4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) A single significance level (i.e., SMALL, MODERATE, OR LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter of the supplemental environmental impact statement (SEIS) addresses the issues related to operation during the renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B and are applicable to North Anna. Section 4.1 addresses issues applicable to the North Anna cooling system. Section 4.2 addresses issues related to transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to groundwater use and quality while Section 4.6 discusses the impacts of renewal-term operations on threatened and endangered species. Section 4.7 addresses new information that was raised during the scoping period. The results of the evaluation of environmental issues

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

related to operation during the renewal term are summarized in Section 4.8. Finally, Section 4.9 lists the references for Chapter 4. Category 1 and Category 2 issues that are not applicable to North Anna because they are related to plant design features or site characteristics not found at North Anna are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to the operation of the North Anna Power Station, Units 1 and 2, cooling system during the renewal term are listed in Table 4-1. The Virginia Electric and Power Company (VEPCo) stated in its Environmental Report (ER) (VEPCo 2001b) that it is not aware of any new and significant information associated with the renewal of the North Anna Power Station operating licenses (OLs). The staff has not identified any significant new information during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the staff concluded in the GEIS that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Altered current patterns at intake and discharge structures. Based on information in the GEIS, the Commission found that

  > Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of altered current patterns during the renewal term beyond those discussed in the GEIS.

Table 4-1. Category 1 Issues Applicable to the Operation of North Anna Power Station, Units 1 and 2, Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.3.2.2; 4.4.2
Altered thermal stratification of lakes	4.2.1.2.2; 4.4.2.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in wastewater	4.2.1.2.4; 4.3.2.2; 4.4.2.2
Water use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms	4.2.2.1.11; 4.4.3
HUMAN HEALTH	
Microbial organisms (occupational health)[(a)]	4.3.6
Noise	4.3.7

(a) In its Environmental Report (VEPCo 2001b), VEPCo inadvertently stated that this issue was not considered to apply to North Anna. During discussions with the staff during the September visit to Surry and the October visit to North Anna, the staff established that this issue is applicable to North Anna.

- Altered thermal stratification of lakes. Based on information in the GEIS, the Commission found that

  > Generally, lake stratification has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of lake stratification during the renewal term beyond those discussed in the GEIS.

- Temperature effects on sediment transport capacity. Based on information in the GEIS, the Commission found that

  > These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of temperature on sediment transport during the renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found that

  > Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of scouring during the renewal term beyond those discussed in the GEIS.

- Eutrophication. Based on information in the GEIS, the Commission found that

  > Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found that

  > Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information including the National Pollutant Discharge Elimination System (NPDES) permit for North Anna Power Station issued by the Virginia Department of Environmental Quality (VDEQ) (Permit No. VA0052451), or discussion with the NPDES compliance office. Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills. Based on information in the GEIS, the Commission found that

  > Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit for North Anna Power Station issued by VDEQ (Permit No. VA0052451), or discussion with the NPDES compliance office. Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

- Discharge of other metals in wastewater. Based on information in the GEIS, the Commission found that

  > These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit for North Anna Power Station issued by VDEQ (Permit No. VA0052451), or discussion with the NPDES compliance office. Therefore, the staff concludes that there are no impacts of discharges of other metals in wastewater during the renewal term beyond those discussed in the GEIS.

- Water-use conflicts (plants with once-through cooling systems). Based on information in the GEIS, the Commission found that

  > These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of water use during the renewal term beyond those discussed in the GEIS.

- Accumulation of contaminants in sediments or biota. Based on information in the GEIS, the Commission found that

  > Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of available information. Therefore, the staff concludes that there

are no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton. Based on information in the GEIS, the Commission found that

> Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- Cold shock. Based on information in the GEIS, the Commission found that

> Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.

The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

- Thermal plume barrier to migrating fish. Based on information in the GEIS, the Commission found that

> Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that

there are no impacts of thermal plumes during the renewal term beyond those discussed in the GEIS.

- Distribution of aquatic organisms. Based on information in the GEIS, the Commission found that

  > Thermal discharge may have localized effects but is not expected to effect the larger geographical distribution of aquatic organisms.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

- Premature emergence of aquatic insects. Based on information in the GEIS, the Commission found that

  > Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of premature emergence during the renewal term beyond those discussed in the GEIS.

- Gas supersaturation (gas bubble disease). Based on information in the GEIS, the Commission found that

  > Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that

there are no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen in the discharge. Based on information in the GEIS, the Commission found that

  > Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. Based on information in the GEIS, the Commission found that

  > These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms. Based on information in the GEIS, the Commission found that

  > Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem [referring to Oyster Creek Nuclear Generating Station]. It is not expected to be a problem during the license renewal term.

During its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information, the staff identified one potentially new issue associated with stimulation of nuisance organisms. See Section 4.7.2 for a discussion of this issue. However, the staff concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Microbiological organisms (occupational health).[(a)] Based on information in the GEIS, the Commission found that

  > Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of microbiological organisms during the renewal term beyond those discussed in the GEIS.

- Noise. Based on information in the GEIS, the Commission found that

  > Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the renewal term that are applicable to North Anna Power Station, Units 1 and 2, are listed in Table 4-2 and are discussed in Sections 4.1.1, 4.1.2, 4.1.3, and 4.1.4.

(a) In its Environmental Report (VEPCo 2001b), VEPCo inadvertently stated that this issue was not considered to apply to North Anna. During discussions with the staff during the September visit to Surry and the October visit to North Anna, the staff established that this issue is applicable to North Anna.

Table 4-2. Category 2 Issues Applicable to the Operation of the North Anna Power Station, Units 1 and 2, Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY (FOR PLANTS WITH ONCE-THROUGH HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.3.3	B	4.1.1
Impingement of fish and shellfish	4.2.2.1.3; 4.3.3	B	4.1.2
Heat shock	4.2.2.1.4; 4.3.3	B	4.1.3
HUMAN HEALTH			
Microbiological organisms (public health) (plants using lakes or canals or cooling towers that discharge into a small river)	4.3.6	G	4.1.4

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

For plants with once-through cooling systems, entrainment of fish and shellfish in early life stages into cooling water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal.

The staff independently reviewed the VEPCo ER (VEPCo 2001b), visited the site, and reviewed the applicant's NPDES Permit No. VA0052451, issued by VDEQ, that expires on January 11, 2006.

Section 316(b) of the Clean Water Act (CWA) requires that any standard established pursuant to Sections 301 or 306 of the CWA shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Entrainment through the condenser cooling system of fish and shellfish in the early life stages is one of the adverse environmental impacts that the best technology available minimizes. Virginia State Water Control Board (VSWCB) regulations provide that compliance with a NPDES permit constitutes compliance with Sections 301 and 306 of the CWA (9 VAC25-31-60.A.1). In response to Board requirements, VEPCo submitted a CWA Section 316(b) demonstration for North Anna in May 1985 (VEPCo 1985a). Based on this and other input, the Board issued NPDES Permit No. VA0052451 for North Anna.

When both units are operating, the North Anna station draws water from Lake Anna at a rate of about 1.2E05 L/s (1.9E06 gpm). The water is circulated through the turbine condensers and service water system and returned to Lake Anna via the Waste Heat Treatment Facility (WHTF). Cooling water for the circulating water system is withdrawn from Lake Anna through two screenwells (one per nuclear unit) located in a cove just north of the station. Each screen-well contains four intake bays. Each intake bay is equipped with a trash rack, a traveling screen, and a circulating water pump. The traveling screens have a screen mesh size of approximately 1 cm (3/8 in.) and are designed to move every 24 hr or when a predetermined pressure differential exists across the screens. Debris and fish collected from the traveling screens are washed into wire baskets for disposal as solid waste.

Entrainment refers to the process in which organisms that are smaller than the screen mesh pass through the cooling system. Entrainment can result in a reduction in the ichthyoplankton (fish eggs and larvae) populations. Entrainment studies were conducted for North Anna between 1978 and 1983 to determine the species and quantities of ichthyoplankton entrained into the intake cooling water flow and passed through the power station (VEPCo 1985a). Once a week, sampling was conducted in front of the intake forebays from March to July of each year. Samples were collected from the surface, at mid-depth, and bottom by placing paired conical fine mesh nets in front of a pre-selected intake forebay. Nets were retrieved after 10 min. Sampling was conducted four times over 6 hr. The volume of water filtered during the sampling period was determined using a digital flowmeter.

