8.0 Environmental Impacts of Alternatives to Operating License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of the operating licenses (OLs) (i.e., the no-action alternative); the potential environmental impacts from electric generating sources other than Catawba Nuclear Station, Units 1 and 2 (Catawba); the possibility of purchasing electric power from other sources to replace power generated by Units 1 and 2 and the associated environmental impacts; the potential environmental impacts from a combination of generating and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by Units 1 and 2. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC's) three-level standard of significance (i.e., SMALL, MODERATE, or LARGE) developed using the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of 10 CFR 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999)[(a)] with the additional impact category of environmental justice.

8.1 No-Action Alternative

NRC's regulations implementing the National Environmental Policy Act (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (40 CFR Part 51, Subpart A, Appendix A[4]). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the Catawba OLs, and Duke Energy Corporation (Duke) would then decommission both units when plant operations cease. Replacement of

(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.

Catawba's electricity generation capacity would be met by (1) demand-side management and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than Catawba, Units 1 and 2, or (4) some combination of these options.

Duke will be required to comply with NRC decommissioning requirements whether or not the OLs are renewed. If the Catawba OLs are renewed, decommissioning activities may be postponed for up to an additional 20 years. If the OLs are not renewed, Duke would conduct decommissioning activities according to the requirements in 10 CFR 50.82.

The environmental impacts associated with decommissioning under both license renewal and the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the GEIS, Chapter 7 of this draft Supplemental Environmental Impact Statement (SEIS), and the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586 dated August 1988[(a)]. The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those occurring after 40 years of operation.

The environmental impacts for the socioeconomic, historic and archaeological resources, and environmental justice impact categories are summarized in Table 8-1 and discussed in the following paragraphs. In some cases, impacts associated with the no-action alternative would be positive. For example, closure of Units 1 and 2 would eliminate any impingement and entrainment of fish and shellfish and any negative impacts resulting from thermal discharges to Lake Wylie.

Table 8-1. Summary of Environmental Impacts of the No-Action Alternative

Impact Category	Impact	Comment
Socioeconomic	SMALL to MODERATE	Decrease in employment, higher-paying jobs, and tax revenues
Historic and Archaeological Resources	SMALL	Land occupied by Units 1 and 2 would likely be retained by Duke
Environmental Justice	SMALL to MODERATE	Loss of employment opportunities and social programs

(a) The NRC staff is currently supplementing NUREG-0586 for reactor decommissioning. In October 2001, the staff issued draft supplement 1 to NUREG-0586 dealing with Decommissioning of Nuclear Power Reactors (NRC 2001a) for public comment. The staff is currently finalizing the draft supplement for publication as a final document.

- Socioeconomic: When Catawba ceases operation, there will be a decrease in employment and tax revenues associated with the closure. Impacts on employment (primary and secondary) and population would occur over a wide area. Employees at Catawba reside in a number of Counties in South and North Carolina. The majority live in York County, South Carolina (55 percent) and Gaston and Mecklenburg Counties, North Carolina (15 and 14 percent, respectively; Duke 2001).

  Tax-related impacts would occur in York County and the town of Clover, which is within York County. In 2000, Duke paid property taxes for Catawba to York County in the amount of $35,861,194, or 21.9 percent of the real and personal property taxes paid in the county (see Table 2-16). Approximately 75 percent of the property taxes paid by Catawba are allocated in support of the Clover School District in York County.

  The no-action alternative would result in the loss of the taxes attributable to Catawba as well as the loss of plant payrolls 20 years earlier than if the OLs were renewed. Given the relatively large percentage of revenue in York County and the Clover School District derived from Catawba, the decline in property tax revenue would have a LARGE impact on the school district and SMALL to MODERATE impact on the county depending on future economic growth in the county. The ability of the two jurisdictions to provide public services and road maintenance (York County) and school services (Clover School District and to a lesser extent the remaining three school districts) would be adversely impacted.

  There would also be an adverse impact on housing values (probably concentrated in upper scale homes due to the higher salaries and wages paid by Catawba) and the York County economy if Catawba were to cease operations.

  Duke employees working at Catawba currently contribute time and money to community activities, including schools, churches, charities, and other civic activities. It is likely that with a reduced presence in the community following decommissioning, community involvement by Duke and its employees in the region would be less.

