on minority or low income populations; and based on actual employment experience, positive economic benefits have been shown to be available to all members of the population regardless of income or ethnicity. In addition, if no significant health and safety impacts are identified from reactor construction and operation, there would be no environmental justice concerns, regardless of the percentage of minority or low income populations found within the surrounding communities. Furthermore, this site has been operating as a power generating facility for a number of years. Therefore, environmental justice impacts would be SMALL.

9.3.2.2.3.10 Transmission Corridors

Transmission systems are estimated to require significant additional infrastructure for the addition of an 1100-MWe generating unit (Reference 9.3-001). Additional infrastructure will be needed for a two-unit facility. However, efficiencies can be gained by using existing and proposed switchyards and corridors. If additional transmission corridors and towers are needed, they would be situated (if possible) in existing ROWs to avoid critical or sensitive habitats/species as much as possible. Environmental impacts are anticipated during the expansion of existing lines and/or the construction of new lines. Specific monitoring requirements for new transmission lines and corridors and associated switchyards will be designed to meet conditions of applicable federal, state, and local permits to minimize adverse environmental impacts and to ensure that organisms are protected against transmission line alterations. Transmission corridor impacts are expected to be LARGE based on anticipated environmental impacts on ecological resources associated with the installation of the necessary transmission corridor infrastructure.

9.3.2.3 Evaluation of Population Density for Alternative Sites

The NRC Standard Review Plan, NUREG-0800, section 2.1.3, III. 5, notes that if the population density of the proposed site exceeds, but is not well in excess of, 500 people per square mile (ppsm) over a radial distance out to 32 km (20 mi.), then the analysis of alternative sites should evaluate alternative sites having lower population density. The underlying regulation for this guidance is 10 CFR 100.21(h), which states:

> Reactor sites should be located away from very densely populated centers. Areas of low population density are, generally, preferred. However, in determining the acceptability of a particular site located away from a very densely populated center but not in an area of low density,

consideration will be given to safety, environmental, economic, or other factors, which may result in the site being found acceptable[3].

Footnote 3 states:

> Examples of these factors include, but are not limited to, such factors as the higher population density site having superior seismic characteristics, better access to skilled labor for construction, better rail and highway access, shorter transmission line requirements, or less environmental impact on undeveloped areas, wetlands or endangered species, etc. Some of these factors are included in, or impact, the other criteria included in this section.

For the HAR site, the current population (year 2000) density for the 0 to 32 km (0 to 20 mi.) radius is 383 ppsm, which is below the 500 ppsm guidance. Projections estimate a population density of 511 ppsm in 2010 and 574 in 2015 for the 0 to 32 km (0 to 20 mi.) radii. The population densities identified in the PEC Siting Study are slightly lower than the more current numbers presented above. For the purpose of this analysis, the numbers are equivalent to the "approximately 500" ppsm in the PEC Siting Study. The population density projected for the HAR site at the time of initial site approval and 5 years thereafter is expected to exceed, but not be well in excess of, 500 ppsm in 2015. (Reference 9.3-001)

The largest portion of the population that contributes to the relatively high population density is associated with the City of Raleigh, which is located beyond the 16-km (10-mi.) radius of the HAR Emergency Planning Zone (EPZ). Projections estimate a population density of 340 ppsm in 2010 and 384 in 2015 for the 0 to 16 km (0 to 10 mi.) radii.

The HAR site has a higher population density than the other three alternative sites considered. County population information for the locations of the four sites considered is provided in ER Table 10.4-1. However, a number of beneficial factors are associated with the HAR site, compared with the other acceptable locations, which include transmission deliverability and proximity to load, available land area, adequate water supply for multiple units, minimal environmental impact, and safety considerations.

From a safety perspective, HAR 2 and HAR 3 are advanced reactors with passive safety systems. The probabilistic analysis in ER Chapter 7 demonstrates that, even with HAR 2 and HAR 3 located in a relatively high population density area, the consequences of postulated accidents meet the NRC safety goals by a significant margin (Table 7.2-6). Also, site-specific off-site exposures during the spectrum of design basis accidents is significantly below the NRC's guideline limits (Table 7.1-2). While projected doses at the alternative sites would similarly benefit from the advantages of the AP1000 design, the significant margin provided diminishes the relevance of the 500 ppsm guidance.

The siting analysis conducted for this project indicated that the HAR site was the best location when compared with the other three alternative sites. The other three alternative sites included a Marion County greenfield site, the Brunswick site, and the Robinson site. Overall, the HAR is superior to Robinson with regards to the lake cooling water and availability of PEC-owned property. While Brunswick has access to more than adequate river water for cooling, the transmission system upgrades required are significant. The Marion County site had the largest land area, but also the largest percentage of wetland acreage and less than preferable geotechnical features.

The HAR site has the least environmental impact and the best characteristics for seismic safety as compared with the other alternative sites. Of the existing nuclear sites considered as alternatives (Brunswick and Robinson), HAR has the lowest evaluated peak ground acceleration. The Marion County site is expected to have similar seismic characteristics to Robinson and has seismic concerns due to its proximity to Charleston, South Carolina, an area with significant historic seismic activity.

Environmental factors that make the HAR site preferable include a smaller number of listed, threatened, or endangered species and critical habitat; no spawning grounds for any state or federal threatened or endangered species are present as is the case at the Brunswick site; and no postulated effluent discharge beyond the limits of existing NPDES permits or regulations. Potential impacts of a new nuclear facility on terrestrial or aquatic environments at the HAR site would not be greater than at the other alternative sites; and the siting of the new units at the HAR site would not require significant land use changes for construction in the area designated for the new units when compared to the other three alternative sites. Additionally, impacts to cultural resources at HAR are anticipated to be small in comparison to Marion County, where there is potential to impact a confederate naval yard, Pee Dee Indian Town, and a large graveyard.

The existing nuclear plant locations provide an advantage due to the ability to leverage existing site facilities and resources, such as warehousing, security, and operator training. HAR demonstrated an advantage over Brunswick and Robinson due to larger acreage of PEC-owned property and the clear ability to accommodate additional future generation capacity. HNP was originally planned for multiple units.

Co-location of the new units at the HAR site will allow some shared use of existing infrastructure, reducing both developmental costs and environmental effects associated with construction of new access roads, waste disposal areas, and other supporting facilities and structures. Construction impacts associated with new transmission lines can be minimized at the HAR site because of the potential use and/or expansion of existing corridors.

The HNP was originally designed as a four reactor site. Although only one reactor was built, certain infrastructure was built to support the four reactors, which can be used to support HAR 2 and HAR 3. The infrastructure includes transmission line corridors, a switchyard currently sized for two units, and a lake that can be increased in water level to support multiple units. The lake is currently filled to a level required for one reactor; however, the dam was designed and constructed to accommodate the four reactors and can be increased in level to support HAR 2 and HAR 3 with spillway modifications. In contrast, the Robinson site has limited water availability, the Marion County site would require a new impoundment, and the Brunswick site would use saltwater for cooling that could pose cooling tower salt drift concerns.

Transmission deliverability analysis has further concluded the HAR site was best suited to the existing transmission system requirements. The HAR site has minimal transmission impact of costs for the installation of a 1100-megawatt (MW) nuclear unit. Existing transmission lines and corridors would be used for HAR 2, and existing transmission corridors would be expanded for HAR 3. Only three new lines would need to be developed for the HAR site in the existing corridors. In contrast, the Robinson and Marion County sites are not located near major load centers, and new transmission corridors and switchyards would need to be developed. The Brunswick site is near the Wilmington, NC load center, but new transmission corridors and switchyards would need to be developed to serve other load centers on the PEC system. Transmission system upgrades at the other alternative sites were estimated to total $600 million for Brunswick, $286 million for Robinson, and $410 million for the Marion County site. In comparison, estimated costs of transmission upgrades for the HAR site were evaluated as negligible.

The HAR site, with its higher population density, also offers greater availability to skilled workers than the alternatives. The HAR site has significantly more-developed infrastructure than the other alternative sites, with major highways including Interstate Highways 40 and 440, interconnections with Interstate 85 at Durham, North Carolina, and U.S. Highway 1. None of the other alternative sites are in close proximity to Interstate or major United States highways.

Construction of new rail lines also favor using an existing nuclear plant location. Railroad improvement costs at the three existing facilities are as follows: approximately $600,000 for HAR; approximately $300,000 for Brunswick; and approximately $600,000 for Robinson. The cost of railroad improvements at the proposed Marion County greenfield site is approximately $3.42 million.

The siting analysis indicated that all three of the existing nuclear sites are suitable for a new nuclear power plant; the Marion County site (greenfield site) ranks significantly lower than the existing sites, as a result of high transmission costs and seismic, land acquisition, and wetlands issues. Of the existing nuclear sites, HAR rated highest, followed by Robinson and Brunswick. Robinson rated somewhat lower, primarily due to potential cooling water supply operational limitations and a lower rating in the geology/seismic category. Brunswick rated lower primarily due to transmission challenges, as well as being slightly less favorable with respect to ecology and nearby hazardous land uses. Based on these environmental factors and other applicable considerations related to PEC's business plans, HAR was selected as the proposed site for the PEC COLA. In addition to its advantages as an existing nuclear power plant site, HAR ranged highest or equal-highest in 26 of the general siting criteria composite ratings. (Reference 9.3-001)

As stated above, the NRC Standard Review Plan, NUREG-0800, section 2.1.3, III. 5, notes that if the projected population density of the proposed site exceeds, but is not well in excess of, 500 ppsm over a radial distance out to 32 km (20 mi.), then the analysis of other alternative sites should evaluate other alternative sites having lower population density. However, "consideration will be given to safety, environmental, economic, or other factors, which may result in the site being found acceptable." Population projections currently estimate a population density of 511 ppsm in 2010 and 574 in 2015 for the 0 to 32 km (0 to 20 mi.) radii, which is not well in excess of the criteria. As demonstrated in the siting analysis described in this chapter, the HAR site is acceptable based on consideration of factors considered in 10 CFR 100.21(h).

Seven EPRI potential sites were evaluated by PEC as potential sites with low population densities, but these sites were eliminated from further consideration. The site southeast of the city of Marion was eliminated because seismic criteria could not be met. The Fayetteville site was eliminated because the tract of land was not of suitable size. The "South River" site was eliminated due to soil liquefaction issues. A grouping of sites evaluated together on the Pee Dee River was eliminated because a new cooling water reservoir would have been required, as well as significant transmission line upgrades. The SRS was eliminated because it lies outside the PEC Service Territory and the ROI. Two sites in eastern North Carolina were eliminated because they are being considered for new fossil plants and the location lacked sufficient off-site voltage to support a nuclear unit. Although these seven sites had lower population densities, other siting criteria (e.g., hydrology, environmental) resulted in the sites being eliminated during the screening process. (Reference 9.3-001)

9.3.3 SUMMARY AND CONCLUSIONS

The advantages of the HAR site over the other alternative sites are summarized as follows:

- The postulated consumptive use of water by a new unit at the HNP site would not be greater than water use at the other alternative sites.
- A smaller number of listed, threatened, or endangered species and critical habitat has been identified at the HAR site than at the other alternative sites. Through consultation with the appropriate state and federal agencies and/or potential mitigation measures, it is expected that impacts of development of a new unit at the proposed site on endangered species would not be greater than impacts postulated for the other alternative sites.

- The HAR site does not contain spawning grounds for any state or federal threatened or endangered species. Thus, the impacts on spawning areas would not be greater than impacts at the other alternative sites.

- The HAR site impact review does not postulate effluent discharge beyond the limits of existing NPDES permits or regulations. Based on the information available for the other alternative sites, the impacts from effluent discharge at the proposed site would not be greater than impacts at the other alternative sites.

- The siting of a new unit at the HNP site would not require pre-emption or land use changes for construction. Therefore, construction land use impacts at the proposed site would not be greater than the impacts at the other alternative sites.

- The potential impacts of a new nuclear facility on terrestrial and aquatic environments at the HNP site would not be greater than the impacts at the other alternative sites.

- There are a number of beneficial factors associated with the HAR site as compared to other acceptable locations. These include transmission deliverability and proximity to load, available land area, adequate water supply for multiple units, and minimal environmental impact.

- The need for transmission and rail line upgrades is significantly less for the HAR site than for the other alternative sites.

As summarized in Table 9.3-13, no other alternative sites are environmentally preferable and, therefore, cannot be considered obviously superior to the HAR site. Development of a greenfield site would offer no advantages and would increase both the cost of the new facility and the severity of impacts. Co-location of the new reactor unit at an existing site would allow existing infrastructure and transmission lines and corridors to be used. Alternative nuclear sites offer no environmental advantages over the preferred site. The existing facility currently operates under an NRC license, and the proposed location has already been found acceptable under the requirements for that license. Further, operational experience at HAR has shown that the environmental impacts are SMALL, and operation of a new unit at the site should have essentially the same environmental impacts.

9.3.4 REFERENCES

9.3-001 Progress Energy Carolinas, Inc., "Progress Energy: New Nuclear Baseload Generation Addition, Evaluation of Carolina Sites," January 2006 (Proprietary Reference).

9.3-002 U.S. Census Bureau, "Marion County Quickfacts," Website, www.quickfacts.census.gov/qfd/states/45/45067.html, accessed June 26, 2007.

9.3-003 U.S. Census Bureau, "Wake County Quickfacts," Website, www.quickfacts.census.gov/qfd/states/37/37183.html, accessed June 26, 2007.

9.3-004 U.S. Census Bureau, "Brunswick County Quickfacts," Website, www.quickfacts.census.gov/qfd/states/37/37019.html, accessed June 26, 2007.

9.3-005 U.S. Census Bureau, "Darlington County Quickfacts," Website, www.quickfacts.census.gov/qfd/states/45/45031.html, accessed June 26, 2007.

Table 9.3-1 (Sheet 1 of 2)
Carolinas Site Identification and Analysis Status

#	Site Description and Location	Identified By	Evaluation	Status
Carolinas locations identified as candidate sites for further consideration:				
1	Harris Nuclear site	Nuclear Generation Group (NGG) existing site	Existing nuclear power plant site; no issues to preclude consideration for COL site. This site was originally developed to accommodate much more electrical capacity and has much of the infrastructure to support units already in place.	Carried forward as candidate site.
2	Brunswick Nuclear site	NGG existing site	Existing nuclear power plant site; no issues to preclude consideration for COL site.	Carried forward as candidate site.
3	Robinson Nuclear site	NGG existing site	Existing nuclear power plant site; no issues to preclude consideration for COL site. This site is challenged from thermal limits on the lake, based on existing operating experience.	Carried forward as candidate site.
4	Marion County, SC Site	Identified by Emerson Gower	Site identified as being available for acquisition, with adequate land area and water supply from the Pee Dee River.	Carried forward as candidate site.
Carolina Sites eliminated from further consideration:				
5	SC site	Identified by Emerson Gower	Site identified as being available for acquisition, with adequate land and water. Initial evaluation of the site indicated a high likelihood that it would not meet seismic requirements for existing and planned certified reactor designs.	Eliminated from further consideration.
6	NC site	Proposed by the Mayor	Preliminary analysis indicates that there is no block of suitable land of sufficient size in a low population zone without wetlands. The area is also generally too flat for development of the large lake that would be required for a cooling water reservoir, and the site would require considerable expense to make it viable from an engineering perspective.	Eliminated from further consideration.

Table 9.3-1 (Sheet 2 of 2)
Carolinas Site Identification and Analysis Status

#	Site Description and Location	Evaluation	Status
7	NC site	This site was previously considered by PEC for a potential nuclear plant. Soil liquefaction issues have been identified that could make the site unsuitable for a certified plant design, and cooling tower makeup water sources are not adequate. The site also appears to be environmentally sensitive.	Eliminated from further consideration.
8	Three sites near the NC/SC border	This site grouping was identified based on current ownership of the hydro plant and previous Progress Energy site selection studies. The site would require major transmission upgrades and a new cooling water reservoir would likely be needed to deal with periodic low river flows on the Pee Dee at this location.	Eliminated from further consideration.
9	SC site	This site (which is outside the PEC service territory) was identified because Savannah River Site (SRS) has aggressively pursued a new nuclear plant on the reservation with PGN, Duke, and SCANA. The site is not close to the PEC service territory and therefore would have high transmission costs. In addition, SRS controls the on-site cooling water loop from which cooling water would be drawn; the need for operational water arrangements with SRS to obtain cooling water was not desirable.	Eliminated from further consideration.
10	NC site	The site is available, has been identified in previous PEC siting studies, and is actively being considered for a future approximately 800-MW fossil plant. This location also did not have sufficient off-site power voltage to support a nuclear unit.	Eliminated from further consideration.
11	NC site	The site is available, has been identified in previous PEC siting studies, and is actively being considered for a future approximately 800 MW fossil plant. This location also did not have sufficient off-site power voltage to support a nuclear unit.	Eliminated from further consideration.

Source: Reference 9.3-001

Table 9.3-2
South Carolina Rare, Threatened, & Endangered Species Inventory Species Found in Marion County — Terrestrial

Scientific Name	Common Name	Federal Status	State Status
Corynorhinus Rafinesquii	Rafinesque's Big-Eared Bat	--	Endangered
Haliaeetus Leucocephalus	Bald Eagle	Delisted (August 2007)	Endangered
Heterodon Simus	Southern Hognose Snake	--	Species of Concern
Pituophis Melanoleucus	Pine or Gopher Snake	--	Species of Concern

Source: Information taken from the South Carolina Department of Natural Resources.

Table 9.3-3
South Carolina Rare, Threatened, & Endangered Species Inventory Species Found in Marion County — Aquatic

Scientific Name	Common Name	Federal Status	State Status
Ilex Amelanchier	Sarvis Holly	--	Species of Concern
Isoetes Riparia	River Bank Quillwort	--	Species of Concern
Lampsilis Cariosa	Yellow Lampmussel	--	Species of Concern
Thalia Dealbata	Powdery Thalia	--	Species of Concern

Source: Information taken from the South Carolina Department of Natural Resources.

Table 9.3-4
Marion Site Minority and Low Income Population/Percentages

County	Population (2000)	White (%)	Black (%)	Hispanic (%)	Low Income (%)
Marion	35,466	41.7 (14,787)	56.3	1.8	23.2 (8228)
Florence	125,761	58.7 (73,760)	39.3	1.1	16.4 (20,625)
Dillon	31,289	50.4 (15,481)	45.3	1.8	24.2 (7572)
Darlington	67,394	57.0 (38,402)	41.7	1.0	20.3 (13,680)
Total	259,910	54.6 (141,910)	45.4% minority (118,000)		19.3 (50,105)

Source: Reference 9.3-002

Table 9.3-5
HAR Site Minority and Low Income Population/Percentages

County	Population (2000)	White (%)	Black (%)	Hispanic (%)	Low Income (%)
Chatham	49,329	74.9 (36,969)	17.1	9.5	9.7 (4785)
Harnett	91,025	71.1 (64,744)	22.5	5.9	14.9 (13,560)
Durham	223,314	50.9 (113,698)	39.5	7.6	13.4 (29,920)
Orange	118,227	78.0 (92,272)	13.8	4.5	14.1 (16,670)
Wake	627,846	72.4 (454,544)	19.7	5.4	7.8 (48,970)
Total	1,109,741	68.7% (762,392)	32.3% minority (358,446)		10.3 (113,905)

Source: Reference 9.3-003

Table 9.3-6
Federally Listed Terrestrial Species Potentially Occurring in the Vicinity of the Brunswick Site

Scientific Name	Common Name	Federal Status	State Status
	REPTILES		
Alligator mississippiensis	American alligator	Threatened (Similarity of Appearance	Threatened
	MAMMALS		
Puma concolor cougar	eastern cougar	Endangered	Endangered
	BIRDS		
Charadrius melodus	piping plover	Threatened	Threatened
Haliaeetus leucocephalus	bald eagle[(a)]	Threatened	Threatened
Mycteria americana	wood stork	Endangered	Endangered
Picoides borealis	red cockaded woodpecker	Endangered	Endangered
	INVERTEBRATES		
Neonympha mitchellii francisci	Saint Francis' satyr butterfly	Endangered	State Rare
	PLANTS		
Amaranthus pumilus	seabeach amaranth	Threatened	Threatened
Carex lutea	golden sedge	Endangered	Endangered
Dichanthelium hirstii	Hirst's panic grass	Candidate for listing	Endangered
Isotria medeoloides	small whorled pogonia	Threatened	Endangered
Lindera melissifolia	pondberry or southern spicebush	Endangered	Endangered
Lysimachia asperulifolia	rough-leaf loosestrife	Endangered	Endangered
Rhus michauxii	Michaux's sumac	Endangered	Endangered
Schwalbea americana	chaffseed	Endangered	Endangered
Thalictrum cooleyi	Cooley's meadowrue	Endangered	Endangered

Notes:
a) Since the publication of this reference, the bald eagle has been delisted from its "Threatened" status.

Source: Information taken from the NRC's NUREG-1437, Supplement 25.

Table 9.3-7 (Sheet 1 of 2)
North Carolina State-Listed Terrestrial Species Potentially Occurring in the Vicinity of the Brunswick Site

Scientific Name	Common Name	Federal Status	State Status
	MAMMALS		
Corynorhinus rafinesquii	Rafinesque's big-eared bat	Species of Concern	Threatened
Neotoma floridana	eastern wood rat	---	Threatened
	BIRDS		
Falco peregrinus	peregrine falcon	---	Endangered
Sterna nilotica	gull-billed tern	---	Threatened
	REPTILES		
Crotalus adamanteus	eastern diamondback rattlesnake	---	Endangered
Micrurus fluvius	eastern coral snake	---	Endangered
	AMPHIBIANS		
Ambystoma tigrinum	eastern tiger salamander	---	Threatened
Rana capito	Carolina gopher frog	Species of Concern	Threatened
	PLANTS		
Adiantum capillus-veneris	Venus hair fern	---	Endangered
Amorpha georgiana var confusa	savanna indigo-bush	Species of Concern	Threatened
Amorpha georgiana var georgiana	Georgia indigo-bush	Species of Concern	Endangered
Asplenium heteroresiliens	Carolina spleenwort	Species of Concern	Endangered
Astragalus michauxii	Sandhills milk-vetch	Species of Concern	Threatened
Calopogon multiflorus	many-flowered grass-pink	Species of Concern	Endangered
Carex exilis	coastal sedge	---	Threatened
Carya myristiciformis	nutmeg hickory	---	Endangered
Chrysoma pauciflosculosa	woody goldenrod	---	Endangered
Cystopteris tennesseensis	Tennessee bladder-fern	---	Endangered
Eupatorium resinosum	resinous boneset	---	Threatened

Table 9.3-7 (Sheet 2 of 2)
North Carolina State-Listed Terrestrial Species Potentially Occurring in the Vicinity of the Brunswick Site

Scientific Name	Common Name	Federal Status	State Status
Fimbristylis perpusilla	Harper's fimbry	Species of Concern	Threatened
Helenium brevifolium	littleleaf sneezeweed	—	Endangered
Helenium vernale	spring sneezeweed	—	Endangered
Lilaeopsis carolinensis	Carolina grasswort	—	Threatened
Lilium pyrophilum	Sandhills lily	—	Endangered
Lindera subcoriacea	bog spicebush	Species of Concern	Threatened
Lobelia boykinii	Boykin's lobelia	Species of Concern	Threatened
Lophiola aurea	golden crest	—	Endangered
Macbridea caroliniana	Carolina bogmint	Species of Concern	Threatened
Muhlenbergia torreyana	pinebarren smokegrass	—	Endangered
Myriophyllum laxum	loose watermilfoil	Species of Concern	Threatened
Parnassia caroliniana	Carolina grass-of-parnassas	—	Endangered
Parnassia grandiflora	large-leaved grass-of-parnassus	Species of Concern	Threatened
Plantago sparsiflora	pineland plantain	Species of Concern	Endangered
Platanthera integra	yellow fringeless orchid	—	Threatened
Platanthera nivea	snowy orchid	—	Threatened
Pteroglossaspis ecristata	spiked medusa	Species of Concern	Endangered
Pyxidanthera barbulata var brevifolia	Sandhills pixie-moss	Species of Concern	Endangered
Rhexia aristosa	awned meadow-beauty	Species of Concern	Threatened
Rhynchospora macra	southern white beaksedge	—	Endangered
Rhynchospora thornei	Thorne's beaksedge	Species of Concern	Endangered
Sabatia kennedyana	Plymouth gentian	—	Threatened
Solidago pulchra	Carolina goldenrod	—	Endangered
Solidago villosicarpa	coastal goldenrod	—	Endangered
Sporobolus teretifolius	wireleaf dropseed	Species of Concern	Threatened
Stylisma pickeringii var pickeringii	Pickering's dawnflower	Species of Concern	Endangered
Trillium pusillum var pusillum	Carolina least trillium	Species of Concern	Endangered
Utricularia olivacea	dwarf bladderwort	—	Threatened

Source: Information taken from the NRC's NUREG-1437, Supplement 25.

Table 9.3-8 (Sheet 1 of 2)
Federally Listed and State-Listed Aquatic Species Potentially Occurring in the Vicinity of the Brunswick Site

Scientific Name	Common Name	Federal Status	State Status
	REPTILES		
Caretta caretta	loggerhead turtle	Threatened	Threatened
Chelonia mydas	green turtle	Threatened	Threatened
Dermochelys coriacea	leatherback turtle	Endangered	Endangered
Eretmochelys imbricata	hawksbill turtle	Endangered	Endangered
Lepidochelys kempii	Kemp's [Atlantic] ridley turtle	Endangered	Endangered
	MAMMALS		
Balaenoptera borealis	sei whale	Endangered	---
Balaenoptera musculus	blue whale	Endangered	---
Balaenoptera physalus	fin whale	Endangered	---
Eubalaena glacialis	right whale	Endangered	---
Megaptera novaeangliae	humpback whale	Endangered	---
Physeter macrocephalus	sperm whale	Endangered	---
Trichechus manatus	West Indian manatee	Endangered	Endangered
	FISH		
Acipenser brevirostrum	shortnose sturgeon	Endangered	Endangered
Acipenser oxyrhynchus	Atlantic sturgeon	Species of Concern	Special Concern
Carcharhinus obscurus	dusky shark	Species of Concern	---
Carcharhinus signatus	night shark	Species of Concern	---
Elassoma boehlkei	Carolina pygmy sunfish	Species of Concern	Threatened
Eleotris pisonis	spinycheek sleeper	—	Significantly Rare
Epinephelus drummondhayi	speckled hind	Species of Concern	---
Epinephelus nigritus	Warsaw grouper	Species of Concern	---
Etheostoma perlongum	Waccamaw darter	Species of Concern	Threatened
Evorthodus lyricus	lyre goby	—	Significantly Rare
Fundulus luciae	spotfin killifish	—	Significantly Rare
Fundulus waccamensis	Waccamaw killifish	Species of Concern	Special Concern
Gobionellus stigmaticus	marked goby	—	Significantly Rare
Heterandria formosa	least killifish	—	Special Concern

Table 9.3-8 (Sheet 2 of 2) Federally Listed and State-Listed Aquatic Species Potentially Occurring in the Vicinity of the Brunswick Site

Scientific Name	Common Name	Federal Status	State Status
Hypsoblennius ionthas	freckled blenny	—	Significantly Rare
Menidia extensa	Waccamaw silverside	Threatened	Threatened
Microphis brachyurus	opossum pipefish	—	Significantly Rare
Noturus sp.	broadtail madtom	—	Special Concern
Odontaspis taurus	sand tiger shark	Species of Concern	---
Poecilia latipinna	sailfin molly	—	Significantly Rare
	MOLLUSKS		
Anodonta couperiana	barrel floater	—	Endangered
Elliptio folliculata	pod lance	—	Special Concern
Elliptio marsupiobesa	Cape Fear spike	—	Threatened
Elliptio roanokensis	Roanoke slabshell	—	Threatened
Elliptio sp.	Waccamaw lance pearlymussel	Species of Concern	---
Elliptio waccamewensis	Waccamaw spike	Species of Concern	Threatened
Fusconaia masoni	Atlantic pigtoe	Species of Concern	Endangered
Helisoma eucosmium = Taphius eucosmius eucosmius	greenfield ramshorn	Species of Concern	Endangered
Lampsilis cariosa	yellow lampmussel	Species of Concern	Endangered
Lampsilis fullerkati	Waccamaw fatmucket	Species of Concern	Threatened
Ligumia nasuta	Eastern pondmussel	—	Threatened
Planorbella magnifica	magnificent ramshorn	Species of Concern	Endangered
Toxolasma pullus	Savannah lilliput	Species of Concern	Endangered
Triodopsis soelneri	Cape Fear threetooth	Species of Concern	Threatened
Villosa delumbis	Eastern creekshell	—	Significantly Rare

Source: Information taken from the NRC's NUREG-1437, Supplement 25.