A total of 7908 fish larvae were collected in the entrainment samples. No fish eggs were collected. Most species reproducing in Lake Anna produce demersal, adhesive eggs that significantly reduce potential entrainment. The most commonly entrained larvae were gizzard shad (65.7 percent), followed by white perch (15 percent), sunfishes (*Lepomis* sp.) (13.3 percent), yellow perch (4.9 percent) and black crappie (1.0 percent). The channel catfish and largemouth bass were each represented by only a single collected individual. There were no larvae collected from any threatened or endangered species. Seasonal variation was observed in the timing of collection and reflects the spawning characteristics of the species. The total estimated fish larvae entrained ranged from 8.4E07 in 1982 to 2.5E08 in 1981. The difference reflects the average number of circulating water pumps running each year (3.2 for 1982 and 6.4 for 1981) and changes in the fish standing crop in Lake Anna.

Under natural conditions, only a very small percentage of fish larvae survive predation and other natural mortality factors to become adult, reproducing fish. To assess the impact of the loss of fish larvae due to entrainment on the fisheries of Lake Anna, the adult equivalent model of Goodyear (1978) was used. This model estimates the number of adult fish that would have resulted from the entrained larvae had they not been lost to entrainment. This results in an estimate of the potential percent reduction in the adult fish population as a consequence of

entrainment. Values ranged from a low of 0.01 percent for black crappie in 1978 and 1979 and sunfishes in 1982, to a high of 4.13 percent for gizzard shad in 1980. These reductions in adult recruitment would not be expected to significantly impact the Lake Anna fishery. This conclusion is supported by data from the annual fish monitoring conducted by VEPCo (VEPCo 1999).

The staff has reviewed the available information and based on the results of entrainment studies and the operating history of the North Anna intake structure, concludes that the potential impacts of entrainment of fish and shellfish in the early life stages in the cooling water intake system are SMALL, and no additional mitigation is warranted.

4.1.2 Impingement of Fish and Shellfish

For plants with once-through cooling systems, impingement of fish and shellfish on debris screens of cooling water systems is considered a Category 2 issue, requiring a site-specific assessment before license renewal.

The staff independently reviewed the North Anna ER (VEPCo 2001b), visited the site, and reviewed the applicant's NPDES Permit No. VA0052451, issued by VDEQ, that expires on January 11, 2006.

Section 316(b) of the CWA requires that any standard established pursuant to Sections 301 or 306 of the CWA shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Impingement through the condenser cooling system of fish and shellfish in the early life stages is one of the adverse environmental impacts that the best technology available minimizes. VSWCB regulations provide that compliance with a NPDES permit constitutes compliance with Sections 301 and 306 of the CWA (9 VAC25-31-60.A.1). In response to Board requirements, VEPCo submitted a CWA Section 316(b) demonstration for North Anna in May 1985 (VEPCo 1985a). Based on this and other input, the Board issued NPDES Permit No. VA0052451 for North Anna.

Impingement is the process in which fish that are too large to pass through the intake screen mesh, stay in front of the screens, and eventually tire and become impinged. Impingement studies were conducted from April 1978 through December 1983 to determine the species and number of fish colliding and being subsequently retained upon the traveling screens of the water intake structure (VEPCo 1985a). Samples were collected on a four-week cycle. Sampling during the first three weeks consisted of two 24-hr sample periods on non consecutive days. During the fourth week, a composite sample was taken consisting of 12 continuous 2-hr samples.

Samples were collected by washing the screens for ½ hr prior to the beginning of a 24-hr sampling period. Each screen was washed for a minimum of 10 min, and fish were caught in a basket at the end of a sluiceway.

Impingement rates generally declined with time, corresponding with a reduction in overall fish population associated with stabilization of the lake. Over the course of the study, a total of 2.4E05 fishes weighing 5.7E03 kg (1.3E04 lb) were collected, representing 34 species and 13 families. This extrapolates to an estimated total number of fishes impinged of 9.6E05 with an estimated total weight of 2.3E04 kg (5.1E04 lb). Total impingement estimates per year ranged from 4.8E04 in 1983 to 5.9E05 in 1979. Of the study total, 61 percent of the impinged fish (5.9E05) were collected in 1979. After 1979, the impingement quantity, as a percentage of the overall total estimated impinged, generally declined with each year, with 13 percent (1.25E05) for 1981, 12 percent (1.2E05) for 1980, 7 percent (6.7E04) for 1982 and 5 percent (4.8E04) for 1983. The fish most commonly impinged during the study was gizzard shad (61 percent of total). In 1979, it comprised 77.6 percent of the total, of which 64 percent (2.9E05 total estimated impinged) were impinged between February 20 and March 20 of that year. High rates of impingement in 1979 corresponded to the lowest water temperature recorded between 1975 and 1983 in the intake area 1.2°C (34.1°F). Low water temperatures reduce shad mobility (Griffith 1978; McLean et al. 1982), and winter kills are common for this species when the water temperature falls below 3.3°C (37.9°F) (Jester and Jensen 1972). The higher estimated annual impingement rates in 1979 were likely influenced by the extreme cold experienced that year. Other fish commonly impinged during the study were black crappie (16 percent, 1.5E05 total estimated impinged), yellow perch (16 percent, 1.5E05), bluegill (4 percent, 3.8E04) and white perch (1 percent, 9.6E03). No other species comprised more than 1 percent of the total.

A comparison of the impingement numbers to Lake Anna's standing crop estimates indicated a low percentage of the population was affected by impingement. The average percentage of the gizzard shad standing crop that was removed annually by impingement was 0.38 percent (number) and 0.32 percent (weight). For crappie, the percentages averaged 3.1 percent (number) and 3.8 percent (weight). Black crappie creel harvest estimates declined sharply in 1979, when it was 5.7E04 compared to the 1978 estimate of 1.1E05, a 48 percent reduction (VEPCo 1989a). A comparison of the size and age structure of black crappie impinged between 1979 and 1983 to those found in Lake Anna showed a similar range, indicating impingement affected no specific size or age class selectively. In addition, the amount of black crappie impinged in subsequent years declined following the decline in the overall lake population (VEPCo 1986). Therefore, it is highly unlikely that the large decline in black crappie populations was related to the relatively small loss of fish due to impingement. A large standing crop of black crappie immediately post-impoundment may have been due to increases in food as a consequence of the increased nutrient supply. As nutrient loads decreased and stabilized,

black crappie may have been attracted to the intake structure to feed on the smaller fish feeding on the planktonic food organisms near the structure. Black crappie may also be attracted to structures in deeper water (Pflieger 1975). The lake was completely clear-cut prior to impoundment and thus lacks a deep, submerged structure, possibly making the intake structure attractive to black crappie (VEPCo 2001b). Between 1983 and 1990, the Virginia Department of Game and Inland Fisheries (VDGIF) placed 20 artificial structures in the lake to provide additional habitat in areas with "clean" bottoms. The percentage of black crappie in gill net samples since 1987 fluctuated between 18.8 percent and 5 percent (VEPCo 1989a -1995, 2000a) and was 10 percent in the most recent report available (VEPCo 2000a).

The mean standing crop of fishes was relatively stable from 1978 through 1983 (VEPCo 1989a). The 316(a) demonstration and most recent monitoring data also show the Lake Anna fish populations to be diverse and relatively stable.

The staff has reviewed the available information relative to potential impacts of the cooling water intake on the impingement of fish and shellfish, as set forth above, and based on these data, concludes that the potential impacts are SMALL, and no additional mitigation is warranted.

4.1.3 Heat Shock

For plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal.

The staff independently reviewed the North Anna ER (VEPCo 2001b), visited the site, and reviewed the applicant's NPDES Permit No. VA0052451. This permit does not require reporting of discharge temperatures from the WHTF to Lake Anna; it limits the heat rejection rate to the lake to a calculated maximum of 1.354E10 Btu/hr. However, part I.E.6 of the current NPDES permit does require temperature monitoring in two quarters during the year at locations throughout Lake Anna and the WHTF.

The temperature of the cooling water increases by as much as 8.1°C (14.5°F) as it moves through the condensers. The heated cooling water is discharged into the WHTF. The cooling water residence time in the WHTF is approximately 14 days, and more than half of the station's waste heat is dissipated during this time. High-velocity jets discharge water from the WHTF into Lake Anna. This enhances the mixing of the heated effluent in the Lower Lake, resulting in nearly uniform temperatures across horizontal layers and preventing the formation of a clearly defined thermal plume in the Lower Lake (VEPCo 2001b). According to the CWA Section 316(a) demonstration report produced by VEPCo in 1986, the North Anna thermal contribution to Lake Anna corresponds to about 10 percent of the solar heat that enters the reservoir.