Table 9.3-9
Brunswick Site Minority and Low Income Population/Percentages

County	Population (2000)	White (%)	Black (%)	Hispanic (%)	Low Income (%)
Brunswick	73,143	82.3 (60,200)	14.4	2.7	12.6 (9216)
Columbus	54,749	63.4 (34,737)	30.9	2.3	22.7 (12,430)
New Hanover	160,307	79.9 (128,098)	17	2.0	13.1 (21,000)
Pender	41,082	72.7 (29,882)	23.6	3.6	13.6 (5587)
Total	329,281	76.8 (252,887)	23.2 minority (76,393)		14.6 (48,233)

Source: Reference 9.3-004

Table 9.3-10
Federally Listed and State-Listed Terrestrial Species Potentially Occurring in the Vicinity of the H.B. Robinson Site

Scientific Name	Common Name	Federal Status	State Status
	BIRDS		
Haliaeetus leucocephalus	bald eagle[(a)]	Threatened	Endangered
Picoides borealis	red-cockaded woodpecker	Endangered	Endangered
	MAMMALS		
Corynorhinus rafinesquii	Rafinesque's big-eared bat	—	Endangered
	AMPHIBIANS		
Hyla andersonii	pine barrens treefrog	—	Threatened
	PLANTS		
Schwalbea americana	chaffseed	Endangered	Endangered
Lysimachia asperulifolia	rough-leaved loosestrife	Endangered	Endangered
Oxypolis canbyi	Canby's dropwort	Endangered	Endangered

Notes:
a) Since the publication of this reference, the bald eagle has been delisted from its "Threatened" status.

Source: Information taken from the NRC's NUREG-1437, Supplement 25.

Table 9.3-11
Federally Listed and State-Listed Aquatic Species Potentially Occurring in the Vicinity of H.B. Robinson Site

Scientific Name	Common Name	Federal Status	State Status
	FISH		
Acipenser brevirostrum	shortnose sturgeon	Endangered	Endangered
Acipenser oxyrinchus	Atlantic sturgeon	Candidate for listing	—
Etheostoma flabellare	fantail darter	—	Species of Concern
Notropis chiliticus	redlip shiner	—	Species of Concern
Semotilus lumbee	sandhills chub	—	Species of Concern
	MOLLUSKS		
Elliptio congaraea	Carolina slabshell	—	Species of Concern
Elliptio lanceolata	yellow lance	—	Species of Concern
Lasmigona decorata	Carolina heelsplitter	Endangered	Endangered
Pyganodon cataracta	Eastern floater	—	Species of Concern
Villosa constricta	notched rainbow	—	Species of Concern
Villosa delumbis	Eastern creekshell	—	Species of Concern

Source: Information taken from the NRC's NUREG-1437, Supplement 25.

Table 9.3-12
H.B. Robinson Site Minority and Low Income Population/Percentages

County	Population (2000)	White (%)	Black (%)	Hispanic (%)	Low Income (%) (population)
Darlington	67,394	57.0 (38,402)	41.7	1.0	20.3 (13,680)
Chesterfield	42,768	64.3 (27,500)	33.2	2.3	20.3 (8682)
Lee	20,119	35 (7048)	63.6	1.3	21.8 (4386)
Kershaw	52,647	71.6 (37,701)	26.3	1.7	12.8 (6739)
Sumter	104,646	50.1 (52,462)	46.7	1.8	16.2 (16,953)
Total	287,574	56.7 (163,305)	43.3 minority (124,520)		17.5 (50,440)

Source: Reference 9.3-005

Table 9.3-13
Comparison of Candidate and Potential Sites

Location	HAR Site	Marion County (Greenfield) Site	Brunswick Nuclear Power Plant Site	H.B. Robinson Nuclear Power Plant Site
Land Use	SMALL to MODERATE	MODERATE to LARGE	SMALL	SMALL
Air Quality	SMALL	SMALL	SMALL	SMALL
Water	SMALL	LARGE	SMALL	SMALL to MODERATE
Terrestrial Ecology	SMALL to MODERATE	MODERATE	MODERATE to LARGE	SMALL
Aquatic Ecology	SMALL	SMALL to MODERATE	SMALL	SMALL
Socioeconomics	SMALL	SMALL	SMALL	SMALL
Historic, Cultural, and Archeological Resources	SMALL	MODERATE to LARGE	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL	SMALL
Transmission Corridors	SMALL	LARGE	LARGE	LARGE
Transportation	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Is this Site a Candidate Site (Yes or No)	Yes	Yes	Yes	Yes
Is this Candidate Site a good Alternative Site to the Proposed Site	Yes	Yes	Yes	Yes
Is the Site Environmentally Preferable?	Preferred alternative	No	No	No
Is the Site Obviously Superior?	Preferred alternative	Not Evaluated	Not Evaluated	Not Evaluated

9.4 ALTERNATIVE PLANT AND TRANSMISSION SYSTEMS

In accordance with NUREG-1555, Section 9.4, this section describes the evaluation of the alternative plant and transmission systems for heat dissipation, circulating water, and power transmission at the HAR. PEC proposes to build and operate two Westinghouse AP1000 units, a certified nuclear plant design under 10 CFR 52, Subpart B.

Throughout this chapter, environmental impacts of the alternatives are assessed using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE. This standard of significance was developed using the Council on Environmental Quality guidelines set forth in the footnotes to Table B-1 of 10 CFR 51, Subpart A, Appendix B:

- **SMALL**. Environmental effects are not detectable or are so minor they will neither destabilize nor noticeably alter any important attribute of the resource.
- **MODERATE**. Environmental effects are sufficient to alter noticeably but not to destabilize important attributes of the resource.
- **LARGE**. Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2.

Some clearing and other development will be required for the construction and operation of the HAR units, as discussed in ER Chapters 4 and 5. Potential SMALL to MODERATE adverse impacts were noted for the selected heat dissipation and cooling water systems from the installation of the Cape Fear River intake structures and the associated pipelines for the makeup water. Additionally, SMALL impacts are anticipated from the placement of the transmission lines since existing corridors and existing PEC-owned or other ROW are expected to be utilized. Subsection 9.4.1 discusses alternative heat dissipation systems; Subsection 9.4.2 discusses alternative circulating water systems; and Subsection 9.4.3 reviews transmission systems.

9.4.1 HEAT DISSIPATION SYSTEMS

Generally, heat dissipation systems are dependent on the availability of water resources at the particular site. The potential sources of cooling water at HAR sites could be from freshwater cooling ponds, lake water, or wet cooling towers.

The purpose of the plant cooling system is to dissipate energy to the environment. The condenser creates the low pressure required to draw steam through and increase the efficiency of the turbines. The lower the pressure of the exhaust steam leaving the low-pressure turbine, the more efficiency is gained. The limiting factor is the temperature of the cooling water.

The various heat dissipation system options differ in how the energy transfer takes place and, therefore, have different environmental impacts. Potential alternatives considered were those generally included in the broad categories of "once-through" and "closed-cycle" systems. The once-through method involves the use of large quantity of cooling water, withdrawn from and returned to a large water source following its circulation through the main condenser. Closed-cycle cooling systems involve substantially less water usage, since the water performing the cooling is continually re-circulated through the main condenser and only makeup water for normal system losses is required. Normal system losses include evaporation, blowdown, and drift. Evaporation occurs as part of the cooling process in wet systems. The purpose of blowdown is to control solids in the water that accumulate due to evaporation, which helps protect surfaces from scaling or corrosion problems. Drift is liquid water that escapes from the heat dissipation system in the form of unevaporated droplets during operation.

For the HAR, the waste heat would be dissipated by a cooling tower(s), which draws cooling water makeup via a new intake structure from Harris Reservoir. Additional water would be pumped from the Cape Fear River via a new intake structure and associated pipeline to maintain the desired operating level for Harris Reservoir. As discussed in ER Section 3.3, the AP1000 reactor will be used for the HAR. The AP1000 is designed to effectively remove or enable removal of heat from the reactor during all modes of operation, including shutdown and accident conditions.

According to guidance provided in NUREG-1555 Environmental Standard Review Plan (ESRP) 9.4.1, this subsection discusses alternatives to the proposed heat dissipation system that was described in Section 3.4. The information provided in this subsection is based on a report generated by the applicant, *Engineering and Economic Evaluation of the Integrated Heat Rejection Cycle* (Reference 9.4-001). A summary of the environmental impacts of the heat dissipation system alternatives is provided in Table 9.4-1. As indicated in Table 9.4-2 (single hot year weather), indicates that the generation benefits partially offset the high initial cost of the two natural draft towers. The generation benefits analysis is repeated in Table 9.4-3 for the average weather year.

Heat dissipation systems are generally included in the broad categories of "once-through" and "closed-loop" systems. The once-through method involves the use of a large quantity of cooling water, withdrawn from a water source and returned to that source (receiving body of water) following its circulation through the normal heat sink (i.e., main condenser). Closed-loop cooling systems use substantially less water because the water performing the cooling is continually recirculated through the normal heat sink (i.e., the main condenser), and only makeup water for evaporative losses and blowdown is required. In closed-loop systems, two pumping stations are usually required — a makeup water system and a cooling water system. Closed-loop systems include cooling towers and a cooling pond or a spray pond. As a result of the evaporation process, the concentration of chemicals in the water will increase. To maintain acceptable water chemistry, water must be discharged at a small rate (blowdown) and compensated by a makeup water source.

Heat dissipation systems are categorized as wet or dry, and the use of either system depends on the site characteristics. Both wet and dry cooling systems would use water as the heat exchange medium. A wet cooling tower cools water circulated through the tower. Heat from the water is dissipated by direct contact with air circulating through the tower. The heat transfer takes place primarily by evaporation of some of the water into the air stream (latent heat transfer). Generally, a relatively minor amount of sensible heat transfer (heating of the air and cooling of the water) also occurs. During very cold weather, the amount of sensible heat transfer can be fairly substantial. On the other hand, during a warm, dry summer day, the amount of sensible heat transfer might be nil or even negative (when negative, the air discharged from the tower is cooler than the ambient dry bulb). This does not adversely affect the cold-water performance of mechanical draft towers but does affect evaporation rate. The wet cooling tower is used widely in the industry and is considered a mature technology.

Because wet cooling towers provide direct contact between the cooling water and the air passing through the tower, some of the liquid water could be entrained in the air stream and be carried out of the tower as "drift" droplets. The magnitude of drift loss is influenced by the number and size of the droplets produced within the cooling tower. The droplets, in turn, are influenced by the fill design, the air and water patterns, and other interrelated factors. Tower maintenance and operation levels can influence the formation of drift droplets. For example, excessive water flow, excessive air flow, and water bypassing the tower drift eliminators can promote and/or increase drift emission. To reduce the drift from cooling towers, drift eliminators usually are incorporated into the tower design to remove as many droplets as practical from the air stream before exiting the tower. The drift eliminators rely on inertial separation of the droplets, caused by direction changes, while passing through the eliminators. Types of configurations for drift eliminators include herringbone, wave form, and cellular (or honeycomb) designs. The cellular units are generally the most efficient. Drift eliminators include various materials, such as ceramics, fiber-reinforced cement, fiberglass, metal, plastic, and wood installed or formed into closely spaced slats, sheets, honeycomb assemblies, or tiles. The materials might include other features, such as corrugations and water removal channels that enhance the drift removal further (Reference 9.4-002).

9.4.1.1 Screening of Alternative Heat Dissipation Systems

PEC performed a heat rejection system optimization study for the HAR 2 and HAR 3 AP1000 pressurized water reactor, and the alternatives evaluated were those generally included in the broad category of "closed-loop" systems (Reference 9.4-001).

The result of the evaluation identified two additional natural draft cooling towers, one per AP1000 unit, as the preferred heat dissipation system for HAR 2 and HAR 3. The proposed cooling towers will be hyperbolic natural draft cooling towers with counterflow.

Heat dissipation system alternatives were evaluated by the applicant and the alternatives considered were those generally included in the broad categories of "once-through" and "closed-loop" systems. Other heat dissipation systems such as dry cooling systems, hybrid wet/dry cooling systems, and once-through cooling were considered but rejected early in the process. These alternatives were eliminated from further consideration because it was determined that these systems were not environmentally preferred alternatives, given the location of the plant and existing infrastructure at the HNP. A summary of the environmental impacts of the heat dissipation system alternatives is provided in Table 9.4-1. The closed-loop category includes the following types of heat dissipation systems:

- Wet cooling systems (closed-loop cooling system):
  - Single natural draft hyperbolic cooling tower per one AP1000 unit.
  - Two natural draft hyperbolic cooling towers per one AP1000 unit.
  - Three round mechanical draft cooling towers per one AP1000 unit.
- Dry cooling tower systems.
- Hybrid wet/dry cooling tower system.
- Once-through cooling system.

An initial evaluation of the closed-loop alternative and the once-through cooling alternative designs was performed to eliminate systems that are unsuitable for use in the HAR.

Harris Reservoir was originally designed to provide cooling water for four reactor units and to remove the design heat load from the cooling tower blowdown water associated with those units. During construction activities for all units, a decision was made to reduce the number of units to one; therefore, only the HNP was completed. Given the existing cooling water capacity potential, construction of an additional cooling pond was considered unnecessary and not practicable for HAR.

The spray pond alternative is similar to cooling ponds because it involves the creation of new bodies of surface water. Spray modules are included to promote evaporative cooling in the ponds, which reduces the land requirements. However, this advantage is offset by higher operating and maintenance costs for the spray modules. This alternative is considered unsuitable for the HAR site for the same reasons that cooling ponds are unsuitable.

9.4.1.1.1 Dry Cooling Tower Systems

Dry cooling is an alternative cooling method in which heat is dissipated directly to the atmosphere using a tower without the evaporative loss of water. This tower transfers the heat to the air by conduction and convection rather than by evaporation. The condenser coolant is enclosed within a piping network with no direct air to water interface. Heat transfer is then based on the dry bulb temperature of the air and the thermal transport properties of the piping material. Both natural and mechanical draft can be used to move the air. While water loss is less for dry cooling towers than wet cooling towers, some makeup water is typically required.

There are two types of dry cooling systems for power plant applications: direct dry cooling and indirect dry cooling. Direct dry cooling systems utilize air to directly condense steam, while indirect dry cooling systems utilize a closed-cycle water cooling system to condense steam, and the heated water is then air cooled. Indirect dry cooling generally applies to retrofit situations at existing power plants because a water-cooled condenser would already be in place for a once-through or recirculated cooling system (Reference 9.4-003).

Because there is no evaporative or drift losses in this type of system, many of the problems of conventional cooling systems are eliminated. For example, there are no problems with blowdown disposal, water availability, chemical treatment, fogging or icing when dry cooling towers are utilized. Although the elimination of such problems is beneficial, the dry towers have associated technical obstacles such as high turbine backpressure, and possible freezing in cooling coils during periods of light load and startup.

This is an inherently less efficient process and required an extensive heat transfer surface area of metal fin tubing within the tower, which could be either mechanical or natural draft. In this system, the temperature of the water leaving the tower could only approach the dry-bulb temperature of air which was invariably higher than the wet-bulb temperature approached by the wet towers.

PEC concluded that this alternative is not suitable for the reasons discussed in the USEPA preamble to the final rule addressing cooling water intake structures for new facilities (Reference 9.4-004). Dry cooling carries not only high capital but operating and maintenance costs that are sufficient to pose a barrier to entry to the marketplace for some facilities. In addition, dry cooling has a detrimental effect on electricity production by reducing the efficiency of steam turbines. Dry cooling requires the facility to use more energy than would be required with wet cooling towers to produce the same amount of electricity. This energy penalty is most significant in warmer southern regions during summer months when the demand for electricity is at its peak. The energy penalty would result in an increase in environmental impacts, because replacement of the generating capacity would be needed to offset the loss in efficiency from dry cooling. USEPA concluded that dry cooling is appropriate in areas with limited supplies of water available for cooling or where the source of cooling water is associated with extremely sensitive biological resources (e.g., endangered species and specially protected areas). The conditions at the HAR site do not warrant further consideration of dry cooling. A summary of the environmental impacts of the dry cooling tower heat dissipation system alternative is provided in Table 9.4-1.

Additionally, the thermal performance of the dry cooling tower is only dependent on the dry-bulb temperature of the entering air, therefore the cold water temperature attainable could be 20 degrees Fahrenheit (°F) to 30°F higher than would be expected from a normal evaporative-type cooling tower. This warmer circulating water temperature would result in maximum turbine backpressures that are higher than AP1000 standard turbine trip set point of 7.4 in heat generating assembly (HgA).

9.4.1.1.2 Hybrid Wet/Dry Cooling Tower System

Hybrid wet/dry cooling tower systems are used primarily in areas where plume abatement is necessary for aesthetic reasons or to minimize fogging and icing produced by the tower plume. Dry/wet cooling towers use approximately one-third to one-half less water than wet cooling towers (Reference 9.4-003). Additionally, somewhat more land is required for the dry/wet cooling tower due to the additional equipment (fans and cooling coils) required in the tower assembly. The same disadvantages described above for dry cooling towers would apply to the dry cooling portion of the dry/wet cooling tower. The dry cooling process is not as efficient as the wet cooling process because it requires the movement of a large amount of air through the heat exchanger to achieve the necessary cooling. This results in less net electrical power for distribution. Consequently, an increase would occur in environmental impacts because replacement generating capacity would be needed to offset the loss in efficiency from dry cooling. Therefore, this alternative is not considered to be environmentally preferable to the proposed natural draft wet cooling towers. A summary of the environmental impacts of a hybrid wet/dry cooling tower heat dissipation system alternative is provided in Table 9.4-1.

In a wet/dry cooling tower, efficient wet cooling cold water temperatures are achieved with reduced visible plume similar to dry cooling systems. Fans are located in both the wet section and the dry section of the tower. In the dry section, the fans are located above the wet level in front of the heat exchangers. The hyperbolic shell achieves a natural draft effect that helps reduce power consumption.

9.4.1.1.3 Once-Through Cooling System

In a once-through cooling system, water is withdrawn from a body of water, passes through the heat exchanger, and is discharged back to the same source. The discharged water temperature is higher than the intake water due to the warmth gained when passing through the heat exchanger.

Based on the current Harris Reservoir configuration and size, the once-through cooling alternative would not support the cooling requirements for the proposed units. Additionally the once-through design could have a LARGE environmental impact by discharging high-temperature water (delta t of more than 13.9°C [delta t of 25°F] higher than intake) at 31.55 m^3/s (1114.01 ft^3/s) or 500,000 gpm per unit. Therefore, the temperature rise after mixing could not meet the criteria a sufficient amount of time to justify the once-through cooling system.

Once-through cooling would pose risks of thermal effects and damage to aquatic organisms. USEPA regulations (40 CFR Part 125) governing cooling water intake structures under Section 316(b) of the Clean Water Act (CWA) make the use of once-through cooling systems difficult for steam electricity-generating plants (Reference 9.4-004). For these reasons, impacts from once-through cooling systems were considered LARGE and, therefore, eliminated from further consideration. A summary of the environmental impacts of the once-through cooling heat dissipation system alternative is provided in Table 9.4-1.

Only mechanical draft and natural draft cooling towers are considered suitable heat dissipation systems for the HAR site and were evaluated in detail. Because natural draft cooling towers were selected as the preferred heat dissipation system for the HAR 2 and HAR 3 (see ER Section 5.3), the two natural draft cooling towers, one per AP1000 unit, are evaluated further in Subsection 9.4.1.2. In accordance with NUREG-1555, the heat dissipation alternatives were evaluated for land use, water use, and other environmental requirements (Table 9.4-1).

9.4.1.1.4 Mechanical Draft Cooling Tower

A mechanical draft water-cooling tower induces or forces air through the tower by one or more fans built into the tower. Mechanical draft towers are divided into two basic designs: forced draft or induced draft. Mechanical draft cooling towers consist of forced draft towers, which contain side fans that force the air through the system, and induced draft cooling towers, which contain overhead fans that pull the air through the system. Mechanical draft cooling towers are often used in smaller cooling tower systems. Mechanical draft cooling towers may also employ a crossflow or counterflow design. Round mechanical draft towers consists of shared fans that are clustered in the center of the tower (crossflow [XF] towers) or uniformly spaced on the fan deck (counterflow [CF] towers). An XF tower is designed so that the air and water are mixed at a 90-degree angle. A CF cooling tower design allows vertically falling water to mix with vertically rising, cooling air at an angle of 180 degrees. Generally XF and CF cooling towers have similar drift loss. Water to be cooled is pumped to a hot water distribution system above the fill and falls over the fill to the cold water basin. Air is drawn through the falling water by a fan, which results in the transfer of heat from the water to the air, and the evaporation of some of the water. The fill serves to increase the air-water contact surface and contact time, thereby promoting heat transfer. A mechanical draft cooling tower employs large fans to either force or induce a draft that increases the contact time between the water and the air maximizing the heat transfer. A forced draft tower has the fan mounted at the base, forcing air in at the bottom and discharging air at low velocity through the top. An induced draft tower uses fans to create a draft that pulls air through the cooling tower fill. A typical mechanical draft cooling tower has a loading capacity of 1.4 to 4.1 liters per second per square meter (l/[s/m^2]) (2 to 6 gpm per square foot [gpm/ft^2]) (Reference 9.4-005). Additionally, a rectangular mechanical draft cooling tower consists of a continuous row of rectangular cells in a side-by-side arrangement sharing a common cold water basin.

Most mechanical draft towers are wood-framed structures based on cost considerations. Wood towers generally are constructed of treated redwood or treated Douglas fir. Redwood is a better material but has become increasingly expensive in recent decades and now is seldom used for new construction. In addition, such wood has to be treated for outdoor use with copper arsenate (CCA) or similar compounds. Concerns over leaching chromium, copper, and arsenic compounds into the environment have resulted in decreased usage of treated lumber and has spurred research into alternative wood preservation methods. Wooden structures are not considered to be a preferable option. Wood towers offer the shortest life expectancy, leach the preservative chemicals (chromated copper arsenate [CCA] or acid copper chromate [ACC]) with which they are treated into your blowdown and tower sediment, and require a pH balance below 8.5, but they are relatively inexpensive to build and repair. A summary of the environmental impacts of round mechanical draft cooling tower heat dissipation system alternative is provided in Table 9.4-1.

Other materials commonly used for mechanical draft towers are ceramic, fiberglass, steel, or concrete. Although ceramic cooling towers offer aesthetic advantages over other cooling towers constructed of other materials, they are typically more expensive. Due to their resistance to severe weather, fiberglass cooling towers are considered to be useful in harsher environmental conditions. Additionally, these cooling towers also provide good corrosion resistance, which remains advantageous in applications when the tower is exposed to chemicals, such as in water treatment. Fiberglass is considered to be stronger than Douglas fir and redwood, and because it is available in long lengths, it allows a cooling tower to be designed and built with a minimum number of airflow obstructions. Concrete towers will last the longest, but are the most expensive to build.

The use of mechanical draft towers would require three round towers with thirty-six- 250 BHP motors. The mechanical draft tower was dropped from further consideration based on space requirements, added house load and added maintenance requirements (Reference 9.4-006).

9.4.1.2 Analysis of the Preferred Alternative Natural Draft Hyperbolic Cooling Tower

A cooling tower relies on the latent heat of water evaporation to exchange heat between the process and the air passing through the tower. In a cooling tower, warmer water is brought into direct contact with the cooler air. When air enters the cooling tower, its moisture content is generally less than saturation. When the air exits, it emerges at a higher temperature and with moisture content at or near saturation. Even at saturation, cooling can take place because a temperature increase results in an increase in heat capacity, which allows better absorption of sensible heat. A natural draft cooling tower induces the air flow by generating warm moist air that is less dense than the ambient air, which results in a convection flowing up the tower. This air convection cools the water on contact. Because of the tremendous size of these towers (typically 152.4 m [500 ft.] high, and 121.9 m [400 ft.] in diameter at the base), they are generally used for flow rates above 12,620 l/s (200,000 gpm), generally the flow rates used in utility power stations in the United States (Reference 9.4-005). They are generally loaded at about 1.4 to 2.5 l/s/m^2 (2 to 4 gpm/ft^2). Natural draft towers are however, infrequently used for installation in the United States (Reference 9.4-003).

The preferred heat dissipation system for HAR 2 and HAR 3 is the addition of two natural draft cooling towers (one per unit) with makeup water from Harris Reservoir as the best closed-loop option for circulating water system in the heat dissipation system. As discussed in Chapter 3, the heat dissipation system could have a height of up to 327 m (523 ft.) and would slightly alter the visual aesthetics of the site. Any visual effects from the visible plumes from the facility would be similar to those associated with the other nuclear power plants and that of the present cooling tower for HNP.

An additional visible plume potentially could result from the heat dissipation system. As discussed in Subsection 9.4.1, the proposed cooling towers will be hyperbolic natural draft cooling towers with counterflow. As this type of cooling tower operates without fans, the substantial amount of electric power otherwise required for large cooling tower systems is not needed. The required cooling air is conveyed through the tower by natural draft; therefore, neither fan nor fan power is required.

The proposed cooling towers will be very similar to the existing tower, consequently, lack of adverse observations relating to this tower are the most indicative evidence of the limited potential for adverse effects from the proposed cooling towers. Several important terrestrial species exist within the vicinity of the proposed cooling tower (see ER Sections 2.4 and 4.3). Operation of the heat dissipation system is not expected to have an adverse effect on any terrestrial species due to the height of plume release, minimal amounts of solids deposition, and the historical existence of a cooling tower; therefore, no mitigation is warranted.

The evaporation rate for the proposed cooling towers is estimated to be 1.82 m^3/s (64.30 ft^3/s) or 28,860 gpm during normal operations (Reference 9.4-007). The combination of three cooling towers (one existing and two proposed) creates the possibility of a mixed-plume larger than the single visible plume from the existing cooling tower. The greatest frequency of visible plumes is expected to occur during the winter and fall months due to increasing ambient moisture contents and decreasing temperatures. The greatest frequency of plumes is expected to the north of the plant and the longest plumes are expected to the southwest of the plant. Due to the release elevation and plume rise, the additional water and heat released to the atmosphere by the cooling tower plumes will have a SMALL effect. Mitigation is not required.