VEPCo submitted a CWA Section 316(a) demonstration for North Anna to VSWCB on June 24, 1986 (VEPCo 1986). Although the most recent NPDES permit does not reference the Section 316(a) report, item 12 on page 28 of Part I in the previous permit (issued November 18, 1997) refers to the submittal of the Section 316(a) report. It indicated that the Board found that "effluent limitations more stringent than the thermal limitations included in this permit are not necessary to assure the protection and propagation of a balanced indigenous community of shellfish, fish and wildlife in Lake Anna and the North Anna River downstream of the lake."

VEPCo conducted pre-operational studies from 1972 to 1977 and operational studies from 1978 through 1985 on the aquatic community in Lake Anna and the North Anna River downstream of Lake Anna (VEPCo 1986). Upon impoundment, Lake Anna developed three distinct ecological zones. The Upper Lake is essentially riverine and shallow (average depth 4 m [13 ft]), and shows some evidence of temperature stratification in summer. The Mid-Lake is deeper and stratifies in summer. The Lower Lake is the deepest portion of the lake (average depth of 11 m [36 ft]), clearer (with more light penetration), and shows pronounced annual patterns of winter mixing and summer stratification. During pre-operational years, the summer epilimnion (the warm upper layer of water) was generally from 2 to 5 m (7 to 16 ft) deep. This increased to 8 to 10 m (26 to 33 ft) during operational years. The highest recorded hourly and mean monthly daily maximum temperatures during pre-operational monitoring were in July in the Upper Lake (hourly, 33.7°C [92.7°F]; and mean monthly, 30.2°C [86.4°F]; both during 1977) and during operational monitoring in the Mid-Lake region (hourly, 33.5°C [92.3°F]; and mean monthly, 30.8°C [87.4°F], both during 1983). In the North Anna River, summer water temperatures from 1970 to 1985 were higher near the dam than downstream, reflecting temperatures in the reservoir. The highest water temperature recorded in pre-operational years was 31.9°C (89.4°F), and the highest temperature recorded in operational years was 32.7°C (90.9°F), recorded in August 1983 at the same station.

Biological monitoring was conducted in the upper, middle, and lower portions of the reservoir and in the North Anna River below the reservoir during the pre-operational and operational periods as part of the Section 316(a) demonstration. The phytoplankton, macrophyte, periphyton, benthic, zooplankton, bottom feeding fish, planktivorous, and piscivorous fish communities were studied to determine if the thermal effluent of North Anna caused appreciable harm. Abundance and distribution of fish were evaluated using a variety of sampling methods over a period from 1975 to 1985. Larval fish studies and creel surveys were also conducted. Special studies were conducted that focused on the reproduction and growth of largemouth bass and striped bass. Striped bass seasonal movement and habitat preferences were also investigated using ultrasonic tags. Since the Section 316(a) demonstration was completed, monitoring of fish populations has continued as part of an agreement with the VDEQ to conduct a post-Section 316(a) demonstration environmental monitoring program. As part of this agreement, monitoring data are reviewed every 3 years

and monitoring requirements are adjusted accordingly. In 1991, the age and growth studies of largemouth and striped bass and habitat availability studies for striped bass were discontinued due to the relatively little change in year-to-year data (VEPCo 1992).

Data presented in the Section 316(a) demonstration, in addition to recent monitoring data (VEPCo 1999), showed Lake Anna to contain a highly abundant and diverse population of fish species. Lake Anna supports a higher standing crop of fishes compared to similar southeastern reservoirs (VEPCo 1986). The community structure has remained relatively stable since 1975, with some year-to-year variation in species composition. The Section 316(a) studies indicated that striped bass grow and provide a substantial "put-grow-and-take" recreational fishery in Lake Anna but adults are subject to late-summer habitat restrictions (limited to cooler-water refuge areas) and growth limitations. By late summer, habitat was shown to be only marginally suitable for striped bass without North Anna operations, and this marginally suitable habitat became somewhat more restricted due to North Anna operations. Threadfin shad, introduced in 1983 to provide additional forage to upper trophic level game fish, is vulnerable to cold shock and winter die-off and would likely not survive in Lake Anna if it were not for the operation of North Anna. Recent monitoring data are consistent with historical data and continue to show a diverse and abundant fish community. In 1999, the lake ranked third in the Commonwealth as a trophy bass lake (VEPCo 2000a).

The fish community in the North Anna River appears to be diverse and typical of a community that is in dynamic equilibrium (VEPCo 1986). Species abundance and diversity change from near the dam to farther downstream, paralleling changes in physical features of the river. Underwater observations of largemouth bass and smallmouth bass in 1999 showed largemouth bass to be more abundant in the upper reaches of the river below Lake Anna and smallmouth bass to be more abundant in the lower reaches (VEPCo 2000a).

Based on the foregoing, the staff concludes that the potential heat shock impacts resulting from operation of North Anna's cooling water discharge system to the aquatic environment on or in the vicinity of the site are SMALL, and no additional mitigation is warranted.

4.1.4 Microbiological Organisms (Public Health)

For plants discharging cooling water to cooling ponds, lakes, canals, or small rivers, the effects of microbiological organisms on human health is listed as a Category 2 issue and requires plant-specific evaluation before license renewal.

North Anna Power Station, Units 1 and 2, use an open-cycle cooling system in which cooling water is withdrawn from Lake Anna, heated in the condensers, and returned to Lake Anna through a series of lagoons, referred to as the WHTF. The public has access to areas that

might be impacted by the heated water from the cooling system, including Lake Anna and the WHTF. Activities in these areas include swimming, recreational boating, fishing, and residential housing.

The thermophilic pathogen amoeba *Naegleria fowleri*, found in freshwater throughout the United States, was found in the WHTF following start up of North Anna Unit 1 in June 1978. In 1981, VEPCo environmental personnel met with the Virginia Epidemiologist to determine whether *N. fowleri* at North Anna represented a public health risk. Following consultation with other State and Federal agencies, the risk of contracting primary amoebic meningoencephalitis was determined to be too low to justify any action by VEPCo or State agencies (VEPCo 1985b).

Wastewater is the principal source of pathogens in natural waters. The sewage treatment plant at North Anna disinfects wastewater to reduce coliform bacteria and other microoganisms to levels that meet state water quality standards. In addition, VEPCo monitors temperatures in the cooling water discharge and the WHTF. The cooling water discharge temperatures during the summer are within the range of those known to permit the growth and reproduction of thermophilic pathogenic microorganisms, but are below those considered optimal for thermophilic organisms. Temperatures in the WHTF immediately downstream of the discharge structure are several degrees cooler than those in the immediate outfall and, under normal circumstances, would not support the growth and reproduction of thermophilic pathogenic organisms. Temperatures in Lake Anna and in the North Anna River below the dam are almost always too low to support thermophilic pathogens (VEPCo 2001b).

Consequently, the staff concludes that the potential impacts of microbiological organisms on public health are SMALL, and no additional mitigation beyond current wastewater treatment is warranted.

4.2 Transmission Lines

North Anna Power Station has three 500-kV transmission lines and one 230-kV transmission line leaving the site from the switchyard. Each transmission line occupies a separate right-of-way. The rights-of-way range in width from 37 to 84 m (from 120 to 275 ft) and in length from 24 to 66 km (from 15 to 41 mi) covering a total of approximately 1174 ha (2900 ac) (Table 2-1) (AEC 1973; VEPCo 2001b). The rights-of-way extend from North Anna to the north, south, east, and west terminating in Morrisville, Midlothian, Ladysmith, and at the South Anna non-utility generator (Figure 2-5). The transmission lines and rights-of-way were constructed between 1973 and 1984. The vegetation in the rights-of-way is managed through a combination of mechanical and herbicide treatments conducted on a 3-year cycle. Mowing is the primary mechanical treatment, and Accord and Garlon are the primary herbicides used in the rights-of-way. In some areas (e.g., wetlands, dense vegetation), hand-cutting treatments

are used. Vegetation treatments are developed in cooperation with the Virginia Department of Conservation and Recreation (VDCR) Natural Heritage Program (VEPCo 2001b). Rare and sensitive plant species areas are identified and avoided, or modified treatment practices are used to avoid adverse impacts. In addition, wildlife food plots and Christmas tree plantations are located along the corridors and supported through cost-sharing by VEPCo (VEPCo 2001b).