Water droplets from the cooling tower will contain the same concentration of dissolved and suspended solids as the water within the cooling tower basin. The dissolved and suspended solid concentrations in the cooling tower basins will be controlled via use of the makeup and blowdown water lines from and to Harris Reservoir. The effect from solids deposition will be SMALL and will not require mitigation. Additionally, cloud shadowing, localized increases to precipitation, and increased ground level humidity is possible when a visible plume occurs. However, the increases are expected to be SMALL and mitigation is not warranted.

As discussed in ER Chapter 4, construction of the HAR 3 cooling tower will result in filling an approximate 1-ha (2-ac.) man-made pond. This pond was created during construction of the first reactor as a source of water for fire control until Harris Reservoir filled. There are no industrial, municipal, commercial, or agricultural users of this pond, which has not been used since the reservoir was filled.

Potential impacts to land use from cooling towers are primarily related to salt drift. New cooling towers would be assumed to produce salt concentrations similar to cooling towers at existing nuclear power plants. In addition, fogging, icing, or drift damage potentially could result from a cooling tower plume. While the potential exists for minor salt drift, fogging, and icing to occur, it is expected to be of such SMALL magnitude that no land use changes would result.

Adverse effects on any terrestrial species are not expected to be caused by operation of the heat dissipation system, by the height of the plume released, or by minimal amounts of solids deposition. The historical existence of a cooling tower supports this position; thus, no mitigation is warranted. Salt drift, vapor plumes, localized precipitation modifications, and noise might have a small effect on the terrestrial ecosystem but will not warrant mitigation. Impacts to bird species from collisions with the proposed cooling towers and from shoreline vegetation changes are expected to be SMALL and will not warrant mitigation.

9.4.1.3 Summary of Alternative Heat Dissipation Evaluation

The information provided in this subsection about the evaluation conducted for the heat rejection system optimization study is from a report generated by the applicant (Reference 9.4-001).The evaluation assumed that if the predicted differences in net economic benefit were small, then other considerations might be given higher consideration. Other considerations include aesthetics, corporate preferences related to operations and maintenance issues, first cost, risk associated with tower technology or vendor capability, and associated site work for arrangement and fit of cooling water piping fit up to tower.

In addition to the above evaluation, a review of cooling of tower blowdown in hot months was performed. Sizing the main towers to maintain tower blowdown to temperatures below expected environmental constraints was not practical. Therefore, blowdown cooling options were reviewed and a recommended option was selected. A summary of the environmental impacts of the three cooling tower alternatives (single natural draft hyperbolic, two natural draft hyperbolic, and three round mechanical draft) are provided in Table 9.4-1.

Each of the cooling tower options was evaluated at three different circulating water flow rates-31.55 m^3/s (1114.01 ft^3/s) or 500,000 gpm, 37.85 m3/s (1336.81 ft^3/s) or 600,000 gpm, and 39.75 m^3/s (1403.65 ft^3/s) or 630,000 gpm using two different weather profiles (the representative 'hot' year and the 'average' year). In addition, two energy rates were applied to the net production differences between the base case and each option (Reference 9.4-001). For this evaluation, 'net' power referred to gross production less the circulating water pump and tower fan power consumed for each option. Auxiliary power serving the power block was common to all options and therefore was not considered for the evaluation. For the base case, a single natural draft hyperbolic tower with 37.85 m^3/s (1336.81 ft^3/s) or 600,000 gpm circulating water flow was used.

It was determined that the environmental impacts of the three cooling tower alternative evaluated were SMALL to MODERATE. Therefore in considering the comparison of the various cooling tower options, three main costs/benefits were considered:

- Production — Calculated the detailed net present value for production benefits for an average and the hot single year of plant operation for each cooling tower option.
- Initial Cost — Initial 'overnight' cooling tower cost was based on vendor input and expected cost differences associated with procurement, support systems, and general contractor items to integrate the towers into the site.
- Maintenance — Inspection and maintenance (replacement parts) cost differences were considered over the anticipated 60 years of the plant life.

Because the evaluation was performed at different circulating water flows, temperatures, and condenser heatloads, a separate evaluation was performed to determine the condenser backpressure at these operating conditions. The methodology used in the evaluation allowed for condenser backpressure to be determined for a given steam loading, condenser surface area, circulating water temperature and flow rate, condenser cleanliness, tube material, and other plant specific parameters. The condensing temperatures then are computed based on this input. The condenser backpressure is then the saturation pressure at the condensing temperature.

The evaluation used weather data for Raleigh, North Carolina, from 1961 to 1990 to develop a hottest and an average year based on hourly wet bulb temperatures (Reference 9.4-001). The average year weather data were developed from the 30 years of the meteorological data by averaging the hourly wet bulb temperatures and relative humidities to generate a single year of average weather.

In addition to the differences in the initial cost of construction for each of the cooling tower options, some differences exist in the expected maintenance cost that were included in the overall economic evaluation. These include the following:

- Inspection and replacement of the cooling tower fill.
- Inspection and replacement of the distribution piping/nozzle.
- Inspection and maintenance of mechanical components.
- Replacement of mechanical components.

Blowdown from the towers, whether of natural or mechanical draft design, is required to maintain tower water chemistry within design limits. Blowdown will be regulated by environmental permit. Although a maximum blowdown temperature was not identified, the evaluation assumed that the blowdown would be limited to a maximum temperature of 32.8°C (91°F); however, this temperature will be established as a part of the final NPDES permitting process. The current regulations for new generation do not refer to a maximum blowdown temperature, but do refer to the temperature mixing zone. The measurement of mixing zone temperatures and averaging periods currently might not be defined.

With expected extreme wet-bulb temperatures in the range of 25.6 to 27.2°C (78 to 81°F), and expected approach temperatures for aged towers to be in the range of 8.3 to 11.1°C (15 to 20°F), it might not be prudent to expect that blowdown temperatures and associated mixing zone temperature will comply with environmental regulations (Reference 9.4-001). A forced downpower to address periodically high blowdown temperatures might not be economical. As a result, the following options were considered to address high blowdown temperatures:

- Blowdown Tower — A dedicated (small) cooling tower for blowdown could be included in the design. However, in addition to operating and maintenance expense, such a tower would have the same difficulty in achieving the close-approach temperature needed to meet the environmental limit (as would the main tower). With the complexity and cost of a separate tower that would be used only a small fraction of operating hours; this alternative is not practical or cost effective.

- Cooling Blowdown using Makeup — For this option, blowdown is cooled, as necessary, by makeup using a plate-and-frame heat exchanger. Large units such as these are equipped with titanium or stainless steel plates for freshwater duty. These units are capable of very close approach temperatures (approaches in the range of 1.9 to 2.8°C [3.5 to 5.0°F] are economically achievable). A single unit is capable of flow in excess of 0.95 m^3/s (33.42 ft^3/s) or 15,000 gpm, and likely could accomplish the total blowdown cooling duty for two units (Reference 9.4-001).

  Because blowdown and makeup are operated simultaneously, the design will essentially always have a cooling medium. Further, the design is passive without requirements for power-actuated valves or devices. Blowdown is either gravity fed or pump driven, depending on plant layout. The plate-and-frame heat exchanger would not impact this aspect of the blowdown system design.

  Because heating of the makeup adds to the tower heat load and costs some plant efficiency, a bypass is included in the design such that cooling would be effected only when required by permit. This flow balancing through and around the heat exchanger likely could be performed as a seasonal activity (without the need for automated valves and associated instrumentation). Flow balancing would assist in improvement of the heat rate without the associated capital, operating, and maintenance costs of automated equipment

  Because the heat exchanger is passive and has high anticipated reliability, and it is expected that it will only occasionally require cleaning, there is no required redundancy for this equipment. The unit can simply be bypassed during the short time frame associated with disassembly for cleaning.

  A makeup/blowdown system designed to cool blowdown (as necessary) using makeup in a plate-and-frame heat exchanger could be a cost-effective alternative to reliably maintain blowdown and mixing zone temperatures within environmental limits. This approach would eliminate constraints on main tower performance and avoid unit downpowers (for this issue). Because a cost-effective alternative to address the environmental permitting issue associated with blowdown heat load is available and common to all alternatives, the need for and cost of this supplemental cooling option was not evaluated further.

To prevent any undesirable impact of the hot makeup water on the service water system (makeup system is planned to be common for service water and circulating water) the plate-and-frame heat exchanger should be installed only on the circulating water leg of the makeup system.

The cooling tower performance evaluation demonstrated that the two natural draft cooling towers, one per AP1000 unit, design resulted in the largest yearly gross generation revenue for all cases considered. However, this is also the cooling tower alternative with the highest initial cost. The simplified economic evaluation shown in Table 9.4-2 incorporates the initial tower cost and maintenance differences along with the generation revenue differences for the expected 60-year life of the plant for the cases with an assumed 37.85 m^3/s (1336.81 ft^3/s) or 600,000 gpm of circulating water flow (Reference 9.4-001).

The generation benefits shown in Table 9.4-2 (single hot year weather) indicate that partially offset of the high initial cost of the two natural draft towers, one per AP1000 unit. For the high (2005 year) energy rate, the mechanical draft tower has the lowest overall cost (net present value) The single natural draft tower was next in cost (-$9,616,000) and the two natural draft towers cost the most (-$13,439,000). Costs are per one AP1000 unit.

For the average (2004 year) energy rate, the mechanical draft tower has the lowest overall cost (net present value) with the single natural draft tower next (-$8,019,000) and the two natural draft towers with the highest costing the most (-$19,970,000) per one AP1000 unit (Reference 9.4-001).

The summary shown in Table 9.4-3 (single average year weather) indicates that the generation benefits partially offset the high initial cost of the two natural draft towers, one per AP1000 unit. For the high (2005 year) energy rate, the mechanical draft tower has the lowest overall cost, with the single natural draft tower next (-$3,772,000) and the two natural draft towers costing the most (-$13,835,000) per one AP1000 unit.

For the average (2004 year) energy rate the mechanical draft tower has the lowest overall cost with the single natural draft tower next (-$3,708,000) and the two natural draft towers costing the most (-$20,213,000) per one AP1000 unit (Reference 9.4-001).

These differences in impacts are SMALL for the HAR site. These alternatives for heat dissipation systems are considered environmentally equivalent.

9.4.2 CIRCULATING WATER SYSTEM

In accordance with NUREG-1555 ESRP 9.4.2, this subsection presents a discussion of alternatives to the following components of the circulating water system (CWS) for the HAR: intake systems, discharge systems, water supply, and water treatment processes.

As stipulated in NUREG-1555 ESRP 9.4.2, this subsection should present only those alternatives that are:

- Applicable at the HAR site.
- Compatible with the proposed heat dissipation system.

- Feasible for construction and operation at the proposed site.
- Not prohibited by federal, state, regional, or local regulations nor affected by Native American tribal agreements.
- Consistent with any of the NPDES or the Federal Water Pollution Control Act (FWPCA), commonly referred to as the CWA findings.
- Can be judged as practicable from a technical standpoint with respect to the proposed dates of plant construction and operation.

The CWS is an integral part of the heat dissipation system. It provides the interface between (1) the normal heat sink, main steam turbine condenser (heat exchanger), where waste heat is discharged from the steam cycle and is removed by the circulating water, and (2) the heat dissipation system where the heat energy is then dissipated or transferred to the environment.

Essentially, two CWS are available for removing this waste heat, once-through (open-loop) and recycle (closed-loop) systems. In once-through cooling systems, water is withdrawn from a cooling source, passed through the condenser, and then returned to the source (receiving body of water). In the recycle (closed-loop) cooling system, heat picked up from the condenser by the circulating water is dissipated through auxiliary cooling facilities, after which the cooled water is recirculated to the condenser.

As discussed in Chapter 4, the HAR site will use surface water from Harris Reservoir for domestic, process, and cooling tower makeup water. No groundwater is used at the HAR site. Water from the Cape Fear River would be used to increase the water level of Harris Reservoir approximately 6 m (20 ft.) to provide adequate cooling tower makeup water for HAR 2 and HAR 3. As discussed in Subsection 9.4.1, the CWS for HAR 2 and HAR 3 would be a closed-loop system, including concrete-volute pumps and piping, a water retention basin, and two concrete natural draft hyperbolic cooling towers. Freshwater from the CWS would be pumped from the cooling tower basin through the main steam turbine condensers and turbine plant auxiliary heat exchangers, where heat transferred to the cooling water in the condenser would be dissipated to the atmosphere by evaporation, cooling the water before its return to the condenser. The water from the cooling system lost to the atmosphere through evaporation must be replaced. In addition, this evaporation would increase the level of solids in the circulating water. To control solids, a portion of the recirculated water must be removed (generating blowdown) and replaced with clean water. In addition to the blowdown and evaporative losses, a small percentage of water in the form of droplets (drift) would be lost from the cooling tower. Water pumped from the Harris Reservoir (see Subsection 9.4.2.1) intake structure would be used as the source for makeup water to replace water lost by evaporation, drift, and blowdown from the cooling tower. Blowdown water would be returned to Harris Reservoir via the existing discharge flume structure (see Subsection 9.4.2.1).

9.4.2.1 Intake and Discharge Systems

This subsection provides a discussion of the intake and discharge alternatives reviewed by PEC for HAR.

For both once-through and closed-loop cooling systems, the water intake and discharge structures can be of various configurations to accommodate the source body of water and to minimize impacts to the aquatic ecosystem. The intake structures generally are located along the shoreline of the body of water and are equipped with fish protection devices. The discharge structures are generally of the jet or diffuser outfall type and are designed to promote rapid mixing of the effluent stream with the receiving body of water. Biocides and other chemicals used for corrosion control and for other water treatment purposes can be mixed with the condenser cooling water and discharged from the system. Only biocides or chemical additives that are approved by USEPA and North Carolina as safe for humans and the constituent discharged to the environment will satisfy requirements established in the NPDES permit.

Cooling water intake structures (CWIS) are typically regulated under Section 316(b) of the federal CWA (Reference 9.4-008) and under Section 15A of the North Carolina Administrative Code (NCAC) 2H.0100, which sets the procedure used to apply for, develop, and issue wastewater discharge permits (Reference 9.4-009). However, a federal court decision in January 2007 changed that regulatory process. The regulations that implemented Section 316(b) were suspended, and USEPA recommended that all permits formerly under Section 316(b) for Phase II facilities should include conditions developed on a best professional judgment basis (Reference 9.4-010).

According to the North Carolina NPDES, a mixing zone could be established in the area of a discharge to provide reasonable opportunity for the mixture of the discharge with the receiving waters. Water quality standards will not apply within regions defined as mixing zones. The limits of such mixing zones will be defined by the North Carolina Division of Water Quality (DWQ) on a case-by-case basis after consideration of the magnitude and character of the discharge and the size and character of the receiving waters. For the discharge of heated wastewater, compliance with federal rules and regulations pursuant to Section 316(a) of the CWA, as amended, shall constitute compliance with Subparagraph (b) of this Rule (Reference 9.4-011). Thermal wastewater discharges in North Carolina are subject to effluent limitations under Section 15A NCAC 02B.0211 (3) (j). This rule limits thermal discharges to 2.8°C (5.04°F) above the natural water temperature and includes further restrictions based on geographic regions of the state. Exceptions to these limits are allowed under the temperature variance provisions of the CWA, Section 316(a). Under this provision, permittees must demonstrate that the variance for the thermal component of the discharge ensures the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in the receiving water.

Intake and discharge structures will be required for operation of the HAR. No long-term physical changes in land use are anticipated from construction of the water intake structure, the pumphouse, and the makeup-water pipeline corridor. Construction activities will cause only temporary effects to streams and wetlands.

Long-term changes in land use from operation of the HAR 2 and HAR 3 will be associated primarily with the roads, cooling/heat dissipation systems, makeup water pipeline, intake structure, and pumphouse, as well as with the increase in the water level in the Main Reservoir. The long-term impacts on land use are expected to be moderate, caused primarily by the increased water level of approximately 6 m (20 ft.) in Harris Reservoir.

Short-term changes in land use from operation of the HAR 2 and HAR 3 will be associated primarily with impacts resulting from the increase in the water level of Harris Reservoir. Short-term changes in land use would be minor and would include recreational areas, roads, HAR facilities, municipal facilities, and ecological issues.

During HAR construction activities, the potential main effect to water use will be short term, consisting of temporary increases in the suspended solids concentrations of water drawn into the existing water systems at HNP. Long-term effects are less significant, consisting of temporary increases in the sediment loading to the Main Reservoir and the loss of capacity in the reservoir with associated ecological and cooling water storage issues.

As discussed in Subsection 2.4.2.2, a significant amount of wetlands exist within the 67.1-m to 73.2-m (220- to 240-ft.) NVGD29 contours. These wetlands will be delineated according to USACE guidelines and mitigation measures will be implemented prior to construction. Potential mitigation strategies include the creation of wetlands along the new perimeter of Harris Reservoir, particularly in areas with gradual slopes and suitable underlying soils. Other possibilities for mitigation include creating wetlands in areas already undergoing earthmoving activities or the acquisition of additional land that would support wetland mitigation. Mitigation activities will require careful planning and close coordination with the NCDENR to determine if the North Carolina Ecosystem Enhancement Plan is an appropriate mitigation strategy.

Measures such as accepted best management practices (BMPs) will be taken during construction to minimize effects to ground and surface waters. Construction will be conducted when conditions in streams are low flow or dry. All relevant federal, state, and local permits and regulations will be followed during construction activities. Adhering to the conditions specified in the permits and regulations should minimize temporary effects. Specific erosion control measures will be implemented to minimize effects to Harris Reservoir (i.e., the Main Reservoir and the Auxiliary Reservoir) and existing HNP operations. In addition, HAR site preparation and construction activities will comply not only with BMPs but also with federal, state, and local regulations to prevent adverse aquatic ecological effects along the perimeter of Harris Reservoir. PEC is committed to conducting a Phase 1 cultural resource assessment for the HAR site to determine the potential to affect cultural resources (such as archaeological, historical, or architectural resources).

During HAR site preparation, construction activities such as clearing and grading activities will have localized noise and air quality effects. Construction noise will occur during construction activities and while installing equipment (such as turbines, generators, pumps, transformers, and switchyard equipment). As a result, background noise levels will increase in the short term. To minimize the increased ambient noise, mitigation measures will be implemented. Additionally, controls will be implemented to mitigate potential air emissions from construction sources. Slight but negligible increases in emissions of particulate matter and combustion by-products might occur during HAR site preparation and construction activities. Construction-related dust and air emissions from equipment, which are expected to be minimal, would be controlled by implementing mitigation measures.

HAR site preparation and construction activities could result in some temporary visual aesthetic disturbance. Because these impacts will be temporary, no long-term indirect or cumulative impacts to visual aesthetics are expected.

9.4.2.1.1 Intake System

HNP collects cooling tower makeup water at the cooling tower makeup water intake structure located on the Thomas Creek branch of Harris Reservoir east of the HNP site. After cooling, the blowdown water will be discharged into Harris Reservoir through a pipeline at a location north of the Main Dam.

The Cape Fear makeup water intake structure is too be located in the cove adjacent to the Buckhorn Dam, routing of the makeup water pipeline north from the intake connecting with the PEC transmission line, and continued pipe routing along the PEC transmission line to the west bank upstream from the HNP cooling tower blowdown line discharge point.

HAR 2 and HAR 3 will collect cooling tower makeup water at the HAR raw water pumphouse structure located on the Thomas Creek branch of the Harris Reservoir east of the HAR site. It was determined that the number of intake bays in the existing HNP CWIS were inadequate to accommodate the additional volume of makeup water needed for the proposed HAR 2 and HAR 3. Placement of the new CWIS near the existing CWIS would result in SMALL impacts to the perimeter of Harris Reservoir and the bottom sediments because of the existing infrastructure in the area. The existing conventional intermittent traveling screens technology that is used at the existing CWIS is proposed for the new CWIS. Under normal operations, the low-speed drive for the traveling screens is expected to minimize wear and tear on the screens. During periods of high debris loading, it is expected that the traveling water screens will operate at high speeds. The intent is to meet the through-screen velocity required under Section 316(b) of the NPDES permit program.

As discussed in above and in ER Chapter 4, makeup water would be obtained from Cape Fear River to maintain the proposed operating water level of 73.2 m (240 ft.) NVGD29 in the Harris Reservoir. The Harris Reservoir makeup water system has been designed to maintain the required water level at Harris Reservoir and to minimize buildup of tritium in the Harris Reservoir. This system includes the Intake Channel in the Cape Fear River, the Harris Reservoir makeup water system intake structure and pumphouse, the Harris Reservoir makeup water system pipeline from the Cape Fear River to the Harris Reservoir, and the HAR Reservoir makeup water discharge structure on the Harris Reservoir. A conceptual description of the intake design is provided in ER Section 3.4. Three alternatives were assessed for the location of the makeup water pumphouse on the Cape Fear River. Alternative 1 was the location of the original makeup pumphouse design which has good access to major roads and no land ownership concerns. The location for Alternative 2 was on the CP&L transmission line corridor, but was a wetland site with little or no direct access to major roadways. New access road construction would be required along the CP&L transmission corridor or from an existing roadway that might result in multiple waterway crossings including a large forested wetland area. The location of Alternative 3 was directly adjacent to a public boat launch where the Cape Fear River and the Dixie Gas pipeline intersect. This site had good access, but had many disadvantages including: land ownership issues, recreational boat hazards or obstructions from the newly constructed pipeline, potential for site vandalism, and safety concerns during construction.

The increase in the water level of the reservoir will be relatively slow. Therefore, the fish and invertebrate communities in Harris Reservoir will be able to relocate to and colonize at suitable depths and habitats as the reservoir water level rises. No adverse effects to fish and invertebrate species in Harris Reservoir, beyond displacement and relocation to favorable habitats, are expected.

Generally, the makeup water pipeline corridor primarily will follow the existing Fayetteville transmission line ROW. An alternative route for the makeup water pipeline was the Dixie pipeline corridor. It was determined that this route was not adequate for staging and construction. Additional issues related to land ownership, access /permission to cross land and roadways, close proximity of water line to gas pipeline in Dixie pipeline corridor ROW. The remaining portion of the makeup water pipeline corridor will run along Buckhorn Road, an existing access road, and through forested land adjacent to the proposed intake structure and pumphouse at the Cape Fear River. Impacts from construction to existing land use in the ROW are expected to be SMALL and short-term. Operational impacts of the makeup pipeline will be SMALL. The design being considered for the intake system on the Cape Fear River to support HAR 2 and HAR 3 is consistent with the original design for the four-unit HNP site. Impacts will be limited to maintenance of access roads and vegetation, as required for maintenance and repair of the pipeline. Maintenance activities will take place on pre-existing road and transmission line ROW and are not expected to cause any significant impacts.

As noted above, the makeup water pipeline discharge structure would be built at the terminating end of the makeup water pipeline on Harris Reservoir at the fourth estuary from the west end of the Main Dam. This location will provide makeup water upstream of the cooling tower blowdown pipeline discharge.

The amount of shoreline and bottom that would be disturbed is an insignificant percentage of the total for the supply lake. As stated in Section 3.4, the approximate intake dimension of 30.5-m (100-ft.) wide by 45.7-m (150-ft.) deep (shore- to lake-dimension) has been estimated based on intake velocity and flow rate. During construction of the proposed intake structure for HAR 2 and HAR 3, the HNP intake structure will be protected to prevent suspended sediment from entering the cooling system. Special construction techniques (such as watertight sheet piling with dewatering of submerged areas to expose the construction zone) will be implemented, where necessary, to prevent migration of suspended solids. Water collected from dewatering operations will be settled or filtered before returning it to the reservoir system.

No federal, state, or regional land use plans apply to the area where the intake structure and pumphouse will be located. Due to the use of existing ROW, no restrictions, changes, or variances to current land use ordinances will be required for the operation of the makeup water pipeline and discharge structure.

As discussed in Section 4.3, dredging will be required in the channel of the Cape Fear River and the inlet at the confluence with the discharge channel. Disposition of this dredged material will require sediment analysis and identification of an acceptable disposal location. As needed, measures will be taken to eliminate the development of disease vectors (for example, mosquitoes) in dredge-spoil ponds. The overall short- and long-term effects of construction at the proposed location of the Harris Reservoir makeup water system intake structure and pumphouse, should be SMALL due to the small footprint and the existence of other water-related infrastructure in the area.

As stated previously, Section 316(b) of the federal CWA requires USEPA to ensure that the location, design, construction, and capacity of CWIS reflect the best available technology (BAT) for minimizing adverse environmental impact (Reference 9.4-004). The objective of any CWIS design is to have adequate flow sweeping past the screens to achieve entrainment and impingement-reduction goals established under the 316(b) requirements. In addition to the impingement and entrainment losses associated with CWIS, are the cumulative effects of multiple intakes and re-siting or modification of the CWIS contributing to environmental impacts at the ecosystem level. These impacts include disturbances to threatened and endangered species, to keystone species, to the thermal stratification of bodies of water, and to the overall structure of the aquatic system food web.

Consequently, in addition to evaluating alternative screen operations and screening technologies, such as fine-mesh traveling water screens or wedge-wire screens, other means of reducing impingement, such as curtain walls, fish return systems, or other physical barriers, also must be assessed. A number of different alternatives exist for reducing impingement and entrainment impacts, including changes in intake structure operation, fish handling, and external structure design; however, no single operational or technological change will have the same effects or benefits at all facilities. Therefore, site-specific studies and evaluations are critical to be successful, cost-effective reductions of CWIS impacts.

9.4.2.1.2 Discharge System

The cooling tower blowdown water from HAR 2 and HAR 3 will be discharged into Harris Reservoir through a new blowdown discharge pipeline installed adjacent to the existing blowdown discharge pipeline for the HNP. A conceptual description of the intake design is provided in Section 3.4. The design being considered for the discharge system into Harris Reservoir to support HAR 2 and HAR 3 is consistent with the original design for the four-unit HNP site.

The final plant discharge consists of cooling tower blowdown from both the CWS cooling towers and site wastewater streams, including the domestic water treatment and circulation water treatment systems. As noted in Section 9.4.2.1, only biocides or chemical additives that are approved by USEPA and North Carolina as safe for humans and the constituent discharged to the environment will satisfy requirements established in the NPDES permit.

Prior to the startup of HAR, PEC will acquire an NPDES permit. This permit will specify threshold concentrations of Free Available Chlorine (when chlorine is used) and Free Available Oxidants (when bromine or a combination of bromine and chlorine is used) in cooling tower blowdown when the dechlorination system is not in use. Lower discharge limits would apply to effluent from the dechlorination system when in use. The effluent would be released into Harris Reservoir. Cooling-tower blowdown and other wastewater resulting from electric power generation typically will be monitored for flow, pH, total residual chlorine, free available chlorine, total chromium, total zinc, priority pollutants, temperature, and 7-day chronic toxicity; however, monitoring requirements will be stipulated in the new NPDES permit for HAR 2 and HAR 3 or the revised combined permit for HNP and HAR 2 and HAR 3. Chromium and zinc are widely used in the United States as corrosion inhibitors in cooling towers. The existing number of permitted waste streams will be reduced because the AP1000 design consolidates several facility liquid-waste streams from facility operations into a single discharge point that will discharge to Harris Reservoir through one NPDES-permitted outfall. Chemicals that are added to cooling water for treatment are effective at low concentrations and are mostly consumed or broken down in application. Bioassay testing required by the NPDES permit will assess the potential toxicity of the discharge and provide for corrective action, if necessary. Little, if any, fouling in the plant heat exchangers is expected. The pH of the circulating water is controlled by the addition of sulphuric acid or sodium hydroxide, as needed. Discharge will be permitted by NCDENR and will comply with applicable state water quality regulations. Impacts to aquatic biota from chemicals added to the cooling water are expected to be SMALL and will not warrant mitigation.

Because the HNP is located on a large reservoir system that likely would provide sufficient heat-rejection capacity for a new unit (appropriately located, using a closed cooling water system), plant operation should not have significant thermal impacts to aquatic/marine ecology and water quality. No information was discovered during the evaluation that revealed any concerns with significant thermal impacts at the candidate site locations.

PEC will continue to employ a closed-loop, cooling-tower-based, heat dissipation system rather than a once-through system. Therefore, the issue of heat shock should not be a factor in Harris Reservoir. Additionally, all discharges in the small mixing zone of the reservoir are required to meet the state NPDES permit requirements. Because most of the water column is unaffected by the blowdown, even under extreme (worst-case) conditions, the thermal plume is not expected to create a barrier to upstream or downstream movement of important fish species, including black crappie, bluegill, largemouth bass, redear sunfish, common carp, white perch, and gizzard shad. No thermal impacts exist beyond some thermally sensitive species that would possibly avoid the immediate area of the discharge opening. Impacts to aquatic communities will be SMALL and will not warrant mitigation.

As stated in Section 3.3, cooling tower blowdown is estimated at 0.83 m^3/s (29.41 ft^3/s) or 13,200 gpm (screen wash water, and strainer backwash are returned to Harris Reservoir) (Table 3.3-3 and Figure 3.3-3). The net consumptive use of Harris Reservoir water is estimated to be 1.77 m^3/s (62.66 ft^3/s) or 28,122 gpm (i.e., cooling tower makeup water + raw water use + service water tower makeup water + demineralizer makeup water – sanitary discharge – demineralizer water discharge – cooling tower blowdown – service tower blowdown – based on two AP1000 units) assuming all secondary services of the cooling tower makeup pumps are required simultaneously.

Either a new discharge flume will be constructed or an existing discharge flume will be modified to accommodate discharges from the HAR. The only modification to the existing discharge flume will be to connect discharge pipes from the HAR to the discharge flume. Chapter 3 of the ER provides additional detail on the discharge of cooling tower blowdown.

Assuming the degree/extent of bottom scouring associated with operation of the new discharge is similar to that associated with operation of the existing discharge, an area of several hundred square feet could be rendered unsuitable for benthic organisms. The benthic community in the area of the discharge point could exhibit reduced organism abundance and/or decreased numbers of species (i.e., reduced-species diversity). This reduction, if any, in organism abundance or diversity could be a reflection of increased temperature, substrate scouring, or a combination of both factors. This reduction, however, is expected to occur in only a limited area of the reservoir located in the immediate vicinity of the discharge point, and should not affect the general community structure or ecology of the benthic macroinvertebrates inhabiting undisturbed areas of the reservoir.

The discharge is expected to have a limited impact on the fish community. The area involved is SMALL in comparison to the rest of the reservoir; therefore, even those fish species not able to tolerate these temperatures should be able to avoid the small portion of the mixing zone that has elevated temperatures.

Other than a localized reduction in numbers of benthic organisms, no impacts should occur to macrobenthos or fish. No important aquatic species or its habitat will be affected. Physical impacts to aquatic communities, therefore, are expected to be SMALL and will not warrant mitigation.

9.4.2.2 Water Supply (Makeup Water System)

The HAR facility would need continuous makeup water for the heat dissipation system and the CWS. As described in Subsection 9.4.2, a nonsafety-related freshwater makeup water system using freshwater from Harris Reservoir as the makeup water source would be the best option for the closed-loop natural draft hyperbolic cooling tower system. Additional water would be pumped from the Cape Fear River via a new intake structure and associated pipeline to maintain the desired operating level for Harris Reservoir. The new intake structure on the Cape Fear River likely would be located at the cove at Buckhorn Dam and would use the existing Carolina Power & Light Company (CP&L) transmission line corridor to route the makeup water pipeline to the discharge location at the fourth embayment or "finger" on the west side of the Harris Reservoir. This location resolves the issue of the mixing zone for the water in the Harris Reservoir and provides a location for the discharge of the makeup water that is well upstream of the existing (and probable new) cooling tower blowdown pipe discharge (Reference 9.4-012).

As noted in Chapters 4 and 5, the preferred water supply alternative (freshwater from Harris Reservoir) would have SMALL construction impacts and MODERATE to LARGE operational impacts. The increased reservoir level also will inundate infrastructure along the shores of Harris Reservoir. The most serious impacts will be to county roads, North Carolina game lands, transmission lines, boat ramps, emergency siren towers, Harris Lake County Park, the Wake County sheriff firing range, and several PEC facilities. These impacts will be mitigated through the re-location of the boat launch and parking facilities to an area above the proposed water level. Additionally, PEC is committed to relocating the Harris County Park services affected by the increased level of the reservoir. Park facilities might be removed and/or relocated during the construction phase and prior to the water level increase. PEC could conduct a study of the usage of existing park facilities to evaluate future relocation. PEC will find an alternate location for the impacted portions of the park, as close to the original location as possible and composed as close to the USGS land use designations that are very similar to the current location.

The rise in lake elevation will require enhancements to the existing roads and could entail the purchase of additional ROW. In-use roadways, along with associated infrastructure (bridges and culverts), will be reconstructed in their current locations to accommodate the rise in the water level in the reservoir.

9.4.2.2.1 Summary of Makeup Water Alternatives

The operation of HAR will require a consistent source of fresh makeup water for cooling purposes. HAR will not withdraw any groundwater for use at the site. Harris Reservoir was originally designed to provide cooling water for four (4) reactor units and to remove the design heat load from the cooling tower blowdown water associated with those units and will therefore serve as the cooling tower makeup water source for the closed-loop natural draft hyperbolic cooling tower.

No restrictions on withdrawal volume are anticipated with this water source. The environmental impact of the use of this water supply is SMALL to MODERATE. No alternative source is identified that is environmentally equivalent or superior.

Groundwater was evaluated and not considered a viable water source alternative, as the groundwater would not be able to support the large CWS makeup water requirement necessary for each unit.

9.4.2.3 Water Treatment

The HAR 2 and HAR 3 will require water treatment measures for the influent and effluent water streams for the heat dissipation system and the CWS. Evaporation of water from cooling towers leads to an increase in chemical and solids concentrations in the circulating water, which in turn increases the scaling tendencies of the water. The circulating water system for the new units would be operated so that the concentration of solids in the circulating water would be approximately four times the concentration in the makeup water (i.e., four cycles of concentration). The concentration ratio would be sustained through blowdown of the circulating water from the cooling towers to the Harris Reservoir and the addition of makeup water.

The wetted materials in the primary system of the AP1000 unit typically will be primarily austenitic stainless steel, inconel alloys, and Zircaloy cladding. Reactor water chemistry limits will be established to provide an environment favorable to these materials. Design limits will be placed on conductivity and chloride concentrations. Operationally, the conductivity will be limited because it can be measured continuously and reliably. In addition, conductivity measurements will provide an indication of abnormal conditions and the presence of unusual materials in the coolant. Chloride limits will be specified to prevent stress corrosion cracking of stainless steel.

The service water chemical injection system, demineralized water treatment system, and potable water-processing system operate the same in all plant operational modes (i.e., no difference exists in how the systems operate during full power plant operations, plant shutdown/refueling, and plant startup).

Evaporation of water from cooling towers leads to an increase in chemical and solids concentrations in the circulating water, which in turn increase scaling tendencies of the water. A water treatment system would be required at the HAR to minimize bio-fouling, prevent or minimize growth of bacteria (especially *Legionella*, in the case of cooling towers), and inhibit scale on system heat transfer surfaces. Water treatment will be required for both influent and effluent water streams. Considering that water sources for the new plant are the same as those for the existing plant, treatment methodologies for the two plants will be similar.

The circulating water treatment system provides treated water for the CWS and consists of three phases: makeup treatment, internal circulating water treatment, and blowdown treatment. Makeup treatment will consist of a biocide (for example, Towerbrom 960) injected into bay water influent during spring, summer, and fall months to minimize marine growth and to control fouling on surfaces of the heat exchangers. Treatment will improve the quality makeup water and will allow increased cycles of concentration in the cooling tower. Similar to the existing plant, an environmental permit to operate this treatment system will be obtained from the state. For prevention of *Legionella*, treatment for internal circulating water components (i.e., piping between the new intake structure and condensers) will include existing power-industry control techniques that consist of hyperchlorination (chlorine shock) in combination with intermittent chlorination at lower levels, biocide (for example, bromine), and scale-sludge inhibitor. Blowdown treatment will depend on water chemistry but is anticipated to include application of an acid, biocide, and scale inhibitor to control pH, biogrowth, and scaling, respectively.

As discussed in Subsection 3.3.1.5, potable water used throughout the plant typically will be processed through a reverse osmosis (RO) filtration system and, if necessary, will be treated with an antibacterial inhibitor (such as chlorine). The drinking water treatment system, which supplies water for the potable and sanitary distribution system, will treat the raw water so that it meets the North Carolina potable (drinking) water program and USEPA bacteriological and chemical standards for drinking water quality under the National Primary Drinking Water Regulation and National Secondary Drinking Water Regulation. The system will be designed to function during normal operation and outages (i.e., shutdown).

The system to demineralize water prior to its use in various applications at HAR 2 and HAR 3 typically will consist of an RO system. During demineralization or regeneration, chemicals such as sulphuric acid and caustic soda typically are used to adjust the pH to between 6 and 9 for release to the wastewater stream outfall that discharges to Harris Reservoir.

All nuclear power plants are required to obtain an NPDES permit to discharge effluents. These permits are renewed every 5 years by the regulatory agency, either EPA or, more commonly, the state's water quality permitting agency. The periodic NPDES permit renewals provide the opportunity to require modification of power plant discharges or to alter discharge monitoring in response to water quality concerns.

Discharges to outfalls from processing of demineralized and potable water typically will include coagulation, filtration, disinfection, and ion exchange. Wastes from treatment could include filter backwash and demineralizer regeneration wastes. The spent filters from the RO system are disposed in accordance with applicable industrial solid-waste regulations.

The demineralized water transfer and storage system receives water from the demineralized water treatment system and provides a reservoir of demineralized water to supply the condensate storage tank and for distribution throughout the plant. Demineralized water is processed in the demineralized water transfer and storage system to remove dissolved oxygen. In addition to supplying water for makeup of systems that require pure water, the demineralized water is used to sluice spent radioactive resins from the ion exchange vessels in the chemical and volume control system, from the spent fuel pool cooling system, and from the liquid radwaste system to the solid radwaste system.

Liquid wastes generated by the plant during all modes of operation will be managed by the liquid waste storage and processing systems. The liquid waste storage system collects and segregates incoming waste streams, provides initial chemical treatment of those wastes, and delivers them to one of the processing systems. The liquid waste processing system separates wastewaters from radioactive and chemical contaminants. The treated water is returned to the liquid waste storage system for monitoring and eventual release. Chemicals used to treat wastewater for both systems include sulphuric acid for reducing pH, sodium hydroxide for raising pH, and an antifoaming agent for promoting settling of precipitates.

The existing system will be used to treat sewage for the new plant. This treatment system removes and processes raw sewage so that discharged effluent conforms to applicable local and state health and safety codes, and environmental regulations. Sodium hypochlorite (chlorination) is used to disinfect the effluent by destroying bacteria and viruses, and sodium thiosulfate (de-chlorination) reduces chlorine concentration to a specified level before final discharge. Soda ash (sodium bicarbonate) is used for pH control. Alum and polymer are used to precipitate and settle phosphorus and suspended solids in the alum clarifier; polymer also is used to aid flocculation.

The frequency of treatment for each of the normal modes of operation is described, as well as the quantities and points of addition of the chemical additives. All methods of chemical use are monitored. No substitutions are proposed for the current treatment amounts or methods. The environmental impact on the use of this water treatment is SMALL. No alternative treatment is identified that is environmentally equivalent or superior.

9.4.3 TRANSMISSION SYSTEMS

As specified in the guidelines in NUREG-1555, Section 9.4.3, the preparation of the summary discussion identifies the feasible and legislatively compliant alternative transmission systems. As discussed in Section 3.7, the existing HNP is connected to the PEC transmission grid by seven 230-kilovolt (kV) transmission lines. Five circuits share a common ROW. In that common corridor, the lines are spaced sufficiently far apart to preclude the possibility of the failure of one line causing the failure of more than one other line. These seven lines radiating in different directions from the plant, connect to strong and diverse parts of the PEC system. For the greater part of their lengths, these lines are on separate ROW. The probability is extremely high that a transmission grid would be available to supply off-site power to HNP and the HAR facility.

PEC is a vertically integrated investor-owned company regulated by the State of North Carolina and the Federal Energy Regulatory Commission (FERC). Although PEC will bear the ultimate responsibility for defining the nature and extent of system improvements, as well as the design and routing of connecting transmission lines, separate agencies and reports are required to obtain licenses for the new transmission lines (Reference 9.4-013). Three new transmission lines would be constructed only if the HAR 3 is constructed and were required to distribute generated electricity. If the decision is made not to install the new unit, any plans for new transmission lines also would be abandoned. A Regional Transmission Organization (RTO) or the owner, both regulated by FERC and the Southeastern Electric Reliability Council (SERC), will bear the ultimate responsibility for the following:

- Defining the nature and extent of system improvements.
- Designing and routing connecting transmission.
- Addressing the impacts of such improvements.

Therefore, the construction described in this subsection is based on the existing infrastructure, PEC system design preferences, and best transmission practices. The guiding assumptions for transmission route design are that:

- The new construction will follow in parallel with some of the transmission corridors serving the HNP.
- Reaching the nearest substation to provide connection to the greater area grid is the only requirement.

The HAR facility will be located on the transitional zone between the North Carolina coastal plain and piedmont physiographic regions. Therefore, the new transmission lines will traverse both regions. The coastal plain ranges from nearly flat to very gently rolling. The piedmont region is gently rolling with most steep slopes occurring around drainage ways. The terrain associated with the new transmission lines is not considered rugged. Slopes are no greater than 45 percent, and most areas are gently rolling with no prominent hills. The terrain is mostly broken near large streams where elevation differences range from 15.24 to 30.48 m (50 to 100 ft.) between the highest and lowest elevations. Consequently, no safety-related problems result from the terrain and no unusual features require special design plans. Therefore, the new transmission lines will be constructed using standard designs and routine engineering guidelines that have been proven safe and reliable through experience.

Once the transmission system owner/operator received an interconnection request, the owner/operator would conduct a study to determine the impacts of the generation or transmission service on the existing system. Then, the necessary system improvements would be identified. System improvement needs generally are based on two types of studies, power flow studies to determine the thermal capacity necessary to accommodate the power flows and system stability studies to determine the effects the generation will have on system stability under steady-state and transient conditions, given various system contingencies. The transmission system owner/operator would prepare these studies and additional impact studies under FERC and SERC regulations and guidance.

The output from the HAR is expected to be approximately 2000 megawatt electric (MWe). Although the existing switchyard and transmission corridor system was sized for the transmission capability of the HNP plus one additional unit, the existing system (i.e., the switchyard and lines) may not be able to carry the new generation from HAR 2 and HAR 3. Therefore, a new switchyard and three new lines will be required to accommodate the output from HAR.

As discussed in Subsection 2.2.2, seven 230-kV lines currently connect the HNP to the transmission system. Three new lines will be installed for HAR 3. Three new lines will connect the 230-kV HAR 3 switchyard to the PEC electric grid. These new lines will be connected to the existing Fort Bragg, Erwin, and Wake transmission corridors. The proposed routing of the new lines for HAR 3 are being evaluated to be adjacent to or within existing maintained transmission corridors from the HNP. Use of existing transmission corridors will result in impacts from expansion of the transmission system to be SMALL.

As stated in Subsection 3.7.1.1, the three new lines will connect the new HAR 3 switchyard to the PEC grid. The proposed routing of the new lines for HAR 3 is being evaluated for location adjacent to or within the existing maintained transmission corridors for the HNP. Most transmission corridor ROWs are typically about 30.5 m (100 ft.) wide with 15.2 m (50 ft.) easements on either side. However, they vary depending on the specific location. It is anticipated that the existing transmission corridors will need to be widened approximately 30 m (100 ft.) to accommodate the three new lines; activities for clearing vegetation would involve logging existing forested land along the ROW.

The corridor areas are mostly remote and pass through land that is primarily agricultural and forest land with low population densities. It is anticipated that farmlands that have corridors passing through them will generally continue to be used as farmland. Although noticeable, this effect is not expected to be significant or to noticeably alter significant existing land uses because of the use of existing transmission corridors. The ROW also traverses land in active agricultural production. Minimal plots of land would be removed from agricultural production where new transmission towers might be sited. Land-clearing or construction activities in the ROW would follow BMPs and would be mitigated to the extent possible. The longer transmission lines cross numerous state and United States highways. Therefore, environmental impacts from expansion efforts are anticipated to be SMALL and the effect of these corridors on land usage is expected to be SMALL. No alternative tower designs, tower heights, conductor-to-ground clearances, conductor designs, or ROW widths are necessary (Section 3.7). Auxiliary transmission facilities do not require alternative locations.

The effects of constructing and maintaining new transmission lines are evaluated further in Chapters 4 and 5, therefore no mitigation is required. The measures and controls to limit adverse transmission system impacts that were developed as a result of this environmental review are described in Sections 4.6 and 5.10. No alternative construction methods are indicated to mitigate effects from vegetation, erosion control, access roads, towers, conductors, equipment, or timing.

The startup and shutdown power will be derived from the grid via a new 230-kV transmission system. The new 230-kV lines connecting the HAR to the PEC system will be constructed on PEC standard structures. Through the years, these structures have been very reliable. Experience with similar 230-kV lines on the PEC system has shown availability of power to be virtually 100 percent. Most power companies have an engineering standard and preferred design that consists of wood pole H-frame support structures. Pole heights are typically 24 to 30 m (80 to 100 ft.) with 183- to 213-m (600- to 700-ft.) spans between poles. The poles are typically direct buried, with engineered foundations as needed. Single steel poles with concrete footings will be used, as appropriate. The typical line clearances above ground level will be 9 m (29 ft.) at 15.6°C (60°F) conductor temperature. However, a more typical design for a double circuit line would use steel structures, either lattice tower or monopole construction.

The transmission structures typically will carry a double circuit line consisting of six phases of two- or three-bundle conductors of 1272 thousand circular mils (kcmil) aluminum conductor steel reinforced (ACSR) and two shield wires. Final conductor size will be determined by the transmission system owner based on several factors, including operating voltage, loads to be carried, both initially and in the future, thermal capacity, cost of the conductor, support structures, foundations, ROWs, the present value of the energy losses associated with the conductor size and expected loading, and electric and magnetic field strengths, which depend on operating line voltage, conductor currents, and conductor configuration and spacing.

9.4.4 REFERENCES

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Table 9.4-1 (Sheet 1 of 4)
Comparison of Heat Dissipation Systems Evaluation Criteria

Factors Affecting System Selection	Dry Tower Cooling System	Hybrid Wet/Dry Cooling Tower System	Once –Through Cooling System	Single Natural Draft Hyperbolic Cooling Tower	Two Natural Draft Hyperbolic Cooling Towers	Three Round Mechanical Draft Cooling Towers
Land Use: On-site Land Requirements	Impacts would be SMALL.	Impacts would be SMALL.	N/A Rejected from range of alternatives before land use evaluated. Impacts would be SMALL.	Impacts would be SMALL.	Impacts would be SMALL to MODERATE.	Impacts would be MODERATE.
Land-Use: Terrain Considerations	Terrain features of the HAR site are suitable for a dry tower cooling system. Impacts would be SMALL.	Terrain features of the HAR site are suitable for a hybrid wet/dry cooling tower system. Impacts would be SMALL.	N/A Rejected from range of alternatives before land use evaluated. Impacts would be SMALL.	Terrain features of the HAR are suitable. Impacts would be SMALL.	Terrain features of the HAR are suitable. Impacts would be SMALL.	Terrain features of the HAR are suitable. Impacts would be SMALL.
Water Use	No makeup water needed for use of a dry tower cooling system. No significant impacts to aquatic biota. Impacts would be SMALL.	Potential for SMALL impacts to aquatic biota. Impacts would be SMALL.	Significant volume of makeup water needed. Potential for significant impacts to aquatic biota. Impacts would be LARGE.	Potential for SMALL to MODERATE impacts to aquatic biota. Impacts would be SMALL to MODERATE.	Potential for SMALL to MODERATE impacts to aquatic biota. Impacts would be SMALL to MODERATE.	Potential for SMALL to MODERATE impacts to aquatic biota. Impacts would be SMALL to MODERATE.
Atmospheric Effects	No visible plume associated with a dry tower cooling system. Impacts would be SMALL.	Short average visible plume. Presents minor potential for fogging and salt deposition. Impacts would be SMALL.	Some plume associated with discharge canal. Impacts would be SMALL to MODERATE.	Visible plume. Presents greater potential for fogging and salt deposition. Impacts would be SMALL.	Visible plume. Presents greater potential for fogging and salt deposition. Impacts would be SMALL.	Short average and median visible plume. Impacts would be SMALL.

Table 9.4-1 (Sheet 2 of 4)
Comparison of Heat Dissipation Systems Evaluation Criteria

Factors Affecting System Selection	Dry Tower Cooling System	Hybrid Wet/Dry Cooling Tower System	Once –Through Cooling System	Single Natural Draft Hyperbolic Cooling Tower	Two Natural Draft Hyperbolic Cooling Towers	Three Round Mechanical Draft Cooling Towers
Thermal and Physical Effects	Minor to no discharges associated with a dry tower cooling system would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. The discharge is not likely to produce tangible aesthetic or recreational impacts. No effect on fisheries, navigation, or recreational use of Harris Reservoir. Impacts would be SMALL.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL.	Enormous size of the intake and discharge structures and offshore pipes are needed. Thermal discharges associated with the once-through cooling system would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Thermal discharge study needed to identify environmental impacts on Harris Reservoir. Impacts would be LARGE.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL.	Discharges would need to meet applicable water quality standards and be in compliance with applicable thermal discharge regulations. Discharge is not likely to produce tangible aesthetic or recreational impacts. Impacts would be SMALL to MODERATE.
Noise Levels	Would emit broadband noise that is largely indistinguishable from background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely indistinguishable from background levels and would be considered unobtrusive. Impacts would be SMALL.	N/A Rejected from range of alternatives before noise evaluated.	Would emit broadband noise that is largely indistinguishable from background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely indistinguishable from background levels and would be considered unobtrusive. Impacts would be SMALL.	Would emit broadband noise that is largely indistinguishable from background levels and would be considered unobtrusive. Impacts would be SMALL to MODERATE.

Table 9.4-1 (Sheet 3 of 4)
Comparison of Heat Dissipation Systems Evaluation Criteria

Factors Affecting System Selection	Dry Tower Cooling System	Hybrid Wet/Dry Cooling Tower System	Once –Through Cooling System	Single Natural Draft Hyperbolic Cooling Tower	Two Natural Draft Hyperbolic Cooling Towers	Three Round Mechanical Draft Cooling Towers
Aesthetic and Recreational Benefits	No visible plume with the use of a dry tower air-cooled system. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Harris Reservoir is expected. Impacts would be SMALL.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Harris Reservoir is expected. Impacts would be SMALL.	N/A Rejected from range of alternatives before aesthetic and recreational benefits.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Harris Reservoir is expected. Impacts would be SMALL.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Harris Reservoir is expected. Impacts would be SMALL.	Plumes resemble clouds and would not disrupt the viewscape. The cooling tower discharge is not likely to produce tangible aesthetic or recreational impacts; no effect on fisheries, navigation, or recreational use of Harris Reservoir is expected. Impacts would be SMALL.

Table 9.4-1 (Sheet 4 of 4) Comparison of Heat Dissipation Systems Evaluation Criteria

Factors Affecting System Selection	Dry Tower Cooling System	Hybrid Wet/Dry Cooling Tower System	Once –Through Cooling System	Single Natural Draft Hyperbolic Cooling Tower	Two Natural Draft Hyperbolic Cooling Towers	Three Round Mechanical Draft Cooling Towers
Legislative Restrictions	Potential compliance issues with the requirements for emissions under the federal Clean Air Act. These regulatory restrictions would not negatively affect implementation of this heat dissipation system, but they may impact overall operational cost.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into Harris Reservoir. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL to MODERATE.	Potential compliance issues with Section 316(b) of the CWA. Also, potential significant NPDES thermal discharge issues surrounding discharges back into Harris Reservoir. Impacts would be LARGE.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into Harris Reservoir. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL to MODERATE.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into Harris Reservoir. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL.	An intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from blowdown back into Harris Reservoir. These regulatory restrictions would not negatively affect implementation of this heat dissipation system. Impacts would be SMALL.
Environmental impacts	SMALL.	SMALL to MODERATE.	LARGE.	SMALL to MODERATE.	SMALL to MODERATE.	SMALL to MODERATE.
Is this a suitable alternative heat dissipation system?	No (see discussion in Subsection 9.4.1.1)	No	No	No	Yes	No

Table 9.4-2
Life Cycle Cost Benefit for Tower Options (Hot Weather, 600,000 gpm)

	Hot Year				
Type of Cooling Tower	**Single Tower - Natural Draft**	**Two Towers - Natural Draft**	**Round Mechanical Draft**	**Two Towers - Natural Draft**	**Round Mechanical Draft**
Circulating Water flowrate (gpm)	600,000	600,000	600,000	600,000	600,000
Energy Rate	High	High	High	Average	Average
CT Initial Cost ($\$10^3$)[(a)]	71,249	93,093	67,219	93,093	67,219
Contractor+Eng.+Manag,+Owner+Cont. ($\$10^3$)	42,393	55,390	39,996	55,390	39,996
Construction Cost ($\$10^3$) [(a)]	113,642	148,483	107,215	148,483	107,215
Total Present Value of CT Cost Including Maintenance Differences ($\$10^3$)	113,642	148,483	109,394	148,483	109,394
Total Present Value of CT Cost Including Production Difference Benefits ($\$10^3$)	113,642	117,465	104,026	125,593	105,623

Notes:
a) The presented cost excludes common items such as circulating water pumps, makeup and blowdown systems, and tower fill replacement.

Source: Reference 9.4-001

Table 9.4-3
Life Cycle Cost Benefit for Tower Options (Average Weather, 600,000 gpm)

	Average Year				
Type of Cooling Tower	**Single Tower - Natural Draft**	**Two Towers - Natural Draft**	**Round Mechanical Draft**	**Two Towers - Natural Draft**	**Round Mechanical Draft**
Circulating Water flowrate (gpm)	600,000	600,000	600,000	600,000	600,000
Energy Rate	High	High	High	Average	Average
CT Initial Cost ($\$10^3$)[(a)]	71,249	93,093	67,219	93,093	67,219
Contractor+Eng.+Manag,+Owner+Cont. ($\$10^3$)	42,393	55,390	39,996	55,390	39,996
Construction Cost ($\$10^3$)[(a)]	113,642	148,483	107,215	148,483	107,215
Total Present Value of CT Cost Including Maintenance Differences ($\$10^3$)	113,642	148,483	109,394	148,483	109,394
Total Present Value of CT Cost Including Production Difference Benefits ($\$10^3$)	113,642	123,705	109,870	130,147	109,394

Notes:
a) The presented cost excludes common items such as Circulating Water pumps, makeup and blowdown systems, and tower fill replacement.