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to transmission lines from North Anna Power Station, Units 1 and 2, are listed in Table 4-3. The VEPCo ER (VEPCo 2001b) states that it is not aware of any new or significant information associated with the license renewal of North Anna Power Station, Units 1 and 2. The staff has not identified any significant new information on these issues during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the GEIS that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-3. Category 1 Issues Applicable to the North Anna Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
TERRESTRIAL RESOURCES	
Power line right-of-way management (cutting and herbicide application)	4.5.6.1
Bird collisions with power lines	4.5.6.2
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3
Flood plains and wetlands on power line right-of-way	4.5.7
AIR QUALITY	
Air-quality effects of transmission lines	4.5.2
LAND USE	
Onsite land use	4.5.3
Power line rights-of-way	4.5.3

A brief description of the staff's review and GEIS conclusions, as codified in Table B-1 for each of these issues follows:

- Power line right-of-way management (cutting and herbicide application). Based on information in the GEIS, the Commission found that

  > The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, discussions with the U.S. Fish and Wildlife Service (FWS) and VDGIF, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of power line right-of-way maintenance during the renewal term beyond those discussed in the GEIS.

- Bird collisions with power lines. Based on information in the GEIS, the Commission found that

  > Impacts are expected to be of small significance at all sites.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, discussions with FWS and VDGIF, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

- Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock). Based on information in the GEIS, the Commission found that

  > No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, discussions with FWS and VDGIF, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- Flood plains and wetlands on power line right-of-way. Based on information in the GEIS, the Commission found that

  > Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, discussions with FWS and VDGIF, or its evaluation of other information. Therefore, the staff concludes that there are no impacts on flood plains and wetlands on the power line right-of-way during the renewal term beyond those discussed in the GEIS.

- Air-quality effects of transmission lines. Based on the information in the GEIS, the Commission found that

  > Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- Onsite land use. Based on the information in the GEIS, the Commission found that

  > Projected onsite land use changes required during the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no onsite land-use impacts during the renewal term beyond those discussed in the GEIS.

- Power line right-of-way (land use). Based on information in the GEIS, the Commission found that

  > Ongoing use of power line right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts on use of power line rights-of-way during the renewal term beyond those discussed in the GEIS.

There is one Category 2 issue related to transmission lines, and another issue related to transmission lines is being treated as a Category 2 issue. These issues are listed in Table 4-4 and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-4. Category 2 and Uncategorized Issues Applicable to the North Anna Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
HUMAN HEALTH			
Electromagnetic fields, acute effects (electric shock)	4.5.4.1	H	4.2.1
Electromagnetic fields, chronic effects	4.5.4.2	NA	4.2.2

4.2.1 Electromagnetic Fields—Acute Effects

In the GEIS (NRC 1996), the staff found that without a review of the conformance of each nuclear plant transmission line with the National Electrical Safety Code (NESC) criteria (NESC 1997), it is not possible to determine the significance of the potential for electric shock. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of the transmission lines may have changed or the power distribution companies may have upgraded the line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the potential shock hazard if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

The NESC requires that transmission lines be designed to limit the steady-state current due to the electrostatic effects to 5 mA root mean square (rms). There is one 230-kV line and three 500-kV transmission lines that distribute power from North Anna to the VEPCo grid. The 230-kV line was designed using the 5 mA limit prescribed in the NESC, while the other lines were constructed before the standard was first established in 1977. Therefore, VEPCo performed an analysis to confirm that all of these transmission lines conform to the current NESC clearance requirements for limiting electric shock hazard.

VEPCo calculated field strength and induced current using a computer code called ENG01814 that was developed by Cincinnati Gas & Electric Company (1991). The results of the code have been verified by taking actual field measurements under energized transmission lines. The input parameters for this code include the minimum vertical clearance to the roadbed with line sag determined at 49°C (120°F) conductor temperature, and maximum vehicle size under the line being a semi-tractor trailer.

The analysis determined that none of the four transmission lines has the capacity to induce currents to the level of 5 mA rms in a vehicle parked beneath the lines. Therefore, the staff concludes the expected impact of the potential for electric shock is SMALL, and further mitigation is not warranted.

4.2.2 Electromagnetic Fields—Chronic Effects

In the GEIS, the chronic effects of 60-Hz electromagnetic fields from power lines were not designated as Category 1 or 2 and will not be so designated until a scientific consensus is reached on the health implications of these fields.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE). A recent report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposure. The NIEHS does not believe that other cancers or non-

> cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the staff to change its position with respect to the chronic effects of electromagnetic fields. The staff considers the GEIS finding of "not applicable" still appropriate and will continue to follow developments on this issue.

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to North Anna Power Station, Units 1 and 2, in regard to radiological impacts are listed in Table 4-5. VEPCo stated in its ER (VEPCo 2001b) that it is not aware of any new and significant information associated with the renewal of the North Anna OLs. No significant new information on these issues has been identified by the staff during its independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For the issues, the staff concluded in the GEIS that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-5. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
HUMAN HEALTH	
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Radiation exposures to public (license renewal term). Based on information in the GEIS, the Commission found that

  > Radiation doses to the public will continue at current levels associated with normal operations.

The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

  > Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to radiological impacts of routine operations.

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Term

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-6. VEPCo stated in its ER (VEPCo 2001b) that it is not aware of any new and significant information associated with the

Table 4-6. Category 1 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6
Public services: education (license renewal term)	4.7.3.1
Aesthetic impacts (license renewal term)	4.7.6
Aesthetic impacts of transmission lines (license renewal term)	4.5.8

renewal of North Anna Power Station, Units 1 and 2, OLs. No significant new information on these issues has been identified by the staff in its independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For the issues in the GEIS, the staff concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff's review and the GEIS conclusions for each of these issues, as codified in Table B-1, follows:

- Public services–public safety, social services, and tourism and recreation. Based on information in the GEIS, the Commission found that

  > Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services–education (license renewal term). Based on information in the GEIS, the Commission found that

  > Only impacts of small significance are expected.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on education during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping

process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term). Based on information in the GEIS, the Commission found that

  No significant impacts are expected during the license renewal term.

  The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4-7 lists the Category 2 socioeconomic issues that require plant-specific analysis and environmental justice, an issue that was not generically resolved in the GEIS.

Table 4-7. Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SOCIOECONOMICS			
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public Services, transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental Justice	Not addressed[(a)]	Not addressed[(a)]	4.4.6

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. Therefore, environmental justice must be addressed in the licensee's ER and the staff's environmental impact statement.

4.4.1 Housing Impacts During Operations

10 CFR Part 51, Subpart A, Appendix B, Table B-1, states that impacts on housing availability are expected to be of small significance at plants located in a high-population area where growth-control measures are not in effect. SMALL impacts result when no discernible change

in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). Increases in rental rates or housing values in these areas would be expected to equal or slightly exceed the statewide inflation rate. No extraordinary construction or conversion of housing would occur where SMALL impacts are foreseen.

The impacts on housing are considered to be of MODERATE significance when there is a discernible but short-lived reduction in available housing units because of project-induced in-migration. The impacts on housing are considered to be of LARGE significance when project-related demand for housing units would result in very limited housing availability and would increase rental rates and housing values well above normal inflationary increases in the state. MODERATE and LARGE impacts are possible at sites located in rural and remote areas, at sites located in areas that have experienced extremely slow population growth (and thus slow or no growth in housing), or where growth control measures that limit housing development are in existence or have been recently lifted. Because impact significance depends on local conditions, housing is a Category 2 issue (NRC 1996).

The NRC has developed a method of characterizing population that is based on two factors: sparseness and proximity (NRC 1996, Section C.1.4). Sparseness measures population density and city size within 32 km (20 mi) of the site. Proximity measures population density and city size within 80 km (50 mi) of the site. In these calculations, the density is averaged over the land area covered by the ring; large water bodies are excluded. Each factor has categories of density and size (NRC 1996, Table C.1), and a matrix is used to rank the population category as low, medium, or high (NRC 1996, Figure C.1).

In 2000, the population living within 32 km (20 mi) of North Anna Power Station, Units 1 and 2, is estimated to be approximately 100,255 (Table 2-10). This translates to around 30 persons/ km^2 (80 persons/mi^2) living on the land area present within a 32-km (20-mi) radius of the North Anna site. This concentration falls into the GEIS sparseness Category 3 (i.e., having greater than or equal to 25 to approximately 45 persons/km^2 [60 to 120 persons/mi^2]).