Source: Reference 9.4-001

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PLANNING IMPLICATIONS OF ALTERNATE DEVELOPMENT PATTERNS ON INFRASTRUCTURE AND EXISTING PLANNING POLICIES

PEE DEE REGION OF SOUTH CAROLINA

Funded in part by a
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SC State Budget and Control Board

Prepared by the
Pee Dee Regional Council of Governments

TCSP REGIONAL PLAN
PEE DEE REGION OF SOUTH CAROLINA

I. INTRODUCTION

BACKGROUND ON THE PLAN

This regional Plan is one of several that have been conducted with the assistance of a Transportation and Community and System Preservation Pilot Program (TCSP) grant from the Federal Highway Administration (FHWA) through the auspices of the South Carolina State Budget and Control Board. The project, titled Statewide Integrated Infrastructure Planning, Model Plan and Process, is being conducted by several Councils of Government in South Carolina. The TCSP Pilot Program is a comprehensive initiative of research and grants created under the Transportation Equity Act for the 21st Century (TEA-21). The program is part of FHWA's "Livability Initiative" which focuses on tools and resources to preserve green space, ease traffic congestion and pursue regional "smart growth" strategies. The program is intended to investigate the relationships between transportation and community and system preservation and private sector-based initiatives.

The project is intended to look at ways plan and implement strategies that improve the efficiency of the transportation system; reduce environmental impacts of transportation; reduce the need for costly future public infrastructure investments; ensure efficient access to jobs, services, and centers of trade; and examine private sector development patterns and investments that support these goals. The project includes:

- Identifying the characteristics of current "Trend" development,
- Identifying two alternate development scenarios,
- Assessing the impacts of these development scenarios on existing state and regional plans for energy, transportation, economic development, water quality, & infrastructure,
- Formulating a recommended alternate

The effort was conducted by the staff of the Pee Dee Regional Council of Governments with the advisory assistance of community planners in the six-county region and under the guidance of the staff of the SC State Budget and Control Board.

REGIONAL CHALLENGES AND GROWTH

The Pee Dee Region consists of six counties and 33 municipalities tucked into northeastern South Carolina. It borders North Carolina, with significant economic ties to communities above the border. The Region includes Chesterfield, Darlington, Dillon, Florence, Marion and Marlboro Counties, and encompasses 3,528 square miles (2,257,811 acres). It is bisected by the Great Pee Dee River and its wide floodplain, with three Counties to either side of the river. The Region is also bisected by Interstate 95, which serves as a regional

Main Street.

The Region is centrally located to a number of major urban centers and/or destination areas, including the Charlotte metroplex, 45 miles Northwest of the Region, Columbia, 45 miles West, Charleston and the Port of Charleston, 70 miles South, and the Grand Strand, 45 miles East. To differing degrees, each of these urban areas helps support the Region economically and/or otherwise benefits the Region due to proximity. Accessibility to these markets is critical.

The Region is a diverse group of communities. According to the 2000 Census, the municipalities range from communities of as few as 69 persons (Tatum) to Bennettsville (9,425 persons) and Florence (30,248 persons). Each of the six counties has urban concentrations, including:

- Chesterfield County: Eight municipalities in the Region's physically largest County. Most population is concentrated in a band of moderately sized communities along SC 9 in the northern portion of the County - Pageland, Chesterfield and Cheraw. (This County also has large public land holdings (federal and state) - Sandhills State Forest and National Wildlife Refuge.)

- Darlington County: As a growing small metropolitan County, the County has two large urban areas along the SC 151 and US 52 corridor - Hartsville and Darlington.

- Dillon County: A rural county, there is one major urban concentration at Interstate 95 and US 301/SC 9 - Dillon.

- Florence County: The Region's largest County (from a population standpoint) and a metropolitan are, the County is dominated by the Region's largest urban area - Florence and surroundings. In addition, Lake City anchors the southern end of the County, also on US 52.

- Marion County: This rural County has two major urban areas - Marion and Mullins - on the US 76 corridor. This County is also the primary travel corridor to the Grand Strand.

- Marlboro County: This is a rural county with one primary urban area - Bennettsville - served by SC 9, US 15/401 and SC 38.

Land Use & Development Challenges: Much of the Region's 2.1 million acres is rural and agricultural in character, with only scattered urban areas. The large region and scattered uses creates logistical challenges, both in ensuring movement of people and goods, but also the extension of urban services to a scattered and relatively low-density development patterns. Development factors and challenges include:

- Urban uses comprise only three percent of all land, dominated by the Florence-Darlington-Hartsville urban corridor.

- About 40 percent of the land is under cultivation, nearly 800,000 acres. Prime farmland abounds in the Region, particularly in broad bands on either side of the Pee Dee River floodplain (Marlboro / Dillon / Marion Counties and Darlington / Florence Counties).

- Forested uses are also dominant, concentrated in the forest preserves in southern Chesterfield County (Sandhills State Forest and National Wildlife Refuge), as well as along the major rivers and streams that dominate the Region.

- In general, urban development has grown primarily in the Hartsville / Darlington / Florence corridor. Fortunately, this band of urban development has an existing system of four-lane highways that can at least partially support new development.

- The pattern of scattered development in the surrounding Region, however, tends to place demand on a system of two-lane regional roadways and farm-to-market roadways, some of which is showing the strain of additional traffic, maintenance difficulties, etc. Scattered development in 33 small and large urban centers also complicates the provision of public transit service in such disparate locations.

Growth: Past and current population trends in the Region illustrate a mixed set of growth conditions over the years. The accompanying table illustrates population trends from 1960 to 2000. Although the region saw significant growth between 1930 and 1950, the next 20 years saw stagnation, followed by another growth peak in the decade of the 70's, when 40,000 persons were added in the Pee Dee. In these growth periods, all Pee Dee counties shared in the development, but Florence and Darlington Counties remained the Region's growth center.

Another slowdown occurred in the eighties, followed by a modest recovery in the nineties. Even though 1990 Census counts are suspect, it is felt that even accurate data would still reflect somewhat lackluster growth for the Region in the '80s. This low growth likely reflects underlying economic conditions during the eighties that held back economic expansion and population growth in large portions of the Region. These same counties continue to experience high economic distress.

Current population counts for 2000 show 332,929 persons in the Region, somewhat ahead of official growth estimates by State agencies and the Bureau of the Census. Regional growth was moderate during the past ten years in all but Marlboro County (which supposedly experienced a small decline). Growth in the last decade was about 26,000; this is just over eight percent, compared to 15 percent for the State. While this growth lags behind the State as a whole, this recent growth is nonetheless impressive for a rural region and paints a more positive picture of future growth possibilities.

Population Trends from 1960 - 2000 – Pee Dee Region and Counties

County	Population					Change 1960-2000	
	1960	1970	1980	1990	2000	Persons	%
Chesterfield	33,717	33,667	38,161	38,577	42,768	9,051	27
Darlington	52,928	53,442	62,717	61,851	67,394	14,466	27
Dillon	30,584	28,838	31,083	29,114	30,722	138	<1
Florence	84,438	89,636	110,163	114,344	125,761	41,323	49
Marion	32,014	30,270	34,179	33,899	35,466	3,452	11
Marlboro	28,529	27,151	31,634	29,361	28,818	289	1
REGION	262,210	263,004	307,937	307,146	332,929	70,719	27
STATE	2,382,594	2,590,516	3,120,730	3,486,703	4,012,012	1,629,418	68

Source: US Bureau of the Census, 1960 – 2000; Compiled by PDRCOG.

Although these county and regional data provide an overview of past growth for the Region, the distribution of population growth among the sub-county census tracts is a critical gauge of where growth is taking place and the burden this growth may be placing on the roadway and transit systems in the Region. Areas of growth in the Region include several "hot spots", including: Pageland, Cheraw, Dillon and West Dillon, between Darlington and Hartsville, North Darlington, North Hartsville, the Florence metropolitan area (particularly West and Southwest areas), West of Marion, and West of Lake City. Many of these same areas are forecast to grow over the next several decades.

Future Population Trends: Forecasting population growth for the Region is somewhat difficult due to erratic past trends. At the current time, revised forecasts are not available from state agencies that take into account the 2000 counts. The table below attempts to provide an order-of-magnitude forecast of population for the year 2020.

Two comparisons (from 1990 and 2000 to the year 2020) are made such that the effects of the 1990 to 2000 "growth surge" reflected in the previous table are clearly evident.

Population Forecasts to 2020 - Pee Dee Region and Counties

County	Population			Projected Change	
	1990	2000	2020	1990-2020	2000-2020
Chesterfield	38,577	42,768	47,500	23.10%	11.10%
Darlington	61,851	67,394	74,100	19.80%	10.00%
Dillon	29,114	30,722	32,900	13.00%	7.10%
Florence	114,344	125,761	140,800	23.10%	12.00%
Marion	33,899	35,466	37,600	10.90%	6.00%
Marlboro	29,361	28,818	30,500	3.90%	5.80%
REGION	307,146	332,929	363,400	18.30%	9.20%

Source: US Bureau of the Census, 1960 – 2000; Estimates for 2020 by PDRCOG.

As can be seen, regional growth is still expected to be only about half that of the State as a whole over the next 20 years, growing by about 30,000 persons to 363,000 in the year 2020. Not surprisingly, Florence, Chesterfield and Darlington Counties lead the Region, with over 80 percent of the Region's growth in the next 20 years expected in these three counties. Even so, each of these higher growth counties is still forecast to have less growth than the State.

As will be mentioned later, these forecasts will be maintained for all development scenarios tested, even though development policies <u>could</u> impact overall growth in portions of the Region.

<u>Growth Impacts on Transportation and other Infrastructure</u>: As noted in some of the above commentary, much of the growth in the Region is occurring along major highway corridors. These growth areas also include virtually all of the FLATS area and all of the major population centers in the Region.

The broad implications of the above described growth patterns on the transportation system are several:

- Much of the growth is occurring on major four- and two-lane highway corridors rather than in isolated rural areas. This ensures that many of the planned roadway improvements will serve a good portion of the forecasted population. It also means, however, than those areas which are currently feeling congestion will likely feel it worse, thus putting pressure on the Region to complete several other critical highway corridor improvements beyond current funding. And, development that occurs directly along major routes can increase the potential accident locations and ultimately reduce the carrying capacity of the highway.

- Growth anticipated in the Hartsville – Darlington – Florence corridor increases pressure on the Florence Area Transportation (FLATS) roadway network, a fact that must be considered in FLATS area planning. This concentrated growth band also exerts pressure on not just the four-lane US 52, SC 151 and US 76/301routes, but also the two-lane segments of US 76 toward Sumter, US 52 North of Darlington and SC 51 Southeast of Florence.

- The growth occurring in more dense urban portions of the region also increases the likelihood that transit alternatives will be viable to an expanding segment of the population. In particular, the Hartsville – Darlington – Florence corridor is a magnet for growth and may generate enough activity and population to justify additional fixed route and demand responsive transit service. Certainly, this urban corridor will dictate the need for implementing multi-modal centers already planned.

- Growth in the tourism corridors of Dillon and Marion Counties also will have an impact on congestion along those routes, as local and tourism traffic combines.

- The fact that much of the Interstate 95 and 20 corridors are among the highest growth areas in the Region is expected to place additional burdens on especially I-95. A proposed widening of I-95 from I-20 northward to SC 327 is timely, but other portions of I-95 and its interchanges will be seeing additional pressure from local growth as well as through traffic.

- Finally, the moderate to high growth forecast in the SC 9 corridor between Cheraw and Bennettsville, coupled with the high growth at the Pageland and Dillon ends of this corridor, indicate SC 9 will be under additional traffic pressure in the foreseeable future.

A critically important complement to these growth factors is the specific locations that may generate significant demands on the transportation system. Such "activity generators" include:

- Business and office centers, concentrated in major urban areas such as Florence.

- Newly developing county and multi-county industrial parks (most notably between Cheraw and Chesterfield, North of Bennettsville, on I-95 at SC 38, on the US 501 bypass between Marion and Mullins, on SC 327 Northeast of Florence, North of Lake City, and at SC 340 on I-20). It is evident that most sites have been located to take advantage of interstate accessibility and other major travel corridors. This is advantageous, as major highway improvements will not usually be required in order for the industrial site to be developed.

- Regional-scale malls and centers located in most of the major population centers in the Region, including Cheraw, Hartsville, Lake City, East Marion and in several locations in the Florence urban area.

- Government and institutional sites, including government centers, social service centers, hospitals, and colleges and universities, also concentrated in only the major urban areas.

- The primary health centers in the Region include regional medical centers and community hospitals in Cheraw, Hartsville, Dillon, Florence, Lake City, Marion, and Bennettsville.

- Colleges include Francis Marion University in Florence, four campuses of Northeastern TEC and five campuses of Florence-Darlington TEC, located in all counties.

- Tourism and recreation centers, including coliseums and performing arts centers, scenic or cultural corridors, large-scale recreation, and museums. These facilities include the Florence Civic Center, an amphitheatre near Marion, local museums, three State parks, and State Forests and Wildlife refuges.

REGIONAL TRANSPORTATION PLANNING

In the Pee Dee, formal involvement by the Pee Dee Regional Council of Governments in planning for transportation infrastructure is a relatively new initiative. Transportation facilities have always played an important role in regional development, as evidenced by inclusion of transportation issues in several levels of planning conducted by the COG since 1967:

- Regional development planning,
- Infrastructure planning,
- Local community comprehensive planning, and
- Comprehensive Economic Development Strategies (CEDS)

While transportation needs have been considered an element in such local and regional planning, the process of determining rural roadway needs, assessing alternatives and setting improvement priorities was historically a function of the SC Department of Transportation, particularly the planning and engineering divisions and the Board of Commissioners. It should be noted that urban transportation needs in the Florence urban area have, for many years, been overseen by the City of Florence through FLATS, an MPO serving the metropolitan area. COG staff have historically served on the FLATS Study Committee in an advisory role. But the COG had never had input at the policy level.

The transportation planning process changed in 1998, when a partnership developed between the 10 regional planning councils and the SCDOT. The SCDOT made the decision to allocate highway resources to each COG area based on population. The Pee Dee regional allocation based on 1990 population was $7.9 million per year.

This decision by SCDOT meant that the COG staff and Board of Directors could become involved in policy decisions in several respects:

- Formal consideration of ALL means of transportation, including rail, air, transit and pedestrian/bike in addition to highways. While many of these transportation modes were formally planned and managed by portions of SCDOT or related State agencies, at least these various modes would be considered in planning for the Pee Dee region.

- The COG would be able to formalize its transportation thought processes and recommendations in a regional element of the Statewide Transportation Plan.

- Particularly with regard to highways, the COG could assess roadway needs and set regional priorities, particularly for "Guideshare" funds, the regional allocation of highway widening funds.

Of course, COG involvement in the setting of priorities for widening projects was a very visible role, as was COG "buy-in" to bonding of highway improvements. In 1999, the Board of Directors, upon staff recommendations, recommended to SCDOT a series of roadway projects and agreed to using all of the regional guideshare funds for seven years and half of guideshare funds for an additional 14 years to pay the debt service on highway improvement bonds. That program is currently underway, with decisions regarding the balance of guideshare funds anticipated in 2004. In it's recommendations, the COG stressed regional corridors rather than individual highway segments, opting to complete the widening of the SC 151, SC 38 and US 52 corridors through the region plus complete several local widening projects already underway. These corridor improvements were intended to serve regional development and economic interests better than piece-meal widening projects.

In the four years since the new transportation planning role for the COG was proposed, the staff and Board have seen an increased ability to use its transportation policy decisions to affect development decisions. In addition to the long-range priority list of roadway improvements, the TCSP-sponsored socio-economic data have enabled the COG and SCDOT to develop a regional transportation model that will help refine roadway priorities in the years to come.

II. REGIONAL GROWTH PATTERNS TREND AND ALTERNATE SCENARIOS

INTRODUCTION

The preceding discussions have reviewed broad development issues in the region and the levels and timing of growth that is taking place. Below are described a view of development for the year 2025, using three development scenarios, including a "Trend" scenario and two alternatives. The alternatives were compiled with the assistance of the planning committee and will be described later.

The Trend pattern is an assumed continuation of the urban and rural mix that exists in the region, just with more people. In attempting to define alternate scenarios, several guiding principles were foremost:

- Scenarios represent reasonable alternatives for future development... within the feasible realm of development policies.
- Scenarios are sufficiently different from the Trend to test impacts.
- Scenarios are constrained by the county-wide "control totals" for population, housing, jobs, retail jobs and at-place school attendance, the basis for transportation modeling and trip generation for each alternative.

In the end, the third factor put constraints on the differences between alternatives and their impacts... a muting of effects. However, to assume that one or more alternatives would somehow precipitate dramatic increases or decreases in population and total jobs over the next twenty-five years did not seem to represent reasonable conditions for the future. Thus, the major differences in data assumptions include the pattern of distribution of population and jobs based on the scenario assumptions, as well as the assumed transportation and other infrastructure necessary to support the distribution of growth.

ALTERNATIVE DEVELOPMENT SCENARIOS AND DEVELOPMENT COMPONENTS

As noted above, a "trend" development concept and two alternatives have been formulated to test certain impacts on State plans, etc. Each of the three options is briefly described here, supplemented by the attached graphics that illustrate land use patterns for each of the options, plus highway and water/sewer assumptions for the Trend Development concept.

Each of these discussions provides the basic development and infrastructure assumptions associated with each concept. The Trend concept is the most lengthy, with the alternatives simply being variations.

- Current Trends – a continuation of immediate past trends in growth and development.
- Dispersed Growth – more scattering of development, with less urban growth.
- Clustered Development – more urban growth, with most development in and around selected urban communities and little growth in rural area.

These options are more fully defined later.

To establish "baseline" conditions, the staff of the COG has forecasted growth, land use patterns and infrastructure development for the next 25 years, a so-called "trend" scenario that represents a likely future for the Region. The growth information has been used for transportation modeling purposes.

In addition, two alternatives development scenarios have been identified with the assistance of an advisory group of planners in the region. These are alternate development and infrastructure futures for the Region based on possible changes in development policy or philosophy.

Basic data assumptions of the three development concepts are simple:

- Each assumes the same population "control totals" for the base year 2000 and the planning year, 2025. These control totals are based on 20 year past trends in population and densities from the Census, as well as at-place employment from the SC Employment Security Commission. The SCDOT staff identified 398 Traffic Analysis Zones (TAZs) for the Pee Dee region and the COG staff estimated the following data sets for each TAZ for 2000 and 2025:

    - population,
    - housing units,
    - total employment
    - retail employment
    - at-place school attendance

  The critical value of these data is the forecasting of trips and the forecasting of traffic volumes on the regional roadways in the future. SCDOT planners calibrated the model to actual 2000 traffic counts.

- The difference in the data sets for each of the three alternatives is how the population, households, employment and school attendance are distributed in the future.

- The baseline and future control totals by county are as follows:

	Population		Households		Employment	
	2000	2025	2000	2025	2000	2025
Chesterfield	42,768	48,700	16,900	19,225	16,975	20,124
Darlington	67,394	75,800	26,299	29,689	23,060	27,672
Dillon	30,722	33,450	11,358	12,420	10,050	13,205
Florence	125,719	155,206	46,028	59,603	50,758	66,783
Marion	35,466	38,100	13,429	14,418	12,320	15,272
Marlboro	28,818	30,900	11,078	11,885	7,565	9,830
REGION	332,887	384,181	127,092	149,265	122,728	154,911

Source: Pee Dee Regional COG.

Each of the development options is discussed below, with review of land use, economic development, infrastructure and environmental considerations of each development option.

Trend Development Scenario: The Trend Development pattern assumes residential, commercial and industrial development will continue as it has over the past twenty years. This means:

- Most growth will continue to concentrate in the Florence-Darlington-Hartsville urban areas, with significant commercial activity along four-lane regional routes.

- Some additional expansion is expected in selected smaller urban area, including Marion-Mullins, Cheraw-Bennettsville, Dillon, Chesterfield, Pageland and Lake City. Each of these areas will see far less growth than the primary urban corridor identified above. Commercial growth in each area will be relatively light, just enough to address population increases at a local level.

- Industrial expansion will be primarily in the Florence-Darlington-Hartsville urban corridor and selected public sector industrial parks in each county.

- Transportation improvements will include the "bonded" improvements plus several additional regional corridors, including US 378, portions of US 52 and SC 51.

- Water and sewer expansion will be confined primarily to these growth areas, but some system consolidation is possible. Regional systems could include Florence, Dillon, Hartsville, Lake City, and Cheraw. Some smaller systems may elect to eventually tie to these larger systems due to DHEC mandates, system efficiencies, etc.

- Public transit will still serve the same role as today, perhaps with more feeder service to out-of-region labor or employment centers and with better service between urban centers in the Region.

Now defined, the following land use, economic development and environmental assumptions are made regarding this development scenario:

Land Use: Existing development patterns are summarized by the following observations:

- Urban development is concentrated in Pageland, Cheraw, Bennettsville, Dillon, Hartsville, Darlington, Marion, Mullins, Lake City and the expanding metropolitan area of Florence. Of course, Florence dominates the urban landscape in the Region, with an urban area that has been consistently expanding for decades (usually to the South and West, but recently to the Southeast).

- Industrial development is concentrated in the West Cheraw industrial corridor, Wallace, portions of Bennettsville, North Hartsville, East Darlington, Johnsonville, in several portions of the Florence urban area, and at several locations along the western edge of the Great Pee Dee River.

- About 40 percent of the land is under cultivation, nearly 800,000 acres. Prime farmland abounds in the Region, particularly in broad bands on either side of the Pee Dee River floodplain.

- Forested uses are also dominant, concentrated in the forest preserves in southern Chesterfield County (Sandhills State Forest and National Wildlife Refuge), as well as along the major rivers and streams that dominate the Region. In total, forested lands comprise 48 percent of the Region's land area, with just over 1 million acres. These forest/natural areas have historically served as major barriers to development and transportation linkage between communities.

- The Region has extensive wetland areas associated with the broad Pee Dee River floodplain and other tributaries, totaling some 225,000 acres. These forest and wetland areas limit growth, lower population densities and otherwise restrict additional development and the densities necessary for urban services.

In general, urban development has grown primarily in the Hartsville / Darlington / Florence corridor. Fortunately, this band of urban development has an existing system of four-lane highways that can at least partially support new development. The pattern of scattered development in the surrounding Region, however, tends to place demand on a system of two-lane regional roadways and farm-to-market roadways, some of which is showing the strain of additional traffic, maintenance difficulties, etc. Scattered development in 33 small and large urban centers also complicates the provision of public transit service in such disparate locations.

Unless dramatic policy changes are made, the past trends previously discussed will lead to development in the following areas:

- Highest Growth will continue along the Florence – Darlington – Hartsville corridor, centered about the US 52 and SC 151 routes. Much of this growth is expected outside the respective corporate limits of these three cities, but within their sphere of influence. New infrastructure improvements in this urban band and the continued dominance of retail and service centers in the area will fuel additional growth for particularly the Florence urban area.

- The effects of "smart growth" initiatives and a current tendency toward more infill development and urban redevelopment may shift some of the growth into the more central areas of Hartsville, Darlington and Florence. Regardless of whether such urbanization trends occur, however, the broad trend is for growth throughout this overall corridor.

- In addition to the traditional growth areas to the southwest of Florence, growth is also expected in the Southeast and along the SC 327 / I-95 corridor to the Northeast. The latter area is the site of additional economic development initiatives.

- The Pageland area is forecasted to growth at an above-average rate due to its proximity to the Charlotte metroplex.

- Above average growth is forecast in a crescent from North Dillon to Marion, including portions of the US 501 beach corridor. Despite economic hard times in this area, Interstate 95 and Myrtle Beach accessibility will likely have a sustained growth influence in these two counties over the next twenty years. Inland development in the Grand Strand is still experiencing dynamic growth, and border areas of Dillon and Marion Counties could see above average growth from this "spillover" development. Extensive rural water systems in Dillon and Marion Counties will help, also.

It should be stressed again that these broad forecasts of growth areas are based on erratic past performance by most of the rural areas and a few of the urban communities. Nonetheless, the general trends are considered sound for transportation planning purposes.

Economic Development: As noted above, industrial and commercial growth is concentrated in certain urban centers. Overall, the following characteristics of the economy are relevant:

- The economy is more dependent on manufacturing than the balance of the State, meaning that access to manufacturing facilities in often far-flung locations are a part of Pee Dee life. Even with the advent of multi-county industrial parks and county industrial parks, some new industrial facilities will be locating in remote areas, particularly if they are not in need of public water or sewer service. Although manufacturing employment is not growing, this dependence on the manufacturing sector is not expected to lessen dramatically during the 25-year planning period.

- There is considerable "cross-pollination" of workers between counties, with Darlington and Florence Counties being major magnets for manufacturing and service jobs, especially Florence. Out-commuting to the Grand Strand is also an issue. This regional and external accessibility is a critical factor for the Pee Dee economy.

- With the recent five-year drought, water supply issues have become more critical. While the specific issues are addressed elsewhere, this is a critical economic development issue, as interruption of industrial water supply and/or curtailment of operations because of reduced assimilative capacity of tributaries could spell economic disaster.

- As with the balance of the State, service sector employment is growing. Jobs in this sector go where the people are, scattered in rural areas as well as urban centers. However, legal, medical and major retail outlets are concentrated in Florence and major urban centers in each county. As noted elsewhere, the Florence / Darlington / Hartsville urban corridor is a retail and services employment corridor.

- Unemployment remains dramatically high, with all Pee Dee counties above State and national averages for the most recent 24-month period. Marion, Marlboro and Dillon have unemployment rates in excess of twice the national average.

Finally, it is possible to formulate a broad measure of economic development activity that can be expected over the 25-year planning period if Trend development conditions continue. An assessment of SC Department of Commerce data indicates a per-capita capita investment of $12,000 dollars by industry in the region over the past 10 years. Commercial investment per-capita is further estimated at $3,500 based on property tax ratios. On an annualized basis, about $1,550 per-capita was invested by business and industry each year in the Pee Dee economy. THEREFORE, OVER THE NEXT 25 YEARS, THE 284,000-PERSON REGION COULD ANTICIPATE AN ADDITIONAL $11 BILLION IN ECONOMIC GROWTH AND DEVELOPMENT ACTIVITY.

This is only an order of magnitude estimate, as there are a myriad of variables that influence the regional economy, including accessibility, taxing, labor force and other issues. Nonetheless, this estimate can be part of a gauge of economic potential in the Pee Dee Region.

Infrastructure: Three critical infrastructure elements that support development and growth and serve to enhance economic development are water, sewer and transportation. The current status of each is discussed here.

<u>Water Systems</u>: Water service is the most basic of public utilities, with far more extensive coverage than sewer. It services more densely populated areas in both urban and rural areas. The provision of water service also promotes growth and development. The following observations are relevant concerning existing water infrastructure:

- According to SC Department of Commerce SCIP data, there are 36 water systems in the Region, as follows:

- Chesterfield Co. - 6 municipal systems, 3 others
- Darlington Co. - 3 municipal systems, 1 other
- Dillon Co. - 3 municipal systems, 1 other
- Florence Co. - 9 municipal systems, 1 county system
- Marion Co. - 3 municipal systems, 1 other
- Marlboro Co. - 3 municipal systems, 2 others

- These 36 systems provide public water to 222,000 persons, about 71 percent of the Region's population. Census data indicate public water availability to a somewhat lower percentage, with the difference likely attributable to the growth in systems between the 1990 Census and the 1997 SCIP data, as well as different means of documenting levels of service.

- The vast majority of the systems depend on ground water resources for water supply, a source of increasing concern in much of the Region. Of the approximately 72 million gallons a day capacity of all water systems, all but about 13 million gallons are from groundwater supplies. This has caused some drawdown of aquifers, especially in the Florence area.

- Only six systems in the Region use surface water impoundments for supply, all located in Chesterfield and Marlboro Counties. However, in 2000 the City of Florence contracted for a 5 MGD surface water plant on the Pee Dee River as a means to diversify its current supply from 20 wells. That regional water plant is currently coming on-line, with long-term impacts on growth and development possible due to its availability. As was evident during a recent three-year drought, surface water availability can be a problem, with flows along the Great Pee Dee River a critical problem that requires multi-state cooperation.

- The accompanying figure illustrates water service area of systems in the region. As can be easily seen, large portions of Darlington, Dillon, upper Florence, Marion and Marlboro Counties are served, as well as several other corridors, such as SC 9 across Chesterfield County.

- An assessment by the SC Budget and Control Board determined in 2000 that the above systems had over 20 MGD in available capacity. Of course, that supply is not evenly distributed, and some sources of water are not always dependable, as noted in the discussion of groundwater and surface water supplies.

- In addition to supply issues, distribution systems, treatment, and other needs abound, all factors in whether there is ample water supply available to meet future needs.

- The following summary of broad needs from 1998 is useful in gauging the types of infrastructure projects that may materialize:
  - <u>Water supply improvements</u> - new wells, new or expanded impoundments, new raw water supply source and similar projects (these needs are often mandated

by SC DHEC). For the planning period:

- the 5MGD plant at Florence will likely be doubled, for $10 million
- impoundments and additional wells for Bennettsville, 2.5 MGD, for $5 million
- additional wells for the Hartsville urban area, 2 MGD for $1.5 million
- additional wells in Marion/Mullins, 1 MGD for $1.5 million
- additional wells for Alligator Rural Water, serving most systems in Chesterfield with raw water, about 1 MGD for $1.5 million
- additional wells for Dillon, 1 MGD for $1.5 million.
- Additional surface water impoundments at Cheraw, 1 MGD for $2.0 million

- <u>Water treatment improvements</u> - treatment plant upgrades, filtration improvements, etc. Each of the above system expansions will have some level of treatment required, with an indeterminate cost. Some system improvements will not necessarily increase capacity, just help meet DHEC mandates. In addition to the nine specific system supply projects mentioned above, the other 27 systems are estimated to need at least $500,000 each to prepare their supply systems for the coming 25 years of growth, for a total of $14 million.

- <u>Water storage improvements</u> - elevated tanks and related piping/valves. At least 30 of the 36 systems will need additional storage to handle their additional supply, with the result that at least 15 MGD of storage will be needed, at a cost of $25 million.

- <u>Service area expansions</u> - new lines that expand the coverage of the system by serving new residential or commercial/industrial customers and corridors. The costs of these improvements are indeterminate, but at $500,000 per system, $18 million would be needed.

- <u>Service upgrades</u> - distribution system improvements, meter system upgrades and similar projects. The costs of these improvements are indeterminate.

- <u>System inter-connects and/or consolidation</u> - formal connections between systems that don't already exist. Connections to the Florence regional water plant by Darlington, Dillon and Marion County providers, as well as Johnsonville, are likely. However, the political aspects of such interconnection may be problematic. In Chesterfield County, drought and low-flow conditions over the past five years make further interconnection probable.

- <u>TOTAL IDENTIFIABLE WATER SYSTEM IMPROVEMENTS TO SERVE THE TREND DEVELOPMENT SCENARIO EXCEED $80 MILLION.</u>

Sewer Systems: Key observations regarding sewer systems and likely needs include:

- There are 27 sewer service providers in the Region, as follows:
    - Chesterfield Co. - 4 municipal systems, 1 other
    - Darlington Co. - 3 municipal systems, 1 other
    - Dillon Co. - 3 municipal systems
    - Florence Co. - 6 municipal systems, 1 county system recently merged with the City of Florence
    - Marion Co. - 4 municipal systems, 1 other
    - Marlboro Co. - 3 municipal systems

- A few of the smaller communities in the Region that have water systems do not have sewer systems. In addition, several that collect sewer use other systems to treat their wastes, including Olanta (treated by Lake City) and a new sewer system just completed by the Alligator system in the McBee area (to discharge to Hartsville). Also, Scranton has limited sewer service operated by Lake City. Three systems utilize some form of land application of wastes and two (Sellers and MARCO) use variations on the community septic tank concept.

- The 27 systems have about 50 million gallons a day in sewer design capacity (with one-third of this capacity in the Florence system).

- Less than 15 MGD of available sewer capacity exists in the region, with one-third of the Region's remaining capacity contained in the Florence system.

- The accompanying figure illustrates sewer service in the Region. The area and population served is far more limited than water coverage, with concentrations in mostly urban areas. The largest area served is the Florence area.

- Needs include the following:
    - Sewer treatment plant upgrades - improvements for additional capacity. Likely projects increasing overall treatment capacity in the Region might add 18 million gallons per day. While this total includes a 5 MGD upgrade of the Florence system, it also includes major expansions or replacements for the Cheraw, Hartsville, Lake City, Johnsonville, Pamplico, Marion and Mullins facilities. Several of these systems could function, as regional sewer facilities. At nearly $20 million, the Florence facility expansion would be the largest and most expensive. Improvements will also be needed to meet DHEC discharge limits, accommodate wet weather flows, correct major problems, etc. The costs for all major treatment systems would exceed $45 million.

    - Upgrades of other system elements - pump station upgrades, interceptor upgrades or original construction. The number and costs of such upgrades are indeterminate, especially because small systems often defer maintenance; however, $750,000 average for each of the 19 systems would cost $15 million.

* Expansion of sewer service area - to serve new residential or business customers. Due to population density requirements, major service area expansions are not anticipated except to serve industrial parks. Conservative estimates of costs for new service areas would be $1.75 million each for the larger systems except Florence and $1 million each for the smaller systems. Florence itself should undertake $25 million in service area expansion projects and new interceptors over the planning period. In total, nearly $65 million is needed for service area expansions.

* System interconnects and/or consolidations – with the exception of the City of Florence, few such regional treatment options are likely. Small consolidations of treatment are possible with Darlington to Florence, Latta to Dillon, etc. Over $25 million would be required for these major system interconnects, but some savings might occur with consolidated treatment. Net, at least $20 million would be needed.

* OVERALL, IDENTIFIABLE COSTS FOR SEWER TREATMENT, SERVICE AREA EXPANSION AND SYSTEM INTERCONNECTION/CONSOLIDATION SHOULD EXCEED $145 MILLION.

The Transportation System: The Region is served well by a system of interstate and US highways. Interstate 95 serves as a main street to the Pee Dee, bisecting the region through the Dillon and Florence areas. Interstate 20 also originates at I-95. These interstate routes enhance the Region's accessibility to regional and national markets, as well as port facilities in North and South Carolina. The network of US and SC highways that connect the Region to key urban centers, port facilities or recreation areas include the following:

* US 52: a two- and four-lane facility connecting to Charleston and its ports facilities and serving the northern industrial portions of the Region
* US 301: a mostly two-lane route that is now paralleled by Interstate 95
* US 76: a two- and four-lane facility traversing the Region East-West, a portion of which forms the highway corridor serving the Grand Strand.
* US 501: serving the eastern portion of the Region and forming part of the Beach corridor.
* US 15 and 401: two-lane North-South routes serving the Western half of the Region
* US 378: a two-lane route through the southern tip of the Region to the Grand Strand.

Several State highways also play a key role in connecting the Region to outside resources, including:

* SC 9 and 38: two-lane routes that are systematically being widened to four lane because of their value as strategic highways linking small urban centers to the Interstate system and their traditional role as alternate Beach routes to the-Grand

Strand

- SC 151, a two- and four-lane route connecting the Florence urban area to Charlotte

Improvements in several of these key highway corridors are either planned and/or critically needed.

Currently, those highway improvements funded and under design include those listed below. These funded roadway improvements are part of the State Transportation Improvement Program (STIP).

These funded roads were chosen primarily because they contribute to completion of major corridors or other critical improvements. Construction of these routes is being accelerated by means of a statewide roadway bonding program:

- Widening of US 15 on the southern edge of Hartsville
- Completion of a truck route around Cheraw
- Widening of the SC 9 Bypass around Bennettsville
- Widening of US 601 North of Pageland, part of the Florence to Charlotte corridor.
- Completion of the widening of SC 151 in Chesterfield County – completing the corridor
- Widening remaining segments of SC 38 in Marlboro, Dillon and Marion Counties
- Improving the SC 38 / I-95 interchange
- Widening US 378 from near Turbeville to Lake City, completing portions of the Grand Strand beach access corridor and providing four-lane access from Lake City to I-95.

These programmed improvements are illustrated in the attached Figure, along with existing four-lane routes and other corridors that are considered essential transportation corridors. Together, this system of four-lane highway routes is anticipated to serve the Region over the coming 25 years. These added routes (not currently funded) include the widening of:

- SC 9 from Pageland to Chesterfield,
- US 52 from Darlington to Cheraw,
- SC 51 from Florence to US 378,
- US 378 from Lake City eastward to Conway, and
- US 76 from I-95 to Sumter

FROM A COST PERSPECTIVE, THE "FUNDED" NETWORK OF SC 38, PORTIONS OF SC 9 AND US 378 AND PORTIONS OF US 52 WILL COST IN EXCESS OF $130 MILLION. TO COMPLETE THE REMAINING 25 ROUTE SEGMENTS IN THE ROADWAY PLAN WOULD REQUIRE AT LEAST $345 MILLION IN 2000 DOLLARS. FOR THE TREND SCENARIO, SOME OF THE RURAL ROUTES WOULD NOT BE NEEDED; THUS, ROADWAY NEEDS OF THE TREND CONCEPT COULD BE $400.

<u>Environmental</u>: Environmental considerations include energy consumption, air quality and water quality. Some of the factors can be quantified to a limited extent, but some subjective evaluation is required.

<u>Energy consumption</u>: During the transportation modeling process, estimates were made of vehicle miles traveled on the assumed roadway network in the region. The table below illustrates the results of the VMT and VHT (hours) and assumed speeds for each type of roadway in the highway network. Most importantly, these estimates provide a relative gauge of the travel times and miles for the trips generated by the development assumptions of <u>each</u> of the alternative development scenarios.

As can be seen in the comparison tables, VMT for the year 2025 is almost 30% higher than in 2000, putting additional burden on the region's roadways. There is little difference in VMTs between the scenarios, likely because the data control totals did not change, on the distribution patterns of development and trips. Nonetheless, it can be concluded that the Trend Scenario generates total VMT higher than the more efficient land development patterns of the Cluster Scenario, but less than the Scattered development Scenario.

From an energy consumption perspective, the total VMT for each alternative in the planning year produces the following energy requirements to meet transportation needs (in BTUs). The Trend Scenario is in the middle:

Relative Energy Consumption for Each Alternative (2025)

	TREND	SCATTERED	CLUSTERED
Total Million BTU's Consumed	**45,350**	**45,674**	**44,892**

Vehicle Miles Traveled For Base Year (2000)

FACILITY TYPE	VMT	VHT	SPEED
Freeway	2,070,017	30,139	68.7
Arterial	4,489,117	92,734	48.4
Collector	1,829,273	38,640	47.3
Local	1,221,561	27,102	45.1
Totals	**9,609,968**	**188,615**	**50.9**

Vehicle Miles Traveled For Trend Scenario

FACILITY TYPE	VMT	VHT	SPEED
Freeway	3,076,792	47,679	64.5
Arterial	5,685,473	121,028	47.0
Collector	2,278,542	50,128	45.5
Local	1,556,285	34,534	45.1
Totals	**12,597,092**	**253,369**	**49.7**

Vehicle Miles Traveled For Cluster Development Scenario

Facility Type	VMT	VHT	Speed
Freeway	3,068,423	47,502	64.6
Arterial	5,657,767	120,788	46.8
Collector	2,234,298	49,204	45.4
Local	1,510,172	33,507	45.1
Totals	**12,470,660**	**251,001**	**49.7**

Vehicle Miles Traveled For Scattered (Dispersed) Scenario

Facility Type	VMT	VHT	Speed
Freeway	3,057,280	47,274	64.7
Arterial	5,770,872	124,210	46.5
Collector	2,299,432	50,960	45.1
Local	1,559,722	34,610	45.1
Totals	**12,687,306**	**257,054**	**49.4**

Air Quality: Air emissions from highway travel are also a function of VMT, with the following relative results estimated by SCDOT. These results also place the trend Scenario in the middle in terms of impact. These results may seem superficial; however, the air quality monitoring station on the Darlington/Florence County border is expected to be in non-attainment in 2003, with potential development impacts as a result of air permits possibly being denied for some new facilities.

Relative Air Emissions (tons/day) for Each Alternative (2025)

	TREND	SCATTERED	CLUSTERED
VOC	**5.0**	**5.1**	**5.0**
CO	**103.4**	**103.8**	**102.3**
Nox	**5.6**	**5.7**	**5.6**

Water Quality: The region's water resources are, in limited circumstances, a source of domestic water supply, and each major tributary is critical to waste allocations from domestic and industrial sewer discharges. With the addition of non-point source discharges to streams from development activity, continued growth and development could have degrading effects on the regions water resources.

A detailed assessment of each sub-basin in the region was not possible for this analysis; however, such an assessment by the COG in 1996 provides sufficient background information related to development pressures on water resources to permit a county-by-county qualitative judgment of potential water quality impacts.

Relative Impacts of Alternative Development Patterns on Water Quality

COUNTY	WATER QUALITY IMPACT OF DEVELOPMENT		
	TREND	SCATTERED	CLUSTERED
Chesterfield	**1**	**2**	**1**
Darlington	**2**	**3**	**2**
Dillon	**1**	**2**	**1**
Florence	**2**	**3**	**2**
Marion	**2**	**3**	**1**
Marlboro	**1**	**2**	**1**
REGION	**9+**	**15**	**8**

Scale: 1-Mild Impacts 2-Moderate Impacts 3-Heavy Impacts

ALTHOUGH THIS IS A SUBJECTIVE EVALUATION, THE REGIONAL EFFECTS OF TREND DEVELOPMENT WILL BE MODERATE WATER QUALITY IMPACTS, WITH CLUSTERING OF DEVELOPMENT BEING MINIMALLY BETTER AND SCATTERED DEVELOPMENT PATTERNS CREATING SIGNIFICANTLY GREATER IMPACTS, PRIMARILY BECAUSE OF NON-POINT SOURCE IMPACTS OF DEVELOPMENT.

Alternate Development Scenario #1 - Dispersed Growth: The antithesis of Smart Growth, this alternative development scenario sees development scattered in all parts of the Region, with urban and rural portions seeing equal growth rates, though not necessarily equal growth in numbers.

Land Use: Existing urban areas and existing infrastructure are not necessarily the same magnets for growth and development as in the Trend Development concept; thus, efficiency in public services is reduced. Other development/infrastructure factors:

- There is a far more dispersed employment base due to a lack of planned industrial parks and as retail services go to where the more dispersed population is located.
- Somewhat less population growth is shown in traditional population corridors such as Florence-Darlington, with more growth in more rural counties. This scenario is somewhat counter-intuitive, but could be a realistic development option if rural water systems continue to grow as in the past.
- Industrial development is more dispersed, with less concentration in full-service parks.
- Water and sewer extensions continue at an accelerated rate in rural areas due to increased densities, but densities still do not approach those necessary for efficient operations.

- Transportation linkages within and between regions lags behind needed improvements as other routes are upgraded to serve more rural travel patterns. The core 4-lane network remains essentially that which existed at the end of the bonding program.

The following assessments of impacts are more abbreviated than the Trend Scenario, as the key issues and analysis techniques have already been explained.

Economic Development: The basic economic trends and assumptions reviewed under the Trend Scenario essential hold true for the Scattered or Dispersed Growth pattern, although there could be some limited difference in the <u>dispersion</u> of economic activity and resulting impact on the overall <u>level</u> of development activity. The limited effects could be:

- Commercial activity would be more dispersed in order to serve a more scattered population base. Economies of scale may preclude some vendors from locating in certain areas due to lower overall densities, with the possibility of less investment.

- Industrial investment would also be more dispersed. With fewer incentives to locate in industrial parks and other urban areas with proven utility availability, some investments may not materialize due to the increased burden of extending services to more remote locations.

The net effect of the Scattered development concept could be a minimal lessening of overall economic activity. If industrial investment is lessened by 10 percent due to infrastructure difficulties in rural locations and commercial development is lessened by 15 percent due to lessened population densities, the net effect could be a reduction of per-capita investment by business and industry to $1,350 per person per year, WITH A GROSS IMPACT OF $9.6 BILLION IN ECONOMIC INVESTMENT INSTEAD OF $11 BILLION. As with the Trend Scenario, there are numerous variables that could affect economic activity, but the scattered growth pattern could reduce such activity due to commercial and industrial location decisions.

Infrastructure: Under this development option, the effects on infrastructure needs could be mixed, as discussed below:

<u>Water Systems</u>: Water service by the 36 public systems would likely not grow as much under this development scenario, but service expansion in rural areas would be more expensive on a per-capita basis due to the density of development. While the Scattered development patterns would increase rural populations and increase demand in these more expensive areas.

From a capital improvements perspective, costs may be proportionately greater, as noted below:

- <u>Water supply improvements</u>:
    - Florence regional - 5 MGD - $10 million
    - Bennettsville impoundments – fewer wells – 1.5 MGD - $3 million

  - Hartsville urban area –fewer wells – 1.5 MGD for $1 million
  - Marion/Mullins – fewer wells - .75 MGD for $1 million
  - Dillon – fewer improvements - .75 MGD for $1 million.
  - Cheraw – smaller impoundment - .75 MGD for $1.5 million
  - Alligator Rural Water – the same raw water supply improvements - 1 MGD for $1.5 million
  - Other rural systems – significant supply increases of 8 MGD for $8 million

- Water treatment improvements; The miscellaneous improvement projects mentioned for the Trend scenario are still valid, with an increase to a total of $20 million due to the new emphasis on smaller rural systems.

- Water storage improvements – Water storage needs are similar to the Trend concept, with some increase – estimated at 18 MGD storage for $30 million, mostly in rural areas.

- Service area expansions – With fewer service area expansions in the more dense urban areas, service area expansions will take place in rural areas. Rural line extensions will be less expensive than urban, but greater distances will need to be covered. Overall costs will be somewhat higher, for a total of $20 million.

- Service upgrades - distribution system improvements, meter system upgrades and similar projects will be the same, with costs indeterminate.

- System inter-connects and/or consolidation – Similar to Trend Scenario, except that rural system have less access to large-scale water supply. An estimated $5 million will be necessary to ensure dependable supply to all systems.

- TOTAL IDENTIFIABLE WATER SYSTEM IMPROVEMENTS TO SERVE THE SCATTERED DEVELOPMENT SCENARIO EXCEED $102 MILLION.

- Sewer Systems: Unlike water, sewer service to rural areas to serve a more dispersed population will not be feasible. In comparison to the Trend concept, the following sewer needs to serve Scattered development are forecast:

  - Sewer treatment plant upgrades – With about 18 MGD capacity in existing systems and more of the growth shifting to rural, unserved areas, likely expansion projects will be somewhat less. The $20 million, 5 MGD upgrade of the Florence system would still be needed, but perhaps smaller upgrades for the Cheraw, Hartsville, Lake City, Johnsonville, Pamplico, Marion and Mullins facilities. Sometimes, "smaller" upgrades are not possible due to minimal equipment needs at facilities; however, some savings may be possible. The other system upgrades may cost only $20 million instead of $25, for a total of

$40 million when combined with the Florence upgrade.

- <u>Upgrades of other system elements</u> – with additional growth in the smaller systems, the $750,000 average for each of the 19 systems not identified above would still require over $15 million.

- <u>Expansion of sewer service area</u> - Extension of sewer to very rural areas will not be feasible, but some extensions in the larger urban areas and smaller communities will still be justified. Larger system expansions of $1.25 million each and $1.25 million each for the smaller systems will still require about $25 million in service area expansion projects and new interceptors over the planning period. In total, nearly $65 million would still be needed for service area expansions.

- <u>System interconnects and/or consolidations</u> – Interconnection of systems, joint treatment and other such projects are still viable even with more dispersed growth patterns. Thus, the same $20 million net costs would still be faced under this option.

- <u>OVERALL, IDENTIFIABLE COSTS FOR SEWER TREATMENT, SERVICE AREA EXPANSION AND SYSTEM INTERCONNECTION/CONSOLIDATION SHOULD EXCEED $145 MILLION, SLIGHTLY LESS THAN THE TREND ALTERNATIVE.</u>

<u>The Transportation System</u> - The existing road network and potential regional road widening priorities were reviewed under the Trend Scenario.

<u>FOR THE SCATTERED DEVELOPMENT SCENARIO, THE $130 MILLION IN BONDED ROADWAY IMPROVEMENTS WOULD STILL BE NEEDED, AND IT IS MORE LIKELY THAT ALL OF THE REMAINING $345 MILLION IN OTHER ROAD IMPROVEMENTS WILL BE REQUIRED DURING THE PLANNING PERIOD. THUS, HIGHWAY COSTS ARE LIKELY TO APPROACH $475 UNDER THIS DEVELOPMENT ALTERNATIVE.</u>

<u>Environmental</u>: The same three environmental considerations (energy consumption, air quality and water quality) are evaluated for this development alternative, as follows:

<u>Energy consumption</u>: The VMT tables for all development options presented under the Trend Scenario are valid here. From an energy consumption perspective, it is not surprising that the scattered development pattern consumes more energy due to the dispersed nature of population and jobs, with longer trips and more vehicle miles needed to satisfy trip demands of the population.

Relative Energy Consumption for Each Alternative (2025)

	TREND	SCATTERED	CLUSTERED
Total Million BTU's Consumed	**45,350**	**45,674**	**44,892**

Air Quality: As noted under the Trend scenario, air emissions of the Scattered development pattern have similar results as energy consumption, as they are based on the same VMT data. The results below indicate the Scattered growth pattern produces proportionately more air pollutants, although not dramatically so. Also as noted earlier, this could have significant impacts on regional air quality since portions of the region are already nearing non-attainment status.

Relative Air Emissions (tons/day) for Each Alternative (2025)

	TREND	SCATTERED	CLUSTERED
VOC	**5.0**	**5.1**	**5.0**
CO	**103.4**	**103.8**	**102.3**
Nox	**5.6**	**5.7**	**5.6**

Water Quality: Recapping the assessment of water quality impacts (primarily non-point source pollution from development), the chart below indicates that due to the development exposure of the regions water resources and the existence of two scenic rivers in the region, the Scattered Development concept could have dramatically greater impacts on water quality in the region.

Relative Impacts of Alternative Development Patterns on Water Quality

COUNTY	WATER QUALITY IMPACT OF DEVELOPMENT		
	TREND	SCATTERED	CLUSTERED
Chesterfield	**1**	**2**	**1**
Darlington	**2**	**3**	**2**
Dillon	**1**	**2**	**1**
Florence	**2**	**3**	**2**
Marion	**2**	**3**	**1**
Marlboro	**1**	**2**	**1**
REGION	**9+**	**15**	**8**

Scale: 1-Mild Impacts 2-Moderate Impacts 3-Heavy Impacts

THUS, THE SCATTERED DEVELOPMENT ALTERNATE WILL BE FAR WORSE THAN THE TREND.

Alternative #2 - Clustered Development: The opposite of Alternative Scenario #1 – Scattered Development, very limited growth is seen in rural areas and extended population and employment growth opportunities occur in major urban areas, particularly the Florence MPO, Cheraw/ Bennettsville, Dillon, Marion/Mullins, and Hartsville/Darlington. But Pageland, Chesterfield and other communities also see development.

While all of Smart Growth precepts are not adopted, development has been channeled to those areas with existing urban services and expanded infrastructure capacity, and at densities that can be efficiently serviced. Other factors:

- Transportation improvements have continued to focus on corridors that connect most of the urban centers, with increased regional connectivity and linkages between portions of the region... considerably beyond those roadways bonded.

- Water and sewer extensions have been limited to the immediate urban areas, and regional water and sewer treatment systems have merged to serve several areas.

As was true for the Scattered concept, the following assessments of impacts are more abbreviated than the Trend Scenario, as the key issues and analysis techniques have already been explained.

Economic Development: The basic economic trends and assumptions reviewed under the Trend Scenario also hold true here, except economic activity can be more concentrated. The effects could be:

- Commercial activity could more effectively serve a growing population... economies of scale would prevail, and perhaps additional commercial growth would be possible under this development concept since some retail outlets may be attracted to consolidated market data of several urban areas, especially in the Cheraw/Bennettsville, Marion/Mullins and Florence/Darlington/Hartsville corridors.

- Industrial investment could rise, as full-service industrial sites would be more readily available under this development concept. Added incentives to locate in industrial parks and other urban areas with proven utility availability should help spur additional opportunities.

The net effect of the more concentrated development pattern could be an increase in economic development activity. If industrial development increases only slightly and commercial expands by 10% over the Trend development scenario, the GROSS IMPACT COULD BE $11.5 BILLION IN ECONOMIC INVESTMENT INSTEAD OF $11 BILLION.

Infrastructure: Under this development option, the effects on infrastructure needs could also be mixed, as discussed below:

<u>Water Systems</u>: Most of the 36 public systems would not likely grow as much under this development scenario, but the larger urban systems could see considerable expansion. Urban service expansions would be more cost-effective, with a greater portion of the population served by public water.

From a capital improvements perspective, costs would be as follows:

- Water supply improvements:
    - Florence regional - 5 MGD - $10 million
    - Bennettsville impoundments & added wells – 3 MGD - $6 million
    - Hartsville urban area – more wells – 2.5 MGD for $2 million
    - Marion/Mullins – more wells – 1.5 MGD for $2.5 million
    - Dillon – more improvements – 1.5 MGD for $2 million.
    - Cheraw – larger impoundment – 1.5 MGD for $2.5 million
    - Alligator Rural Water – the same raw water supply improvements - 1 MGD for $1.5 million
    - Other rural systems – fewer increases of 4 MGD for $4 million

- Water treatment improvements; The miscellaneous improvement projects mentioned for the Trend scenario are still valid, with $500, 000 per system for $14 million.

- Water storage improvements – Water storage needs are similar to the Trend concept, with some increase – estimated at 18 MGD storage for $30 million, mostly in urban areas.

- Service area expansions – More service area expansion to serve a growing urban population will still be more cost-effective, with lower costs at $15 million.

- Service upgrades - distribution system improvements, meter system upgrades and similar projects will be the same, with costs indeterminate.

- System inter-connects and/or consolidation – Similar to Trend Scenario, with minimal costs.

- TOTAL IDENTIFIABLE WATER SYSTEM IMPROVEMENTS TO SERVE THE CLUSTERED DEVELOPMENT SCENARIO EXCEED $90 MILLION, SOMEWHAT HIGHER THAN THE TREND BUT LOWER THAN THE SCATTERED DEVELOPMENT CONCEPT.