In 2000, an estimated 1,614,983 people lived within 80 km (50 mi) of the North Anna site (Table 2-10), equating to a population density of around 80 persons/km^2 (205 persons/mi^2) on the available land area. Applying the GEIS proximity measures (NRC 1996), the North Anna site is classified as Category 4 (i.e., having greater than or equal to 73 persons/km^2 [190 persons/mi^2]) within 80 km (50 mi) of the site. Also, the City of Richmond (population 197,790 [USCB 2000]) is located within the 80-km (50-mi) radius of North Anna. Even though Louisa County, where North Anna is located, has a population of only 25,627 (see Table 2-7) (USCB 2000), these sparseness and proximity scores identify the nuclear units as being located in a high-population area.

Henrico, Louisa, Orange, and Spotsylvania counties and the combined Richmond City and County area are expected to bear the brunt of potential impacts (especially Louisa County). They do not have growth-control measures that would limit housing development. Based on the NRC criteria, VEPCo expects housing impacts to be SMALL during refurbishment and continued operations (VEPCo 2001b).

In the GEIS, staff assumed that an additional 60 permanent workers per unit might be needed during the license renewal period to perform routine maintenance and other activities. Although VEPCo expects to perform these routine activities during scheduled outages, it assumes that no more than 60 total employees would be added to its permanent staff during the license renewal period (VEPCo 2001b). The addition of 60 permanent employees, plus 223 indirect workers, would result in an increased demand for a total of 283 housing units[(a)] (VEPCo 2001b). The 283 housing units represent an "upper bound" on the additional housing units required. Of these, approximately 207 housing units would be scattered across the five impact counties.[(b)] Within the five-county area, the 2000 census estimated that there are approximately 265,000 housing units (see Table 2-6). The estimated 207 housing units required to house the additional employees represents 0.08 percent of the total housing available. The potential increased demand for housing units could be met with the construction of new housing or use of existing, unoccupied housing in the five-county area. While four of the five counties are experiencing steady growth, the increased demand for housing would not create a discernable change in housing availability, impact rental rates or housing values, or spur new housing construction or the conversion of existing housing to rental units.

As set forth above, the staff reviewed the available information relative to housing impacts and VEPCo's conclusions. Because the bounding number of new housing units needed is a very small percentage of the available units, the staff concludes that the impact on housing during the license renewal period would be SMALL, and further mitigation is not warranted.

4.4.2 Public Services: Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to the level of demand, and thus there is no need to add capital facilities. Impacts are considered MODERATE if overtaxing of service capabilities occurs during periods of peak demand. Impacts are considered LARGE if existing levels of service

(a) Calculated as follows: 60 (additional employees) multiplied by 4.7204 (regional employment multiplier) = 283 (total employees). VEPCo assumes that all direct and indirect jobs would be filled by in-migrating residents (VEPCo 2001b).
(b) This assumes that 79 percent of the 283 new workers would locate in the impact county area.

(e.g., water or sewer services) are substantially degraded and additional capacity is needed to meet ongoing demands for services. The staff indicates in the GEIS that, in the absence of new and significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies (NRC 1996).

Analysis of impacts on the public water supply system considered plant demand and plant-related population growth. Section 2.2.2 describes the North Anna permitted withdrawal rate and actual use of water. North Anna does not use water from a municipal system and is planning no major refurbishment, so plant demand would not change beyond current demands (VEPCo 2001b).

VEPCo assumed an increase of 60 employees during the license renewal period, the generation of 283 new jobs, and a net overall population increase of approximately 722 as a result of those jobs,[(a)] all of which, VEPCo concludes, would create SMALL impacts.

The plant-related population increase of 722 would require an additional 220 m^3/day(0.06 MGD) of potable water (VEPCo 2001b).[(b)] All public water supply systems in the impact area are under their current maximum daily capacity (see Table 2-8). There is no moratorium in any part of the impact area on drilling new wells or otherwise finding new or expanding existing water resources and infrastructure. The staff assumed that any increase in demand for water use would be distributed across the impact area, consistent with the assumption that 79 percent of new employees would live in the impact area. The increased demand would represent an insignificant percentage of capacity for the water supply systems in that area. In addition, in Louisa and Orange counties the majority of the population uses groundwater wells as a source of drinking water.

The staff independently reviewed available information and VEPCo's analysis, as set forth above. Because the increase in water use is such a small percentage of the available capacity in the area, the staff concludes that the impact of increased water use is SMALL, and additional mitigation is not warranted.

4.4.3 Offsite Land Use During Operations

Offsite land use during the license renewal term is a Category 2 issue (10 CFR Part 51, Subpart A, Appendix B, Table B-1). Table B-1 of 10 CFR Part 51 Subpart A, Appendix B notes

(a) Calculated by using the average number of persons per household in Virginia, which in Virginia is estimated to be 2.55. Thus (283 jobs X 2.55 = 721.65 or 722) (VEPCo 2001b).
(b) Calculated by assuming that the average American uses 80 gallons of water for personal use per day; 722 people x 80 gpd = 0.06 MGD or 220 m^3/day.

that "significant changes in land use may be associated with population and tax revenue changes resulting from license renewal."

In Section 4.7.4 of the GEIS, the staff define the magnitude of land-use changes as a result of plant operation during the license renewal term as follows:

SMALL - Little new development and minimal changes to an area's land-use pattern.

MODERATE - Considerable new development and some changes to the land-use pattern.

LARGE - Large-scale new development and major changes in the land-use pattern.

VEPCo has identified a maximum of 60 additional employees during the license renewal term plus an additional 223 indirect jobs (total 283) in the community (VEPCo 2001b). In Section 3.7.5 of the GEIS (NRC 1996) the staff found that if plant-related population growth is less than 5 percent of the study area's total population, offsite land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 23 persons/km^2 (60 persons/mi^2), and at least one urban area with a population of 100,000 or more within 80 km (50 mi). In this case, population growth will be less than 5 percent of the area's total population, the area has established patterns of residential and commercial development, a population density of well over 23 persons/km^2 (60 persons/mi^2), and one urban area (Richmond) with a population of 100,000 or more within 80 km (50 mi). Consequently, the staff concludes that population changes resulting from license renewal are likely to result in SMALL offsite land-use impacts.

Tax revenue can also affect land use because it enables local jurisdictions to provide the public services (e.g., transportation and utilities, etc.) necessary to support development. In Section 4.7.4.1 of the GEIS, the staff states that the assessment of tax-driven land-use impacts during the license renewal term should consider (1) the size of the plant's payments relative to the community's total revenues, (2) the nature of the community's existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant's tax payments are projected to be small relative to the community's total revenue, tax-driven land-use changes during the plant's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdiction's revenue, the significance level would be small. If the plant's tax payments are projected to be medium to large relative to the community's total revenue, new tax-driven land-use changes would be moderate.

Louisa County receives the majority of property taxes paid on North Anna Power Station, Units 1 and 2, directly. As these payments amount to 42 percent of the total tax revenue collected by Louisa County (year 2000, see Table 2-15), new tax-driven land-use changes could be moderate (NRC 1996). The other counties (Orange and Spotsylvania) receive more modest amounts, on the order of 1.5 percent. Since no major refurbishment activities are planned at North Anna during the license renewal term, no new sources of plant-related tax payments are expected that could significantly influence land use in Louisa County. Notwithstanding the high proportion of tax revenue VEPCo paid to Louisa County and the County's relatively high population growth during the 1990s, there are no growth-control measures that would limit new housing and land developments in the County.

Louisa County's continued receipt of taxes from North Anna keeps tax rates lower in the County than they might be otherwise. This has enabled the County government and schools to provide a higher level of public infrastructure and services than would be possible otherwise. Louisa County's property tax rates are significantly lower than those of any of the surrounding counties because of North Anna's presence in Louisa County. Continued operation of North Anna provides significant economic stability to Louisa County. Other jurisdictions in the impact area benefit from North Anna through its employees who live in the impact area and from the relatively low property taxes paid. Based on the information given above, the staff concludes that tax-related land-use impacts are likely to be SMALL.