- Sewer Systems: Like water, sewer service is more cost-effective in an urban environment, with a larger population served. In comparison to the Trend concept, the following sewer needs to serve Clustered development are forecast:

    - Sewer treatment plant upgrades – With about 18 MGD capacity in existing systems, urban growth will more likely consume this capacity, creating the need for additional treatment at larger systems. The $20 million, 5 MGD upgrade of the Florence system would still be needed, and the same or higher upgrades for the Cheraw, Hartsville, Lake City, Johnsonville, Pamplico, Marion and Mullins facilities. Overall, major plant expansions would be slightly higher than the Trend, about $50 when combined with the Florence upgrade.

- Upgrades of other system elements – few of the smaller systems would need expansion, with perhaps only $500,000 per system for a total of $10 million.

- Expansion of sewer service area - Extension of sewer to a growing urban population is very cost-effective when compared to the other scenarios. Larger system expansions would be perhaps $2 million each, plus $25 million for the Florence system. Small system service area expansion would be minimal. Overall, $40 million should cover the urban systems.

- System interconnects and/or consolidations – Interconnection of systems, joint treatment and other such projects are still viable and may have even more potential. Thus, perhaps $25 million in net costs would apply.

- OVERALL, IDENTIFIABLE COSTS FOR SEWER TREATMENT, SERVICE AREA EXPANSION AND SYSTEM INTERCONNECTION/CONSOLIDATION SHOULD EXCEED $125 MILLION, LESS THAN THE OTHER DEVELOPMENT ALTERNATIVES DUE TO COST-EFFECTIVENESS.

The Transportation System - The existing road network and potential regional road widening priorities were reviewed under the Trend Scenario.

FOR THE CLUSTERED DEVELOPMENT SCENARIO, THE $130 MILLION IN BONDED ROADWAY IMPROVEMENTS WOULD STILL BE NEEDED, AND PERHAPS SLIGHTLY LESS THAN THE TREND SCENARIO FOR OTHER IMPROVEMENTS DUE TO THE CONCENTRATION OF POPULATION IN URBAN CORRIDORS, MOST OF WHICH ARE ALREADY SERVED BY FOUR-LANE ACCESS. IN TOTAL, ROADWAY IMPROVEMENTS MAY REQUIRE $350 MILLION.

Environmental: The same three environmental considerations (energy consumption, air quality and water quality) are evaluated for this development alternative, as follows:

Energy consumption: The VMT tables for all development options presented under the Trend Scenario are valid here. From an energy consumption perspective, it is not surprising that the Clustered development pattern consumes somewhat less energy due to the more concentrated nature of development and activity generators... thus less VMT and less energy consumed.

Relative Energy Consumption for Each Alternative (2025)

	TREND	SCATTERED	CLUSTERED
Total Million BTU's Consumed	**45,350**	**45,674**	**44,892**

Air Quality: As noted under the Trend scenario, air emissions of the Clustered development pattern have similar results as energy consumption, as they are based on the same VMT data. The results below indicate the Clustered growth pattern produces proportionately LESS air pollutants, although not dramatically so. Also as noted earlier, this may have positive impacts on air quality conditions particularly in Florence and Darlington Counties, where these results and other efforts may keep the area from becoming non-attainment (though positive effects of the new growth pattern would be a long time coming).

Relative Air Emissions (tons/day) for Each Alternative (2025)

	TREND	SCATTERED	CLUSTERED
VOC	5.0	5.1	5.0
CO	103.4	103.8	102.3
Nox	5.6	5.7	5.6

Water Quality: Recapping the assessment of water quality impacts (primarily non-point source pollution from development), the chart below indicates that due to the ability of urban areas to better manage non-point source discharges, the Clustered Development concept could at least curtail water quality degradation.

Relative Impacts of Alternative Development Patterns on Water Quality

COUNTY	WATER QUALITY IMPACT OF DEVELOPMENT		
	TREND	SCATTERED	CLUSTERED
Chesterfield	1	2	1
Darlington	2	3	2
Dillon	1	2	1
Florence	2	3	2
Marion	2	3	1
Marlboro	1	2	1
REGION	9+	15	8

Scale: 1-Mild Impacts 2-Moderate Impacts 3-Heavy Impacts

THUS, THE SCATTERED DEVELOPMENT ALTERNATE WILL BE FAR WORSE.

SUMMARY OF EVALUATION CRITERIA AND ALTERNATIVE IMPACTS

In the preceding discussions, each of the Trend and development alternatives have been discussed and the relative impacts, costs and economic benefits have been quantified to the extent feasible. The chart below is intended to summarize the criteria and these impacts in as concise a form as possible.

Summary of Relative Impacts of Alternative Development Patterns

CRITERIA	DEVELOPMENT SCENARIO		
	TREND	SCATTERED	CLUSTERED
Economic Impact of Dev.	$11 B	$9.6 B	$11.5 B
Water Infrastructure Costs	$80 M	$102 M	$90 M
Sewer infrastructure Costs	$145 M	$145 M	$125 M
Transportation Costs	$400 M	$475 M	$350
Energy Consumption	45.4 M BTUs	45.7 M BTUs	44.9 M BTUs
VOC Emissions	5.0 tons/day	5.1 tons/day	5.0 tons/day
CO Emissions	103.4 tons/day	103.8 tons/day	102.3 tons/day
Nox Emissions	5.6 tons/day	5.7 tons/day	5.6 tons/day
Water Quality Impacts	Moderate	Heavy	Moderate

OVERALL, THE CLUSTERED DEVELOPMENT CONCEPT HAS MODERATE ADVANTAGES IN TERMS OF ECONOMIC IMPACT, LOWER OVER INFRASTRUCTURE COSTS, SLIGHTLY LESS ENERGY CONSUMPTION, SLIGHTLY LESS AIR EMISSIONS, AND COULD BE KINDER TO WATER QUALITY DUE TO MANAGEMENT OF NON-POINT SOURCE POLLUTION.

III. OVERVIEW OF THE FIVE STATEWIDE PLANS

Five regional and/or statewide plans have been reviewed, particularly with regard to policies that may be affected by alternate development scenarios. The geographic scope of the plans vary: several have more of a regional focus; one is oriented to non-metro portions of the State; and several are statewide in coverage. The plans include:

1. Pee Dee Regional Multi-Modal Transportation Plan (Regional)
2. Comprehensive Economic Development Strategy (CEDS) (Regional)
3. The 2002 State Energy Action Plan (Statewide)
4. State Infrastructure Plan - Water And Wastewater Element (Statewide)
5. The 208 Water Quality Management Plan for The Non-Designated Area Of South Carolina (Portion of State)

Again, several of the regional plans have more specificity to Pee Dee growth and infrastructure issues and are discussed in more detail here.

PEE DEE REGIONAL MULTI-MODAL TRANSPORTATION PLAN: This Plan was completed in 2002 and is a regional plan that also addresses issues that are important to the State as a whole. The Plan provides analyses and guidance in developing an interconnected, multi-modal transportation system that will meet the needs of the Region in the future. It covers various aspects of transportation infrastructure, including roadways, transit, airports, rail, ports, bike/pedestrian and multi-modal facilities. Several elements have a detailed statewide element referenced, while others, particularly roadways, are analyzed in more detail. Key aspects of the Plan include issues such as:

- Rural and urban issues (dominance of Florence-Darlington-Hartsville area)
- Environmental conditions (forests, wetlands, scenic rivers, historic).
- Transit limitations of rural densities in the region,
- Gaps in the regional four-lane highway network,
- Heavy traffic corridors, especially Beach corridors and commuter routes,
- Traffic forecasts, the status of 50 roadway projects proposed, high accident locations, emergency evacuation routes (hurricane/nuclear),
- PDRTA transit services, proposed Inter-modal centers, passenger and freight rail service, high-speed passenger rail proposals,
- Access to the State's three ports,
- Local character of bike and pedestrian facilities, statewide trail proposals,
- Public safety issues (high accident locations and deficient bridges), and
- Connectivity to other Regions.

The Inter-Modal Plan examines the above issues and provides a series of policy recommendations and specific improvement projects. These recommendations provide a broad framework for meeting transportation needs in the near future.

These recommendations are multi-modal and inter-modal in scope, and include:

- Filling major gaps in the regional system of four-lane highways.
- Expansion of fixed route transit service in the Region and targeting transit to the most distressed areas of the Region.
- Transit linkage with nearby Regions, particularly to key labor markets.
- Development of Inter-modal centers
- Protecting major environmental resources and neighborhoods
- Utilizing abandoned rail lines and public lands as trail options.
- Expanded facilities and services at the Florence Regional Airport.
- Rail commuter service to other labor markets and support of high-speed rail proposals.
- Others.

PEE DEE REGIONAL COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY (CEDS): This is a regional economic policies document required by the Economic Development Administration (EDA) in order for communities in the six counties to be eligible for EDA infrastructure investments. Specifically, the CEDS document provides an in-depth socio-economic analysis, identifies problems and opportunities, defines a vision, provides strategies, establishes and coordinates implementation actions for at least a three year period, and provides a means of evaluating and updating the CEDS process. It has no legislative authority, but provides a policy framework for public action.

Regional constraints and opportunities highlighted in the CEDS include the following:

Opportunities: A favorable climate, good location, interstate access, prime farmlands, diversified manufacturing base, new industries, new industrial parks/sites, available industrial buildings, regional air facilities, abundant water resources, extensive historic resources, technical and higher education facilities, a good work ethic, a coordinated system of economic allies and excellent health care systems, among others.

Constraints: Limited local financial and staff resources, low incomes, high poverty, poor four-lane access from some communities to the interstate, inadequate infrastructure, reliability/availability of water supply, slow population growth, air service limitations and cost, workforce illiteracy, poor education levels, low skills, lack of marketing data, poor living conditions, poor soil conditions, and political divisiveness, among others.

Goals and strategies outlined in the CEDS address wide-ranging issues, including:

- Sound economic and community planning and technical assistance for local governments, including: region-wide economic and strategic planning, well-planned communities, and technical assistance.

- Regional partnerships in economic development, infrastructure and related issues, including support of marketing/promotional organizations.

- More diverse economic growth in all sectors, including: diversification (particularly agriculture), tourism/“heritage” corridors.

- Enhanced infrastructure, adequate to serve the current and future needs of business/industry and the population, including: timely utilities to economic corridors and new business, expansion/consolidation of water and sewer supply/treatment/distribution where feasible, improving highways, improving air service, and communications technologies.

- A greater number of well-planned, full service industrial sites in the region, including: use of public-private partnerships and multi-county consortiums, proper planning of the parks, and priority infrastructure availability, etc.

- Coordinated, multi-jurisdictional, efficient approaches to local problem-solving and services delivery, including: intergovernmental approaches, recognition of regional impacts of investment, multi-county industrial parks, and reducing duplication of effort.

- Readily available data for research and problem-solving, including: development of timely demographic, marketing and infrastructure data.

- Adequate industrial development resources available to local governments, including: an adequate and varied supply of available industrial buildings and industrial parks, using public/private partnerships.

- Aggressive, but wise, use of the region's resources, including: wise economic and recreational use of the Pee Dee and other rivers, development in concert with sensitive resources, and smart growth efforts.

- Well-informed local officials, including: increased awareness of issues and the professional training for elected officials and E.D. professionals.

- Capable, educated, well-trained workforce, including diversified technical training/retraining, expansion/updating of higher education facilities, and improved education in the workforce.

- Availability of adequate and affordable financial resources for business development, including; increased use of public sector loan programs to provide "gap" financing (including COG RLF program).

- Reduced human distress in the region's neighborhoods, including: improving living conditions (housing, incomes, facilities and services), job opportunities, and targeted assistance to areas in economic distress.

- Allocation of resources to the most critical geographic areas and problems

- Attention to the infrastructure and training needs of existing industries.

THE 2002 STATE ENERGY ACTION PLAN: The South Carolina Energy Office (SCEO) offers an annual action agenda for each fiscal year that is designed to promote energy efficiency in all sectors of the State economy. The Action Plan:

- Summarizes historical energy use patterns in South Carolina,
- Sets energy consumption goals for a ten-year period, and,
- Offers broad plans, activities and strategies to meet the consumption goals

Among the policies and goals are:

- Energy conservation,
- Carpooling
- Reduced gas consumption
- Resulting reductions in emissions from vehicles and fossil fuel plants.

STATE INFRASTRUCTURE PLAN: The Water and Wastewater Element of the State Infrastructure Plan was prepared in 2000 by the Division of Regional Development, SC State Budget and Control Board in conjunction with the ten regional councils of government. It is the only comprehensive assessment of regional and statewide water and wastewater infrastructure development needs in the State.

The Plan includes:

- Regional recommendations and project priorities
- Statewide objectives for infrastructure development and allocating increasingly scarce resources in order to sustain economic expansion
- Public policy discussions that provide regional and State decision-makers and the public with information on balancing long-term infrastructure development needs with the conservation of environmental quality and the public health.

Relevant policy guidance includes:

- Having infrastructure be proactive, helping to guide development rather than reacting to it. This will require competent long-range development planning and capital improvements programming.
- Protecting water sources and meeting DHEC water quality limits through appropriate system upgrades in a timely manner.
- Development of regional systems when feasible by system interconnects and consolidation, thus being more cost effective.
- Accommodating economic development needs through extensions and expansions.

The Plan addresses the enormous and expanding wastewater system needs, including current and past due needs, system expansion requirements to accommodate growth and development, and maintenance and operation needs. As noted above, the Plan addresses some practical means of keeping abreast of water and wastewater needs to serve the economic needs of the State without sacrificing environmental priorities.

For the Pee Dee, water needs to catch up and provide for anticipated growth are estimated to be $121 million, an astounding cost considering the regional economy. Sewer needs total $237 million, with even worse prospects for funding.

As a final matter, priority projects for the Pee Dee include the following, although a priority list produced for 2003 would look significantly different:

Water Projects:

Britton's Neck Line Extensions	$ 688,000
Bennettsville Water Main	$8,122,000 (Alt. Proj. complete)
Johnsonville-Hemingway Water Main	$ 232,000 (Underway)

Sewer Projects:

Pamplico/SC 51 Line Ext.	$ 497,930
Darlington WWTP Upgrade	$2,713,770
Latta WWTP Upgrade	$1,090,000 (complete)

THE 208 WATER QUALITY MANAGEMENT PLAN FOR THE NON-DESIGNATED AREA OF SOUTH CAROLINA: The Plan is a portion of South Carolina's response to congressional mandates in Section 208 of the Clean Water Act to address the cleanup of the nation's waterways. The legislation encourages the development and implementation of area-wide wastewater treatment management plans and required the Governor to identify areas with water quality issues and designate "management agencies" that could develop area-wide plans.

In 1975, South Carolina designated five COG areas of the State as such planning agencies where urban development, industrial development or other considerations exacerbated water quality problems. The remaining 26 counties were "non-designated" and were placed under the jurisdiction of the South Carolina Department of Health and Environmental Control (DHEC). This non-designated area includes the Pee Dee COG's six counties. While the Pee Dee Region has a metropolitan "core" and significant industrial development and a major river system, the six counties remain under DHEC.

As the planning agency for the Pee Dee and other portions of the State, DHEC prepares a water quality management plan that covers the area.

The critical policy associated with the Plan is that waters not be degraded by point or non-point sources of pollution. Development has significant impacts on non-point source pollution, particularly related to impervious surfaces and the often-contaminated runoff from those surfaces. The second major issue, of course, deals with point source pollution from treatment facilities, including the ever-changing limits placed on discharges from facilities.

IV. IMPACT OF ALTERNATIVE DEVELOPMENT SCENARIOS ON STATE AND REGIONAL PLANS

An assessment of the impacts on the various plans is a somewhat artful process, as most of the plans are policy oriented. Nonetheless, some broad conclusions regarding the relative degree to which the scenarios are compatible with or counter-productive to the public policies is possible.

IMPACTS OF TREND DEVELOPMENT:

The Trend development concept extends past growth in mostly urban areas, with less growth in most rural areas. Impacts on each plan are as follows:

PEE DEE REGIONAL MULTI-MODAL TRANSPORTATION PLAN: This development concept is generally compatible with and supportive of the Multi-modal plan, as follows:

a) Key policies and projects affected by Trend Development include:

   i. Policy: Filling major gaps in the regional system of four-lane highways by expanding regional access corridors.

   ii. Policy: Expansion of fixed route transit.

   iii. Policy: Development of inter-modal centers.

   iv. Theme: Protecting environmental resources.

   v. Policy: Expanded commuter rail service.

   vi. Projects: widening of SC 38 corridor, widening of US 52 corridor, widening of US 378 corridor, widening of SC 51 corridor, widening of US 76 corridor, widening of SC 9 corridor, widening of other local routes to accommodate local traffic.

b) Compatibility: The development patterns are generally compatible with the major policies and themes in the Plan as well as the recommended roadway improvement priorities except for the widening of local routes. Key thoughts and considerations:

   i. The Trend concept anticipates the major urban areas continuing to grow, with pressure on regional routes rather than local roads or those routes connecting only rural communities. This supports the concept of improving regional corridors rather than small segments of highways with only local impacts.

   ii. Depending on the results of regional transportation modeling (unavailable at the time of this assessment) several segments of regional roadways specifically identified above will not be critically important, but the vast majority will be.

iii. From a transit perspective, the continued expansion of several urban areas and corridors, particularly Florence-Darlington-Hartsville and Cheraw-Bennettsville, will increase densities and make expanded transit services more feasible.

iv. The Trend concept is generally supportive of environmental conservation due to more concentrated development.

c) Inconsistencies: As noted above, the Trend concept has few major inconsistencies with policies and plans except for the improvement of more rural access routes.

d) Barriers to Compatibility: Barriers are relatively few, and most may be incapable of being resolved:

i. There are certainly financial constraints to the implementation of the specific improvements in the Plan. The bonding program has accelerated construction and completion of priority projects in the Plan, but will accomplish only about 20 percent of major roadway needs in the Region.

ii. Although the Plan has few specific transit recommendations, financing of proposed fixed routes, inter-modal facilities and other improvements will be extremely difficult without an additional revenue stream dedicated to such projects. Meeting "improved transit" policy goals will certainly be difficult as well.

iii. Finally, the political cost of making logical and justified decisions regarding roadway improvements can be considerable. Within the Region, the bonding program improvements survived the test of fire by developing a "corridor" improvement rationale that worked. The regional transportation modeling may help continue this success.

e) Strategies to Overcome Barriers: Of course, additional funding can solve some difficulties with fully implementing the Plan, but it is inconceivable that even half of needed improvements will be funded under ANY financial circumstance; the need is just too large, with major-league catching up required. Regarding political influences, it is again pointed out that completion of the modeling may help the process "stay the course".

f) Recommendations for Plan Modification: Except for the use of modeling in the next five-year update of the Plan, no recommendations are offered.

PEE DEE REGIONAL COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY (CEDS): This Trend pattern is generally compatible with and supportive of the Plan, as follows:

a) Key policies and projects affected by Trend Development include:

   i. Policy: Regional partnerships in economic development and infrastructure.

   ii. Policy: Enhanced infrastructure, adequate to serve the current and future needs of both business/industry and the region's population,

   iii. Policy: A greater number of well-planned, full service industrial sites in the region,

   iv. Theme: Aggressive, but wise, use of resources,

   v. Policy: Capable, educated, well-trained workforce.

   vi. Policy: Allocation of resources to the most critical geographic areas and problems.

   vii. Policy: Attention to the infrastructure needs of existing industries.

   viii. Projects: None recommended.

b. Compatibility: The development concept and the Plan are generally compatible. Key thoughts and considerations:

   i. By forecasting the major urban corridors to grow, the Trend concept will be able to support most of the policies regarding servicing the infrastructure needs of public industrial sites, major industrial corridors and major existing industries. (There may some existing industries that cannot be served unless major water/sewer extensions are made.)

   ii. By development being concentrated, the Trend concept also makes wiser use of resources, financial and otherwise. The Trend concept is generally supportive of environmental conservation due to more concentrated development.

   iii. The Trend concept does not necessarily limit excessive sprawl, but it does indicate development will be relatively concentrated in key corridors, thus permitting more intergovernmental cooperation and even consolidation of services.

c. Inconsistencies: There are no major inconsistencies.

d. Barriers to Compatibility: Barriers are relatively few, primarily financial in nature. There may be some financial constraints to the provision of adequate infrastructure to industrial corridors and sites, but the concentration of development in several major growth corridors will make the expenditures more cost-effective. In addition, the political will to consolidate services and be more efficient is sometimes not there.

e. Strategies to Overcome Barriers: The development of in-state financial resources to address major infrastructure improvements and serve the key economic development corridors suggested by the CEDS is not likely available. It is noted that a "Crescent Authority" has been suggested as a federal initiative for the coastal plains of eight states. Although federal funding is also problematic, strategies should be developed regarding the funding of such a federal commission.

f. Recommendations for Plan Modification: Except for additional credence being given to a federal commission that would include the Pee Dee Region of South Carolina, no recommendations are offered.

THE 2002 STATE ENERGY ACTION PLAN: The broad goals and policy framework of the Plan can be addressed in a straightforward manner.

b) Key policies affected by Trend Development include:
   i. Policy: energy conservation, including reduced gas consumption through carpooling, etc.
   ii. Policy: reductions in emissions from vehicles and fossil fuel plants.
   iii. Projects: No relevant projects recommended.

c) Compatibility: The Plan is generally compatible with the major policies and themes in the Plan. Key thoughts and considerations:
   i. The semi-concentrated development pattern limits to some extent overall trip generation, certainly more so than more rural development concepts.
   ii. The urban corridor pattern of the Trend concept also makes transit more feasible, with fewer emissions and reduced energy consumption.

d) Inconsistencies: There are no major inconsistencies except for the modest level of scattered rural development, which consumes more energy for work and shopping trips.

e) Barriers to Compatibility: Rural development could lessen compatibility by increasing the number and length of trips and thus energy consumption.

f) Strategies to Overcome Barriers: Aside from land development regulations and market forces related to gas prices, few strategies are available. Zoning and subdivision standards are likely ineffective in influencing energy consumption in a rural environment, however. In urban portions of the region, smart growth concepts can be somewhat effective in reducing trip generation and length.

g) Recommendations for Plan Modification: No recommendations are offered.

STATE INFRASTRUCTURE PLAN: The assessment of infrastructure plan impacts is as follows:

a) Key policies affected by Trend Development include:

   i. Policy: Having infrastructure be proactive, helping to guide development rather than reacting to it. (This will require competent long-range development planning and capital improvements programming such that infrastructure is ready before or when it is needed.)

   ii. Policy: Meeting DHEC water quality limits through appropriate system upgrades in a timely manner.

   iii. Policy: Development of regional systems when feasible by system interconnects and consolidation.

   iv. Policy: Providing appropriate funding mechanisms that can provide alternative financing for needed improvements.

   v. Projects: In addition to projects listed in the Plan, the following projects are illustrative of those needed to accommodate the development forecasted:

WATER:	
Pageland water supply:	$ 1,000,000
Chesterfield impoundment;	$ 600,000
Bennettsville wells/treatment	$ 1,200,000
Johnsonville wells/tanks:	$ 1,800,000
SEWER:	
Hartsville WWTP Upgrade:	$ 3,000,000
Florence Regional Sewer Plant:	$20,000,000
Pamplico WWTP plant:	$ 2,500,000
Latta WWTP plant upgrade:	$ 500,000

b) Compatibility: The development concept is generally compatible with the major policies in the Plan. The large number of utility providers in the region, however, creates a "critical mass" that resists change, either through upgrading, consolidation or other progressive means. The smaller systems have extreme difficulty in upgrading their system; thus, many systems seem to lurch from one problem to the next, depending on increasingly elusive grant funds. The semi-concentrated development pattern lends itself to consolidation or interconnect of systems, thus leading to economies of scale, consolidation of dischargers, reducing problem dischargers and providing fewer facilities with a greater capability to plan ahead for infrastructure needs. The potentially larger systems would have greater financial capability to keep ahead of development.

c) Inconsistencies: There are no major inconsistencies except for the modest level of scattered rural development which encourages the continuation of some marginal systems with no real ability to keep up with the changing needs of their systems, much less plan ahead.

d) Barriers to Compatibility: Rural development can lessen compatibility, again by encouraging small systems that are really marginal at best.

e) Strategies to Overcome Barriers: Of course, money, and lots of it, could solve some of the problems with systems. Still, the resources necessary to put so many systems in a financial and operational condition such that they can respond quickly and effectively to development needs will be elusive. Nevertheless, a multi-agency, multi-level approach to system financing would help.

f) Recommendations for Plan Modification: The State Plan was originally intended to be, in part, a catalyst for additional funding from State sources. Though that effort was not successful, revisions to the Plan could address other possible funding strategies. Although it is obvious that State budget issues will complicate such efforts for the foreseeable future, problems with system capacities and limits will only worsen.

THE 208 WATER QUALITY MANAGEMENT PLAN FOR THE NON-DESIGNATED AREA OF SOUTH CAROLINA: The assessment of infrastructure plan impacts is as follows:

a) Key policies affected by Trend Development include:
   i. Policy: Minimize degradation of waters by controlling point discharges.

   ii. Policy: minimize degradation of waters by appropriate management of non-point discharges.

   iii. As an additional consideration, at least one major regional water project has placed additional demands on surface water resources. A 10 MGD surface water plant recently completed by the City of Florence on the Pee Dee has the potential to affect sewer discharges in the future.

   iv. Projects: To ensure improvements to water quality while accommodating anticipated growth, potential expansion/upgrade or alternate discharges for several systems would be required:
      1. City of Florence regional system – expand by 15 MGD+
      2. City of Johnsonville (near construction) – expand 1.5 MGD
      3. City of Hartsville – expand by 2.0 MGD+
      4. Town of Pamplico – 300,000 gal
      5. Town of Latta – 200,000 gal

In addition to these communities that need expansions to accommodate mid-term growth, virtually every system in the region needs improvements in order to accommodate growth over the next 25 years. There is at least one system, in Sellers, that needs total replacement or connection elsewhere.

b) Compatibility: The Plan is generally compatible with the major policies and projects in the Plan or deemed necessary to accommodate the growth associated with the development concept.

c) Inconsistencies: There are no major inconsistencies except for the scattered rural development, which will put pressure on small systems incapable of meeting new limits or accommodating sewer discharges from development.

d) Barriers to Compatibility: Rural development can lessen compatibility due to the stated reasons.

e) Strategies to Overcome Barriers: None suggested other than cooperative efforts between systems and increased funding for upgrades.

f) Recommendations for Plan Modification: No recommendations are offered.