Based on a review of the issues related to land use and the criteria in the GEIS, for the reasons set forth below, the staff also concludes that the net impact of plant-related population changes on land-use is likely to be SMALL. There are three reasons for this conclusion. First, VEPCo does not intend to refurbish Units 1 and 2 in conjunction with license renewal. Thus, there will be no increase in employment at the North Anna site as a result of license renewal activities. Second, VEPCo envisions that its permanent workforce will remain stable during the license renewal operation period of up to 20 years. Third, the population increase in Louisa County during the 1990s, not related to North Anna, was approximately 26 percent. While this rate of growth may continue during the first decade of the new century, it is expected to be the result of economic activity not related to North Anna's continued operation. Thus, additional mitigation of land-use impacts during the license renewal term does not appear to be warranted.

4.4.4 Public Services: Transportation Impacts During Operations

On October 4, 1999, 10 CFR 51.53(c)(3)(ii)(J) and 10 CFR Part 51, Subpart A, Appendix B, Table B-1 were revised to clearly state that "Public Services: Transportation Impacts During Operations" is a Category 2 issue (see NRC 1999 for more discussion of this clarification). The issue is treated as such in this SEIS.

In 2001, most of the roadways within Louisa County were operating at acceptable levels of service.[(a)] As shown in Table 2-7, the population in Louisa County, the county most impacted by the presence of North Anna, is projected to increase from approximately 25,625 to 30,005, or by approximately 26 percent, from 2000 to 2010 (Virginia Employment Commission 2001). It is expected to increase by another 15 percent between 2010 and 2020 (Louisa County Planning Department 2001). While such growth would put pressure on the local transportation system, it probably would not overwhelm the system. An adequate transportation system exists, and the population projection increases are based on a small population; i.e., a large percentage increase but small increase in absolute numbers. Also, several improvements are planned in Louisa County over the next 15 years for primary and secondary roads to maintain a level of service "C" rating (Louisa County Planning Department 2001).

However, none of the expected growth and projected improvements to the transportation system are directly due to increases in North Anna's employment. The permanent employment associated with North Anna is currently 851 employees and from 70 to 110 contract and licensee employees assigned from other departments (VEPCo 2001b). During periods of refueling, once or twice a year, an additional 700 temporary workers are hired to participate in refueling and other maintenance activities. The "upper bound" potential increase in permanent staff during the license renewal term is 60 additional workers, or approximately 6 percent of the current permanent and contract work force of 921 to 961 (permanent plus contract employees). Access to North Anna is over secondary, as opposed to primary, roads (State Highways 700 and 652) that carry a level of service designation of "B." In the GEIS (Section 3.7.4.2) the staff concludes that impacts to roads with a level of service designation of "B" are small (NRC 1996). The rationale is that individual users are not substantially affected by the presence of other users. At this level of service, no delays occur and no improvements are needed. Based on these facts, VEPCo concludes that the impacts on transportation during the license renewal term would be SMALL, and no further mitigation would be warranted (VEPCo 2001b).

The staff reviewed VEPCo's assumptions and resulting conclusions and conducted independent onsite interviews and observation of transportation conditions around North Anna during the week of October 14, 2001. The staff found that the bases for the VEPCo conclusions were sound. Therefore, the staff concludes that any impact of North Anna Power

(a) This conclusion is based on several interviews conducted with persons located in Louisa County during a site visit October 15 through October 19. The major bottleneck, mentioned by a number of interviewees, is where State Highway 208 leaves U.S. Route 33 in downtown Louisa. There is a very sharp curve at this intersection that semi-trucks have trouble negotiating. The proposed solution is a by-pass highway around Louisa. Funding for the project is currently in question (personal communication with Mr. Lee Lintecum, County Administrator, Louisa County, October 19, 2001).

Station, Units 1 and 2, license renewal on transportation service degradation is likely to be SMALL and would not require any additional mitigation.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA), as amended through 1992, requires that Federal agencies take into account the effects of their undertakings on historic properties. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800 as amended through 1999. Renewal of an OL could potentially affect historic properties that may be located at the site. Therefore, according to the NHPA, the NRC is required to make a reasonable effort to identify historic properties in the areas of potential effects. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Officer (SHPO) before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

VEPCo has stated in the ER (VEPCo 2001b) that no additional land-disturbing activities at the plant or along the existing transmission line rights-of-way are planned for the North Anna Power Station, Units 1 and 2, license renewal period. VEPCo has recently taken an aggressive approach to recording and protecting known cultural resource sites, as in the case of the five cemeteries at the North Anna site. As part of the cultural resource assessment effort, the entire plant site has been classified into one of three categories, based on the potential for undiscovered historic properties to be present, including recommendations for responding to inadvertent discovery and possible adverse effects to resources. These include the following:

- Areas with No Potential for archaeological resources. These areas include lands where past disturbances related to construction of the power station and appurtenant facilities have taken place to such an extent that any cultural resources that once existed are no longer present. No further archaeological investigations are recommended for these areas.

- Areas with Low Potential for archaeological resources. Lands within the North Anna site that fall into this category are those that are relatively undisturbed but possess characteristics which would normally indicate a low probability for most types of cultural resources to occur. For the most part, these lands have a degree of slope greater than 15 percent. For most of these areas, further archaeological work would not be necessary, although there could be smaller areas within the larger zone where specific ground conditions could require investigation.

- Areas with Moderate-to-High Potential for archaeological resources. These areas are classified as those that are relatively undisturbed by past activities and have a likelihood

for prehistoric and historic archaeological sites according to local models of prehistoric and historic land use and settlement patterning. Archaeological investigation is recommended prior to undertaking any ground-disturbing activities in these areas.

In addition to assessing the known and potential occurrence for cultural resources and classifying plant lands according to resource potential, VEPCo includes cultural resource-specific written directions in their sitewide excavation and backfill work procedures involving an immediate stop work order should archaeological, historical, or other cultural resources be uncovered during excavation. The Construction Supervisor is responsible for ensuring the work stoppage and for notifying the Environmental Compliance Coordinator of the inadvertent discovery.

Based on the staff's cultural resources analysis and VEPCo's conclusion that major refurbishment activities are not needed to support the renewal of the North Anna Units 1 and 2 OLs and that operation will continue within the bounds of plant operations as evaluated in the Final Environmental Statement and its addendums (AEC 1973, NRC 1976 and 1980), the staff concludes that the potential impacts on historic and archaeological resources are expected to be SMALL, and further mitigation is not warranted. The staff also concludes that it is unnecessary at this time to enter into a cultural resources programmatic agreement pursuant to Section 106 (NRC 2002a).

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority[(a)] or low-income populations. Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969 (NEPA). The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although it is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. NRC staff used the guidance in NRC Office of Nuclear Reactor Regulation office instruction number LIC-203 (NRC 2001) for its review.

The staff examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of North Anna, employing the 1990 Census (USCB 1990a) for low-income

(a) The NRC Guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; or Black races; or Hispanic ethnicity. "Other" races and multi-racial individuals may be considered as separate minority categories. (NRC 2001).

populations and the 2000 Census (USCB 2000) for minority populations. The radius within 80 km (50 mi) of North Anna encompassed counties in Virginia and Maryland. The analysis was also supplemented by field inquiries to the planning department and social service agencies in Louisa County.[(a)]

For the purpose of the staff's review, a minority population is defined to exist if the percentage of any minority or aggregated minority category within the census block groups[(b)] potentially affected by the license renewal of North Anna exceeds the corresponding percentage of minorities in the entire Commonwealth of Virginia and State of Maryland (for Charles County, Maryland) by 20 percent, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the entire Commonwealth of Virginia/State of Maryland by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent. For counties and census block groups within an 80-km (50-mi) radius of North Anna, the percentage of minority and low-income populations is compared to the percentage of minority and low-income populations in Virginia or Maryland, as applicable.

VEPCo followed the convention of including census tracts. It included the census tracts where at least 50 percent of their area lies within 80 km (50 mi) of North Anna (VEPCo 2001b). Using this convention, the 80-km (50-mi) radius includes 351 census tracts. The "more than 20 percentage points above the comparison area" criterion was used to determine whether a census tract should be counted as containing a minority or low-income population (VEPCo 2001b). Because the 20 percentage points is a lower threshold, the 50 percent criteria was not needed.

The staff followed the convention of employing census block groups and counts of individuals in minority or low-income status. Figure 4-1 shows the distribution of minority populations (shaded areas) within the 80-km (50-mi) radius. Within 32 km (20 mi) of North Anna, a minority population is concentrated to the southwest of the site in Louisa County.

(a) Louisa County was the focus of this inquiry because North Anna is located there. The staff concluded that any findings of environmental justice issues in the county would warrant further field of inquiries in the neighboring counties. For reasons stated later in this section, further investigation was not warranted.