IMPACTS OF ALTERNATE #1 - DISPERSED GROWTH SCENARIO

This concept is the antithesis of Smart Growth, with development scattered in all parts of the Region, with urban and rural portions seeing equal growth rates, though not necessarily equal growth in numbers. Existing urban areas and existing infrastructure are not necessarily the same magnets for growth and development as in the Trend Development concept; thus, efficiency in public services is reduced. Impacts of this scenario on the various State and regional plans include:

PEE DEE REGIONAL MULTI-MODAL TRANSPORTATION PLAN: This regional plan is generally at odds with the Dispersed Growth scenario, as follows:

a) Key policies and projects:
   i. Policies: The same policies listed under Trend Development
   ii. Projects: The same projects listed under Trend Development.

b) Compatibility: The Plan is generally incompatible with the major policies and themes in the Plan, in that the development scenario scatters people and jobs, thus making roadway improvements less effective and public transit for difficult. Key thoughts and considerations:
   i. The development concept will logically put emphasis on local and county road improvements serving a scattered population and job base, not regional movement of people and goods.

ii. The impact on traffic volumes and levels of service on the regional roadway system can be judged after transportation modeling is completed.
iii. Expanded transit serve is less feasible with this development scenario, since people are more scattered.
iv. The scattered growth may increase the number of trips and thus emissions. In addition, development will scatter non-point source pollution in rural areas, increasing the likelihood of degradation of regional waterways, albeit in relatively small increments.

c) Inconsistencies: As noted above, the scattered development concept is counter-productive to regional access policies and increased use of transit and could increase emissions and have some degrading effects on rural water quality.

d) Barriers to Compatibility: Barriers are readily apparent and are mostly insurmountable.
   i. Once the development pattern becomes even more scattered, the region is caught on the slippery slope. Even if the direction of development changes at a later date, the increased rural densities will forever be a magnet for at least some additional growth and will require access.
   ii. In addition, investment in rural roadways is a sunk cost, serving relatively limited populations and requiring maintenance on an ongoing basis.
   iii. The scattered population will hinder transit expansion.

e) Strategies to Overcome Barriers: As noted in other discussions, the availability of additional funding could help remove barriers and accommodate the inefficient development patterns. But, that is not likely. This would be especially devastating on transit service, which depends on density to be cost-effective.

f) Recommendations for Plan Modification: Except for the use of modeling in the next five-year update of the Plan, no recommendations are offered.

PEE DEE REGIONAL COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY (CEDS): This development concept is only moderately consistent with the Plan, in that some policies related to infrastructure will be more costly to implement:

a) Key policies and projects affected by Trend Development include:
   i. Policies: The same policies considered relevant in the Trend Development discussions.
   ii. Projects: None recommended.

b) Compatibility: The development concept is sometimes compatible with the major policies and themes in the Plan, although service deliver to some economic growth in scattered areas will be difficult and more costly: Key thoughts and considerations:

i. Provision of infrastructure to serve the population and new industry will be more costly in scattered locations. If employment, new industries and other economic activity is scattered, extending services to more remote locations will be expensive.
ii. In addition to cost, there may be some economic activity that cannot be served with infrastructure. The impact on the development is unknown, although lack of services may eliminate the investment opportunity or make the operation more tenuous.
iii. Scattering development can certainly lead to inefficient use of resources, financial and otherwise.
iv. The development concept is less supportive of environmental conservation.

c) Inconsistencies: Inconsistencies are adequately discussed above.

d) Barriers to Compatibility: Barriers are significant. Serving scattered development, particularly economic investment by new industry, could be prohibitively expensive and is a primary concern. Public funds and system operating funds cannot long serve disparate locations. Unfortunately, the inability of the service providers to give quality, cost-effective utility serve may dry up economic investment in rural areas. This may restrict investment to the more urban areas, with long commutes for those who have located in the hinterlands.

e) Strategies to Overcome Barriers: Although outside funding by State or federal agencies, even with new federal initiatives such as a "Crescent Authority", could provide some financial resources for infrastructure in support of economic development, the new initiatives will want to invest in cost-effective services delivery.

f) Recommendations for Plan Modification: Except for additional credence being given to a federal commission that would include the Pee Dee Region of South Carolina, no recommendations are offered.

THE 2002 STATE ENERGY ACTION PLAN: The broad goals and policy framework of the Plan can be addressed in a straightforward manner.

a) Key policies affected by development include:
   i. Policies: The same as considered relevant for the Trend development.
   ii. Projects: No relevant projects recommended.

b) Compatibility: The Plan is mostly incompatible with a scattered development pattern. Key thoughts and considerations:
   i. The scattered development pattern leads to increased trip generation and thus increased energy consumption.

ii. Transit is less feasible with scattered development, with the likelihood of increased trips and increased energy consumption.
iii. The level of impacts may be clearer about transportation modeling is completed.

c) Inconsistencies: There are major inconsistencies in the concepts of scattered development patterns and energy conservation, as noted above.

d) Barriers to Compatibility: Once scattered development patterns are established, there will be major barriers to conservation. Without transit densities, auto trips and trip length will remain high, as will energy consumption.

e) Strategies to Overcome Barriers: Aside from land development regulations and market forces related to gas prices, few strategies are available to alter such development trends.

f) Recommendations for Plan Modification: No recommendations.

STATE INFRASTRUCTURE PLAN: The assessment of infrastructure plan impacts is as follows:

a) Key policies affected by Trend Development include:
i. Policies: The same policies considered relevant under the Trend development discussions.
ii. Projects: Aside from the larger projects identified for urban areas, a scattered development pattern will require expansion of smaller, more rural systems. In addition to those water and sewer projects listed in the discussion of the Trend development scenario, the following order-of-magnitude estimates are offered:

WATER:
8 additional system expansions: $ 6,000,000
SEWER:
8 additional system upgrade/exp: $ 6,500,000

Reference is made to the more complete tally of regional water and sewer needs in the infrastructure plan, with hundreds of millions in needs to accommodate growth and "catch up" on system deficiencies. Such estimates will more likely be the case if scattered development is the rule.

b) Compatibility: The development concept is mostly inconsistent with the policies in the Plan, for the same reasons as enumerated under the CEDS Plan. Provision of water and sewer service serving the resident population and new economic investment will be more difficult and more expensive due to lower densities. As noted earlier, some critical infrastructure service may not even be possible due to cost considerations. Smaller will have more difficulty in upgrading their systems due to their financial limitations.

c) Inconsistencies: As can be surmised from the discussion above, the scattered development scenario is inconsistent with provision of water and sewer infrastructure in a timely and cost-effective manner. Nothing can change that.

d) Barriers to Compatibility: Economies of scale and financial ability are the two major barriers; neither can be easily overcome.

e) Strategies to Overcome Barriers: As noted earlier, money, and lots of it, could solve some of the problems with rural-dominated systems. Still, the resources necessary to put so many systems in a financial and operational condition such that they can respond quickly and effectively to development needs will be elusive. Consolidation of some of the smaller systems, joint service agreements, interconnected systems, consolidation of supply and/or treatment.... All of these may make the smaller rural systems somewhat more efficient; but these efforts may not be enough.

f) Recommendations for Plan Modification: As noted earlier, a more financially focused Plan may help, but currently there are no magic funding bullets to put forth.

THE 208 WATER QUALITY MANAGEMENT PLAN FOR THE NON-DESIGNATED AREA OF SOUTH CAROLINA: The assessment of impacts of the scattered development scenario on this Plan is as follows:

a) Key policies affected include:
   i. Policies: The same as for the Trend development scenario
   ii. Projects: The same as for the Trend development scenario.

b) Compatibility: The development concept is somewhat inconsistent with the Plan, in that smaller systems will feel the brunt of development and are least able to meet SC DHEC water quality limits at treatment plants.

c) Inconsistencies: Scattered rural development will put pressure on small systems incapable of meeting new limits or accommodating sewer discharges from development. In addition, non-point source impacts will be more scattered and more difficult to deal with.

d) Barriers to Compatibility: See above.

e) Strategies to Overcome Barriers: None suggested except for possible consolidation of systems.

f) Recommendations for Plan Modification: No recommendations are offered.

IMPACTS OF ALTERNATIVE #2 – CLUSTERED DEVELOPMENT:

As a reminder of this development concept, it has very limited growth in rural areas and extended population and employment growth opportunities occurring in major urban areas, particularly the Florence MPO, Cheraw/ Bennettsville, Dillon, Marion/Mullins, and Hartsville/Darlington. But Pageland, Chesterfield and other communities also see development. While all of Smart Growth precepts are not adopted, development has been channeled to those areas with existing urban services and expanded infrastructure capacity, and at densities that can be efficiently serviced.

PEE DEE REGIONAL MULTI-MODAL TRANSPORTATION PLAN: This development concept is generally compatible with and supportive of the Multi-Modal Plan, as follows:

a. Key policies and projects affected:
   i. Policies: The same as considered relevant for the other scenarios.
   ii. Projects: The same as for the other scenarios.

b. Compatibility: The development concept is quite compatible with the major policies and themes in the Plan as well as the recommended roadway improvement priorities except for the widening of local routes. Key thoughts and considerations:
   i. The development concept anticipates the major urban areas continuing to grow, with pressure on regional routes rather than local roads or those routes connecting only rural communities. This supports the concept of improving regional corridors.
   ii. Depending on the results of regional transportation modeling (unavailable at the time of this assessment) several segments of regional roadways specifically identified above will not be critically important, but the vast majority will be.
   iii. From a transit perspective, the concentrating of growth in urban centers, even in some more rural counties, enhances the opportunities for collector transit service and fixed route service between more dense centers, particularly in the Florence-Darlington-Hartsville and Cheraw-Bennettsville. Therefore, expanded transit services are more feasible with this development scenario.
   iv. The Cluster concept is generally supportive of environmental conservation due to more concentrated development.

c. Inconsistencies: There are few inconsistencies; all are minor.

d. Barriers to Compatibility: No barriers exist, except for the persistent financial issues related to transit. The Cluster concept should enhance system revenues, however. With more population in urban centers around the region, the political decisions necessary to make efficient, regional roadway decisions should be bolstered.

e. Strategies to Overcome Barriers: None needed.

f. Recommendations for Plan Modification: None suggested.

PEE DEE REGIONAL COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY (CEDS): This development concept is generally compatible with and supportive of the CEDS, as follows:

a) Key policies and projects affected by the development concept:
   i. Policies: The same as for the other scenarios.
   ii. Projects: None recommended.

b) Compatibility: The development concept is generally compatible with the major policies and themes in the Plan. Key thoughts and considerations:
   i By forecasting the major urban corridors to grow, the concept will be able to support most of the policies regarding servicing the infrastructure needs of public industrial sites, major industrial corridors and major existing industries.
   ii. By concentrating development, the Cluster concept also makes wiser use of resources, financial and otherwise. The concept is generally supportive of environmental conservation due to more concentrated development.
   iii. Excessive sprawl is limited.

c) Inconsistencies: There are no major inconsistencies.

d) Barriers to Compatibility: Barriers are relatively few, primarily financial in nature. There may be some financial constraints to the provision of adequate infrastructure to industrial corridors and sites, but the concentration of development in several major growth corridors will make the expenditures more cost-effective. In addition, the political will to consolidate services and be more efficient is sometimes not there.

e) Strategies to Overcome Barriers: The development of in-state financial resources to address major infrastructure improvements and serve the key economic development corridors suggested by the CEDS is not likely available. As noted earlier, a federal initiative for the coastal plains of eight states has been suggested.

f) Recommendations for Plan Modification: Except for additional credence being given to a federal commission that would include the Pee Dee Region of South Carolina, no recommendations are offered.

THE 2002 STATE ENERGY ACTION PLAN: The broad goals and policy framework of the Plan are as follows:

a) Key policies affected by the concentrated development pattern include:

i. Policies: The same as considered under the other scenarios.
ii. Projects: No relevant projects recommended.

b) Compatibility: The development pattern is compatible with the major policies and themes in the Plan. Key thoughts and considerations:

i. The concentrated development pattern limits overall trip generation, certainly more so than more rural development concepts. This reduces fuel consumption and emissions.
iii. The concentrated development pattern also makes transit more feasible between urban clusters.

c) Inconsistencies: There are no major inconsistencies.

d) Barriers to Compatibility: None.

e) Strategies to Overcome Barriers: None suggested.

f) Recommendations for Plan Modification: No recommendations.

STATE INFRASTRUCTURE PLAN: The assessment of infrastructure plan impacts is as follows:

a) Key policies affected by the development concept include:
   i. Policies: The same as considered under the other scenarios.
   ii. Projects: The projects listed in the plan should be the major ones needed since smaller systems will not need to undergo major expansion.

b) Compatibility: The development concept is supportive of major policies in the Plan. Pressure on smaller systems will be reduced, and larger, more regional systems will be called upon to provide needed services. The availability of service near urban centers will help guide growth. The concentrated development pattern lends itself to consolidation or interconnect of systems, thus leading to economies of scale, consolidation of dischargers, reducing problem dischargers and providing fewer facilities with a greater capability to plan ahead for infrastructure needs. The potentially larger systems would have greater financial capability to keep ahead of development.

c) Inconsistencies: There are no major inconsistencies.

d) Barriers to Compatibility: None.

e) Strategies to Overcome Barriers: None required.

f) Recommendations for Plan Modification: None.

THE 208 WATER QUALITY MANAGEMENT PLAN FOR THE NON-DESIGNATED AREA OF SOUTH CAROLINA: The assessment of water quality impacts is as follows:

a) Key policies affected by the Cluster Development concept include:
   i. Policies: The same as considered in the other scenarios.
   ii. Projects: The same as included in the other two scenarios.

b) Compatibility: The development concept is compatible with the water quality goals of the Plan.

c) Inconsistencies: There are no major inconsistencies.

d) Barriers to Compatibility: None apparent.

e) Strategies to Overcome Barriers: None required.

f) Recommendations for Plan Modification: No recommendations are offered.

V. RECOMMENDED ALTERNATIVE PLAN POLICIES AND CAPITAL IMPROVEMENTS

INTERGOVERNMENTAL INVOLVEMENT

During initial stages of the project, a tentative review of regional development options was made in an attempt to gauge the level and type of intergovernmental involvement that was advisable. Several considerations came into play:

- It was clear that the relatively low population growth forecasts for the region would limit basic growth and development options: Population projections being used were moderately optimistic; yet, overall growth was still low, far less than more metropolitan portions of the State. To presume high growth would be unrealistic, meaning issues, policies and other investigations of the work program would not be realistic.

- Development patterns have been fixed for decades: Only a few urban corridors are seeing significant development. To presume other portions of the region would experience a dramatic shift in population distribution was not realistic.

For these reasons, the development options to be examined would likely involve rather subtle shifts in population distribution. It was concluded that practicing planners would best understand such principles and would be the best members for an advisory body. The type, number and background of planners in the region was thought to be sufficiently large to generate ideas and provide initial guidance on alternatives. In addition, many in this network of professionals knew each other, permitting the development of consensus on issues more readily. Invitations were extended to ten city and county planners, two COG planners and two planners for higher education facilities with multi-county knowledge.

An initial meeting of the planners was well attended. Informal presentations were made by project staff on the following:

- Existing land use
- Population projections by county and region
- Transportation networks
- Future roadway improvement priorities
- Existing water service areas
- Existing sewer service areas

There was general agreement on the Trend Development scenario, described conceptually as a more "balanced" pattern with scattered rural development accentuated by a more urban corridor concentration of growth. The working group also identified the two most logical alternate development scenarios, representing two population distribution schemes described as "scattered development" and "concentrated development". All three development scenarios are more fully described in previous sections. The population, employment and school enrollment assumptions of these three schemes were broadly agreed upon.

After the initial modeling and policy plans evaluations, informal consultations were held with three small working groups of the planners, discussing conclusions and selecting a "preferred" alternative based on public policy. There was unanimity, with the consensus of the advisory group that a sense of community, preservation of downtowns, efficient provision of services and similar factors suggested that clustering of development represented the best development alternative for the region.

In the end, despite the limited options in terms of development alternatives, input from the advisory group was nominally useful. Perhaps as important, it was useful for planners to network, as no formal interaction currently takes place.

RECOMMENDED PLAN

As evident in the previous sections and the most recent narrative regarding advisory group opinions, the alternative development concepts have been evaluated by various means:

- Relative Impacts of each of the alternatives in terms of economic development impacts, infrastructure costs and environmental impacts (previously charted in Section II).
- Policy implications regarding statewide and regional plans (previously charted in Section IV)
- Advisory opinion

The table below attempts to summarize these various factors as a means to recommend the better development alternative for the region. With regard to the table and its evaluations:

- It is certainly recognized that none of the options is universally ideal and that all may be at least somewhat less than desirable on some issues. It isn't which is perfect, however; rather, the question is, which option is the better of the alternatives presented.
- There is some overlap between issues.
- Often the "score" or raw data for an issue are very, very close between alternatives, particularly in terms of some air emissions data.

The goal is not to develop a numerical score, but simple to determine the degree to which one alternative is consistently better "across the board".

In the table, a simple rank order is provided, represented by three numerical designations:

-1 least desirable (generally, less than acceptable)
0 somewhat acceptable (generally, of modest impact when compared to other options)

1 better than normal

These scores are not additive, as that would suggest that each issue is equal and that there are no overlaps between issues; that is certainly NOT the case.

Summary of Relative Rank-Order for Alternative Development Patterns

CRITERIA	DEVELOPMENT SCENARIO		
	TREND	SCATTERED	CLUSTERED
Economic Impact of Dev.	0	-1	1
Water Infrastructure Costs	1	-1	0
Sewer infrastructure Costs	0	0	1
Transportation Costs	0	-1	1
Energy Consumption	0	-1	1
VOC Emissions	0	-1	0
CO Emissions	0	-1	1
Nox Emissions	0	-1	0
Water Quality Impacts	0	-1	0
Consistency with Regional Multi-Modal Transportation Plan	1	-1	1
Consistency with Regional Economic Development Strategies	1	0	1
Consistency With State Energy Plan	1	-1	1
Consistency With State Infrastructure plan	0	-1	1
Consistency With State Water Quality Management Plan	1	-1	1
Advisory Group Opinion	0	-1	1

Overall, the clustered development concept has moderate advantages in terms of economic impact, has lower overall infrastructure costs, slightly better environmental impacts in the long-term, and is more consistent with the State and regional plans that are currently in place. Since the Trend development scenario has at least some emphasis on growth in urban corridors like Florence/Darlington/Hartsville, it too has some positive aspects; however, it is primarily a second choice. The "scattered" development concept has few redeeming qualities from a planning and infrastructure perspective.

As the Clustered Development Concept had overall advantages, it is the selected alternative.

As a reminder, this alternative has the following characteristics:

- Very limited growth is seen in rural areas and extended population and employment growth opportunities occur in major urban areas, particularly the Florence MPO, Cheraw/ Bennettsville, Dillon, Marion/Mullins, and Hartsville/Darlington. But Pageland, Chesterfield and other communities also see development.

- While all of Smart Growth precepts are not adopted, development has been channeled to those areas with existing urban services and expanded infrastructure capacity, and at densities that can be efficiently serviced. Other factors:

- Transportation improvements have continued to focus on corridors that connect most of the urban centers, with increased regional connectivity and linkages between portions of the region... considerably beyond those roadways bonded.

- Water and sewer extensions have been limited to the immediate urban areas, and regional water and sewer treatment systems have merged, serving several communities.

PLAN POLICIES

To ensure the above "Alternate" vision is met, a number of goals and policies have been established for the four basic aspects of the Clustered Development Concept: land development, economic development, infrastructure and environment.

Land Development:

Sound Planning on a Local and Regional Scale that Permits and Encourages More Clustered Development Patterns:

- The development of a sound, long-range, region-wide planning program in the Pee Dee that encourages or directly assists in the planning, technical assistance and joint action on critical needs of the Region. This includes economic planning and growth management and resource conservation.

- The formulation of a re-development strategy that identifies communities which have potential for increasing densities, making better use of existing infrastructure and re-developing town centers.

Appropriate changes in regulatory tools that will promote more dense development in areas with existing infrastructure:

- The fostering of well-planned "clustered" communities by implementing land planning and land use controls in all communities in order to incorporate smart-growth principles into law. This will include specific guidelines on increasing densities, the provision of basic urban services, revision to subdivision regulation and intergovernmental review of plans.

Tax, infrastructure and other financial incentives and disincentives to make clustered development more attractive to development interests:

- Develop "disincentives" for sprawl development, including tax policies on rural farmland conversion
- Develop incentives for infill development.

Clustered public-sector activities:

- Encourage the clustering of social services near population centers.

Economic Development:

The focusing of new jobs where the people are.

- Protect and develop prime business and industrial areas in existing urban environments, including brownfield re-development. This re-development would remove environmental hazards and increase job accessibility.
- Develop full service, publicly owned industrial parks using public-private partnerships. This can ensure not only the availability of a series of pre-developed sites ready for occupancy... but can ensure they are located near urban development so as to foster clustered development.

A diversified regional and local economy:

- Further development of the Tobacco Trail and other heritage corridors as means to use existing historic resources to best advantage, resources that are clustered in towns already and could provide additional service-based employment in existing communities.

Environmental compatibility of new economic activity:

- Incorporate environmental design considerations in the siting of new industry.
- Adopt relevant and effective development controls that will protect sensitive development clusters in the urban areas.

Existing development as an economic engine generating new activity:

- Use the region's economic strengths (clusters of retail/medical/legal services and small industry clusters) to "channel" additional industrial and service activity. This also will assist in justifying transit services by the clustering of activity generators.

Infrastructure:

Timely provision of utility services in economic development corridors and existing urban enclaves:

- Ensure urban centers receive priority in utility expansions, thus encouraging them as development magnets.
- Consider utility expansions in only prime economic development corridors and major industrial areas, thus preventing scattered, inefficient economic activity.

Regional solutions to water and sewer service:

- Provide priority funding to expansion of existing water supply and wastewater treatment facilities and to the consolidation of water and sewer supply, treatment, distribution and collection where feasible, thus fostering countywide water and sewer systems and promoting regional solutions to problems.

An improved system of developmental highways and improvements in other key travel corridors, particularly four-lane connectors to the interstate system, beach-access routes and key roads serving new industrial parks:

- Improve key inter-regional corridors and accessibility to existing growth centers while avoiding roadway improvements that open new areas for development.
- Insure that all such road improvements are made in a socially, environmentally, and economically sound manner.

Environmental:

Clean and energy-efficient transportation systems:

- Incorporate multi-modal design considerations in construction plans and long-range plans for each community, thus promoting transit and alternate modes of travel within urban enclaves.
- Reduce emissions and conserve energy by encouraging transit alternatives in and between urban growth centers.

Environmentally sensitive development:

- Preserve open space and prime farmland through land use ordinances and clustering development when feasible.
- Provide proper buffers and use environmental considerations in the siting of

intensive urban uses such as industrial and commercial activities.

The wise economic and recreational use of the Pee Dee River and other water resources:

- Protect the critical water resources of the region through appropriate development regulations and the consolidation and improvement of wastewater facilities.
- Accommodate the competing uses of river resources and maintain the integrity of water quality by careful planning and wise regulation of construction activities and industrial discharge.

Smart Growth:

- Protect against the indiscriminant conversion of land and guard against the extension of infrastructure beyond reasonable urban boundaries.

INFRASTRUCTURE CAPITAL BUDGET

The chosen development concept theoretically places some limitations on capital expenditures for water, sewer and highways, for several reasons:

Water Systems: Most of the 36 public systems would not likely grow as much under this development scenario, but the larger urban systems could see considerable expansion. Urban service expansions would be more cost-effective, with a greater portion of the population served by public water.

Sewer Systems: Like water, sewer service is more cost-effective in an urban environment, with a larger population served. In addition, more environmentally sensitive treatment facilities are possible due to economies of scale.

The Transportation System - The existing road network and potential regional road widening priorities are still needed, but less new road mileage will be needed, meaning fewer roads to maintain.

Capital Needs:

Even with these "limitations" on infrastructure to serve a "clustered" development pattern, the costs are staggering. The basic water, sewer and highway needs are thought to be as follows, with the indicated capital needs (in 2002 dollars). Small system upgrades are also listed under the regional total at the bottom of each table, as these smaller projects are too numerous to list and whose details have not be quantified.

WATER - Infrastructure Needs – Pee Dee Region – 2025

County	Community	Project	Estimated Cost
Chesterfield	Cheraw	Larger impoundment – 1.5 MGD	$ 2,500,000
	Alligator Rural	Raw water supply - 1 MGD	$ 1,000,000
	Chesterfield	Water supply Impr. – 1 MGD	$ 3,500,000
	Pageland	Water supply Impr. – 1 MGD	$ 1,500,000
Darlington	Hartsville	Wells – 2.5 MGD	$ 2,000,000
	DCWSA	Water supply line interconnect	$ 1,000,000
Dillon	Dillon	Supply improvements –1.5 MGD	$ 2,000,000
Florence	Florence	Rgnl water plant – 5 MGD Exp	$ 10,000,000
	Johnsonville	Wells – 750,000 GPD	$ 1,250,000
	Lake City	Wells – 750,000 GPD	$ 1,250,000
Marion	Marion	Wells – 750,000 GPD	$ 1,250,000
	Mullins	Wells – 750,000 GPD	$ 1,250,000
Marlboro	Bennettsville	Impoundments & wells – 3 MGD	$ 6,000,000
	McColl	System renovation	$ 1,000,000
TOTALS			$ 35,500,000
All Systems		Water Treatment Imp.	$ 14,000,000
		Water Storage – 18 MGD total	$ 30,000,000
		Urban Service expansions	$ 15,000,000
REGION			$ 94,500,000

SEWER - Infrastructure Needs – Pee Dee Region – 2025

County	Community	Project	Estimated Cost
Chesterfield	Cheraw	Expansion – 1 MGD	$ 2,000,000
Darlington	Hartsville	Expansion – 1.0 MGD	$ 2,000,000
	Darlington	Expansion or interconnect	$ 2,500,000
Dillon			$ 0
Florence	Florence	Rgnl plant – 5 MGD	$ 20,000,000
	Johnsonville	Expansion – 1.1 MGD	$ 1,500,000
	Lake City	Expansion – 1.5 MGD	$ 2,250,000
	Pamplico	New plant – 300,000 GPD	$ 2,500,000
Marion	Marion	Expansion – 500,000 GPD	$ 1,250,000
	Mullins	Expansion – 500,000 GPD	$ 1,250,000
Marlboro	Bennettsville	Expansion – 1.0 MGD	$ 2,000,000
TOTALS			$ 37,250,000
All Systems		Upgrade var. system elements	$ 15,000,000
		Expand service areas	$ 65,000,000
		Interconnects & consolidation	$ 25,000,000
REGION			$142,250,000

HIGHWAY - Infrastructure Needs – Pee Dee Region – 2025

County	Project	Estimated Cost
Chesterfield	US 601 widening – North of Pageland – 1.0 Mi.	$ 3,100,000
	SC 151 – North of McBee – 5.7 miles	$ 6,500,000
	SC 9 – 14 Miles	$ 27,000,000
Darlington	US 15 Bus. – 1.9 Miles	$ 3,500,000
	US 52 – 14 Miles	$ 19,000,000
Dillon	SC 38 – Sections 6 & 7 – 6.7 Miles	$ 23,000,000
	SC 9 – 19 Miles	$ 31,000,000
	US 301 – 4.5 Miles (N. Dillon)	$ 14,000,000
	I-95 Interchange at SC 38	$ 5,000,000
Florence	US 378 – 18 Miles	$ 39,000,000
	SC 51 – 5 Miles	$ 14,000,000
	I –95 Interchange at SC 327	$ 6,000,000
Marion	SC 38 – Sec. 8 – 5.5 Miles	$ 28,000,000
	SC 9 – 4 Miles	$ 12,000,000
Marlboro	SC 9 – Cottingham Blvd. – 2.9 Miles	$ 2,500,000
REGION		$233,600,000.00

Source: Statewide Transportation Improvement Program, 2003-2007, SCDOT, and additional regional priorities of PDRCOG.

The combined capital needs of water, sewer and highways is approximately $470 million, summarized as follows.

WATER, SEWER & HIGHWAY - Infrastructure Needs – Pee Dee Region – 2025

Type of Capital Needs	Estimated Cost
Water Improvements	$ 94,500,000
Sewer Improvements	$ 142,250,000
Highway Improvements	$ 233,600,000
REGION	$470,350,000.00

APPENDICES

1. Future Water Concept
2. Future Sewer Concept
3. Future Highway Concept
4. Trend Development Concept
5. Scattered Development Concept
6. Clustered Development Concept