(b) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the Census Bureau collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census data users in accordance with Census Bureau guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2001).

Black minority populations exist within approximately 24 km to 48 km (15 mi to 30 mi) east-southeast of the site on Caroline County's boundary with Hanover County and extending to King William County. Between approximately 64 km (40 mi) and 80 km (50 mi) distance east of the North Anna site, minority populations exist in Essex and Westmoreland counties. A concentration of minority census block groups exists in Charles County (Maryland) and Prince William County in Virginia, east-northeast of the site. Between 64 km (40 mi) and 80 km (50 mi) southeast of North Anna, there is a concentration of minority census block groups in the Richmond City area, and to the south – southwest a concentration in Buckingham, Fluvanna, Goochland and Cumberland Counties. Minority populations also appear northwest of North Anna in Culpeper County. All minority block groups are more than approximately 16 km (10 mi) from North Anna.

Data from the 1990 census characterize 11 percent of Virginia (Weldon Cooper Center for Public Service 1990) and 8 percent of Maryland households as low-income (USCB 1990b). Applying the NRC criterion of "more than 20 percent greater," the census block groups were identified to contain low-income populations. Census block groups containing low-income populations are concentrated in Richmond City, Henrico and Chesterfield Counties to the southeast between approximately 65 km and 80 km (40 mi and 50 mi) from the site. Other areas of low-income populations include Buckingham County, southwest of the site, and Charlottesville. Figure 4-2 shows the locations of the low-income populations within 80 km (50 mi) of North Anna.

With the locations of minority and low-income populations identified, the staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately high and adverse manner. Consistent with staff guidance (NRC 2001), air, land, and water resources within about 80 km (50 mi) of the North Anna site were examined. Within that area, a few potential environmental impacts could affect human populations. All of these were considered SMALL for the general population.

The pathways through which the environmental impacts associated with North Anna Units 1 and 2, license renewal can affect human populations are discussed in each associated section. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations. Accordingly, the staff concludes that offsite impacts from North Anna Power Station, Units 1 and 2, license renewal to minority and low-income populations would be SMALL, and no additional mitigation actions are warranted.

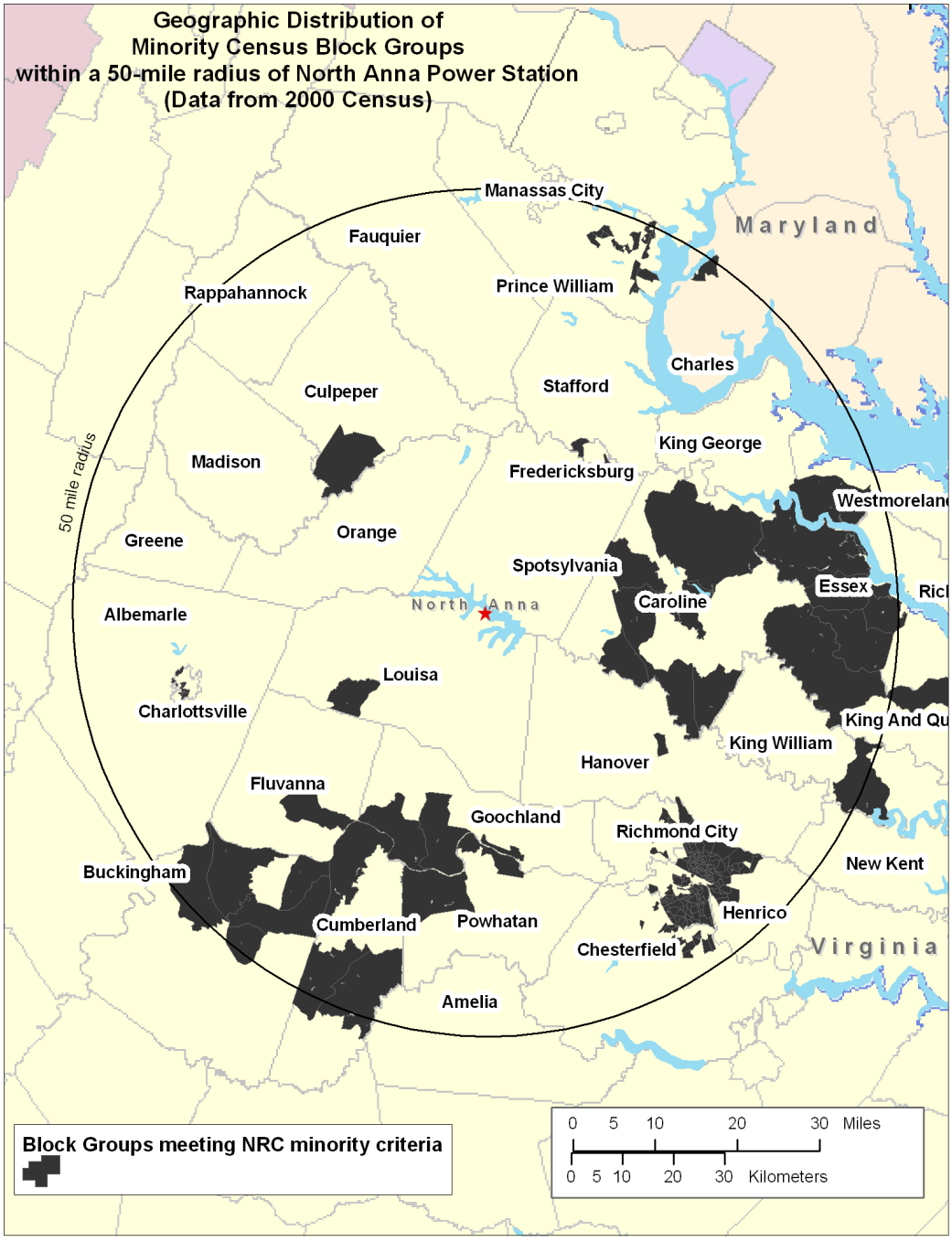

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of North Anna. Based on Census Block Group Data and Individual Counts.

Figure 4-2. Locations of the Low-Income Populations (Shown in Shaded Areas) Within 80 km (50 mi) of North Anna. Based on Census Block Group Data and Individual Counts.

4.5 Groundwater Use and Quality

One Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that is applicable to North Anna Power Station groundwater use and quality, is listed in Table 4-8. VEPCo stated in its ER (VEPCo 2001b) that it is not aware of any new and significant information associated with the renewal of the North Anna OLs. The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS. For this issue, the staff concludes that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-8. Category 1 Issue Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
GROUNDWATER USE AND QUALITY	
Groundwater-use conflicts (potable and service water; plants that use [<]100 gpm).	4.8.1.1

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, follows.

- Groundwater-use conflicts (potable and service water; plants that use <100 gpm).

  Based on information in the GEIS, the Commission found that

  > Plants using less than 100 gpm are not expected to cause any ground-water use conflicts.

  As discussed in Section 2.2.2, North Anna Power Station groundwater use is less than 0.068 m^3/s (100 gpm). The staff has not identified any significant new information on this issue during its independent review of the VEPCo ER (VEPCo 2001b), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no groundwater-use conflicts during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to groundwater use and quality for North Anna.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-9.

Table 4-9. Category 2 Issue Applicable to Threatened or Endangered Species During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
Threatened or endangered species	4.1	E	4.6

This issue requires consultation with appropriate agencies to determine whether threatened or endangered species are present and whether they would be adversely affected by continued operation of North Anna during the license renewal term. The presence of threatened or endangered species in the vicinity of the North Anna site is discussed in Sections 2.2.5 and 2.2.6. The NRC initiated consultation under Section 7 of the Endangered Species Act in January 2002 with a request for information to the FWS concerning species potentially occurring near the North Anna site and related transmission line rights-of-way (NRC 2002b). The results of that request are pending.

VEPCo maintains contacts with agencies responsible for protected and sensitive species to ensure compliance of its activities. In addition to its ongoing discussions, on April 12, 2000, VEPCo initiated correspondence with the FWS Virginia Field Office and VDGIF concerning threatened and endangered species (VEPCo 2000b and 2000c). FWS requested further review of the project by VDGIF, the Virginia Department of Agriculture and Consumer Service (VDACS), and the VDCR Natural Heritage Program (FWS 2000). According to VEPCo correspondence, a meeting was held with these agencies to provide initial information on the project (VEPCo 2000d and 2000e). On January 25, 2001, VEPCo submitted a copy of the draft ER to FWS for review (VEPCo 2001a). A second meeting was held with the agencies to obtain the results of their review of the draft ER. In a letter dated March 13, 2001, to the FWS Chesapeake Bay Field Office, the FWS Virginia Field Office found that the North Anna license renewal would not impact Federally listed species (FWS 2001a). At this point, the FWS Chesapeake Bay Field Office took the FWS lead for review of the North Anna license renewal project.

In a letter dated October 26, 2001, to the NRC, the FWS Chesapeake Bay Field Office provided comments on its detailed review of the licensee's ER (FWS 2001b). In these comments FWS

included information regarding aquatic and terrestrial species that may be in the vicinity of North Anna, Lake Anna, and the transmission line rights-of-way. FWS did not identify additional species beyond those included in the ER.

4.6.1 Aquatic Species

As described in Section 2.2.5, no listed threatened or endangered species have been observed in Lake Anna, the portion of the North Anna River immediately upstream and downstream of Lake Anna, or in streams or tributaries crossed by North Anna transmission lines. As indicated above, VEPCo initiated correspondence with FWS and VDGIF regarding potential effects of license renewal on Federal- and Commonwealth-listed species. VEPCo did not consult with the National Marine Fisheries Service (NMFS) because species under the jurisdiction of NMFS are not known to be in the vicinity of North Anna.

As also mentioned above, the FWS Chesapeake Bay Field Office provided comments to the NRC on its review of the VEPCo ER (FWS 2001b). Included in those comments, the FWS requested that clarification of information on some fish and mussel species be made in the SEIS. This is addressed in Section 2.2.5.

Based on these considerations, the staff has determined that the impacts to endangered, threatened, proposed or candidate aquatic species of an additional 20 years of operation of North Anna Power Station, Units 1 and 2, and continued maintenance of the transmission lines would be SMALL, and no additional mitigation is warranted.

4.6.2 Terrestrial Species

The bald eagle (*Haliaectus leucocephalus*) and loggerhead shrike (*Lanius Ivdovicianus*) are the only Federal- or Commonwealth-listed terrestrial animal species known to occur at North Anna or along the transmission line rights-of-way. A number of other listed species could occur at the North Anna Power Station or along the transmission line rights-of-way. They are listed in Table 2-3. The small whorled pogonia (*Isotria medeoloides*) and swamp pink (*Helonias bullata*) are two Federal- and Commonwealth-listed species known to occur in Carolina County, which contains a portion of the Ladysmith transmission line right-of-way; however, neither species was observed during plant surveys of the lines. Vegetation management protocols for the transmission lines have been developed in cooperation with the VDCR Natural Heritage Program (VEPCo 2001b). In addition, rare plant species surveys are conducted annually along the transmission line rights-of-way. Finally, the staff did not find any evidence that the operation and maintenance of the plant or the transmission lines were adversely affecting protected animal species.

The staff has reviewed the information provided by the applicant and has contacted FWS and VDGIF. Based on the site visit, review of the VEPCo ER, other reports, and consultation with FWS and VDGIF, it is the staff's preliminary conclusion that the impacts on endangered, threatened, proposed, or candidate species of an additional 20 years of operation and maintenance of North Anna Power Station, Units 1 and 2, and associated transmission lines would be SMALL, and additional mitigation is not warranted.

4.7 Evaluation of Potential New and Significant Information on Impacts of Operations During the Renewal Term

During the scoping period, comments were received that indicated concerns related to the North Anna Dam. In addition, the staff identified an issue for consideration that was not specifically addressed in the GEIS. These issues are addressed in the following sections.

4.7.1 Evaluation of Potential New and Significant Information Received from the FWS Chesapeake Bay Field Office

On October 26, 2001 (during the scoping period), the staff received a letter from the FWS Chesapeake Bay Field Office (FWS 2001b) containing comments on their review of VEPCo's ER (VEPCo 2001b). Among the comments, FWS raised concerns that "the [North Anna] dam may be causing significant impacts to the North Anna River," particularly with respect to the distribution of fish (both anadromous and riverine) and mussel species.

The North Anna Dam was licensed by the Commonwealth of Virginia (Commonwealth of Virginia State Corporation Commission 1969), and it had already been constructed before the Atomic Energy Commission (AEC, predecessor to the NRC) performed its environmental review for North Anna. At the time of initial licensing of North Anna Power Station, Units 1 and 2, the AEC considered the construction impacts of the project on the environment in a final environmental statement (FES) (AEC 1973). Operational impacts were discussed in the 1973 FES and the 1976 and 1980 addenda (NRC 1976; NRC 1980). The two licensing actions (the dam and the power station) were separate actions, although the power station relies on the reservoir (Lake Anna) for cooling water.

In 1984, VEPCo applied for and received a licensing exemption from the Federal Energy Regulatory Commission (FERC) for the construction of the hydroelectric unit (FERC 1984). The exemption was applicable to this project because of its small size (design power output of 855 kW). As a result of comments from FWS, VEPCo was required to perform a fish passage study after the hydroelectric unit was built (VEPCo 1989b). Therefore, while AEC/NRC licensed

North Anna Power Station, Units 1 and 2, the dam and the hydroelectric unit were licensed by other government agencies in separate actions.

In addition to providing cooling water for the North Anna Power Station, the impoundment also provides flood control to the lower North Anna River, recreational opportunities, hydroelectric power, water quality improvement, and the opportunity for lakefront residential property.

As noted in Section 2.2.5, the current Lake Anna fish populations are diverse and relatively stable. Since impoundment, the abundance and diversity of fish and mussel populations in the North Anna River below the dam have steadily increased. These increases are largely a consequence of the improvement in water quality in this portion of the river because the lake neutralizes the pollutants coming from Contrary Creek.

In the process of evaluating whether the dam was within the scope of the current action, the staff visited the site and reviewed VEPCo's license renewal ER as well as numerous supporting documents and literature concerning aquatic resources in Lake Anna and the North Anna River, as cited in sections 2.2.5, 4.1.1, 4.1.2 and 4.1.3. The supporting documents included, among others, VEPCo's ER for initial licensing (VEPCo 1972) and NRC's final environmental statement for construction of North Anna (AEC 1973), which described the potential impacts associated with the impoundment of the North Anna River.

Based on its review, the NRC staff considers the impacts associated with the operation of the North Anna Dam to be outside the scope of the current proposed action (license renewal for North Anna Power Station, Units 1 and 2). However, the staff will inform VEPCo of the comments provided by FWS and recommend that VEPCo contact FWS to open a further dialogue about these concerns outside the context of license renewal for North Anna Power Station, Units 1 and 2.

4.7.2 Evaluation of Potential New and Significant Information Related to Hydrilla

During its review, the staff identified a potential issue related to the nuisance species hydrilla (*Hydrilla verticillata*). Hydrilla is a submerged, aquatic macrophyte that inhabits many freshwater rivers, lakes, and ponds in North America (Overton 1995). Higher water temperatures can increase the growing season of hydrilla. By 1994 hydrilla covered more than 304 ha (750 ac) in Lake Anna and about 405 ha (1000 ac) in the WHTF. In 1994, VEPCo stocked the herbivorous grass carp (*Ctenopharyngoden idella*) in Lake Anna and the WHTF, with the approval of VDGIF, to control the growth of the hydrilla. As a result, the area covered by hydrilla has been reduced. In 1999, hydrilla occupied 45.7 ha (113 ac) in Lake Anna and 14.4 ha (35.5 ac) in the WHTF (VEPCo 2000a). This represents 3 percent and 2 percent of the maximum available habitat in the lake and WHTF, respectively. The grass carp appears to be

effectively controlling the growth and biomass of hydrilla. Therefore, the staff concludes that this issue is not significant and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

4.8 Summary of Impacts of Operations During the Renewal Term

Neither VEPCo nor the staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with the North Anna operation during the renewal term. Consequently, the staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concluded that the impacts would be SMALL and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 12 Category 2 issues applicable to the North Anna operation during the renewal term and for environmental justice and chronic effects of electro-magnetic fields. For the 12 issues and environmental justice, the staff concluded that the potential environmental impact of renewal term operations of North Anna would be of SMALL significance in the context of the standards set forth in the GEIS and that further mitigation would not be warranted. This includes the staff's preliminary conclusion, pending concurrence from FWS, that the impact on endangered, threatened, or candidate species from license renewal would be SMALL, and further mitigation is not warranted. In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields. Therefore, no evaluation of this issue is required.

4.9 References

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