- Historic and Archaeological Resources: The potential for future adverse impacts to known or unrecorded cultural resources at Catawba following decommissioning will depend on the future use of the land occupied by the existing plant. Following decommissioning, the land occupied by Catawba probably would be retained by Duke for other corporate purposes. Eventual sale or transfer of the land occupied by Catawba, however, could result in adverse impacts to cultural resources if the land-use pattern were changed too dramatically. Catawba is located on Lake Wylie and is surrounded by upscale housing developments. Land use at the site could change to residential-housing use should Duke sell or transfer the site. However, given the site's small size of approximately 158 ha (391 ac), of which 106 ha (262 ac) is nonforested

and contains the generation and maintenance facilities, parking lots, open water, and roads and the fact that the site is free of significant archaeological and historical sites, the impacts of this alternative on historic and archaeological resources are considered SMALL.

- Environmental Justice: Current operations at Catawba have no disproportionate impacts on the minority and low-income populations of York County and the other counties surrounding the plant, and no environmental pathways have been identified that would cause disproportionate impacts on these populations. Closure of Catawba would result in decreased employment opportunities in York County and surrounding counties, thus tax revenues would decrease possibly leading to negative and disproportionate impacts on minority or low-income populations. Because Catawba is located in a relatively urban area with extensive employment opportunities, the environmental justice impacts under the no-action alternative are considered SMALL to MODERATE.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by Catawba, assuming that the OLs for Units 1 and 2 are not renewed. The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impacts. The following generation alternatives are considered in detail:

- coal-fired generation at the Catawba site and at an alternate greenfield site (Section 8.2.1)
- natural-gas-fired generation at the Catawba site and at an alternate greenfield site (Section 8.2.2)
- nuclear generation at the Catawba site and at an alternate greenfield site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated at Catawba is discussed in Section 8.2.4. Other power generation and conservation alternatives considered by the staff and found not to be reasonable replacements for Catawba are discussed in Section 8.2.5. Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an annual energy outlook. The latest report, *Annual Energy Outlook*

2002 with Projections to 2020, was issued in December 2001 (DOE/EIA 2001a). In this report, EIA projects that combined-cycle[(a)] or combustion turbine technology fueled by natural gas is likely to account for approximately 88 percent of new electric generating capacity between the years 2000 and 2020. Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet baseload[(b)] requirements. Coal-fired plants are projected by EIA to account for approximately 9 percent of new capacity during this period. Coal-fired plants are generally used to meet baseload requirements. Renewable energy sources, primarily wind, geothermal, and municipal solid waste units, are projected by EIA to account for the remaining 3 percent of capacity additions. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest generation cost in 2005 through 2020, followed by coal-fired plants and then wind generation (DOE/EIA 2001a).

EIA projects that oil-fired plants will account for very little of new generation capacity in the United States during the 2000 to 2020 time period because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). However, oil as a back-up fuel to natural-gas-fired generation (combined cycle) is considered.

EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States during the 2000 to 2020 time period because natural gas and coal-fired plants are projected to be more economical (DOE/EIA 2001a). In spite of this projection, a new nuclear plant alternative for replacing power generated by Catawba is considered in Section 8.2.3. Since 1997, the NRC has certified three new standard designs for nuclear power plants under the procedures in 10 CFR Part 52, Subpart B. These designs are the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). The submission to the NRC of these three applications for certification indicates continuing interest in the possibility of licensing new nuclear power plants. NRC has established a New Reactor Licensing Project Office to prepare for and manage future reactor and site licensing applications (NRC 2001b).

(a) In a combined-cycle unit, hot combustion gases in a combustion turbine rotates the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

(b) A baseload plant normally operates to supply all or part of the minimum continuous load of a system and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for baseload generation (i.e., these units generally run near full load).

8.2.1 Coal-Fired Generation

The coal-fired alternative is analyzed for both the Catawba site and an alternate greenfield site. The staff assumed the construction of four 600 megawatt electric (MW[e]) units, which is consistent with the Catawba Environmental Report (ER; Duke 2001). This assumption will slightly overstate the impacts of replacing the 2258 MW(e) generated by Catawba.

Coal and lime or limestone for a coal-fired plant sited at Catawba most likely would be delivered by railroad via the existing rail line. Lime[(a)] or limestone is used in the scrubbing process for control of sulfur dioxide (SO_2) emissions. Rail delivery also would be the most likely option for delivering coal and lime/limestone to an alternate greenfield site for the coal-fired plant. A coal slurry pipeline is also a technically feasible delivery option; however, the associated cost and environmental impacts make a slurry pipeline an unlikely transportation alternative. Construction at an alternate site could necessitate the construction of a new transmission line to connect to existing lines and a rail spur to the plant site.

The coal-fired plant is assumed to utilize tangentially fired, dry-bottom boilers and consume bituminous, pulverized coal with an ash content of approximately 10 percent by weight (Duke 2001). Annual coal consumption would be approximately 5.76 million MT/yr (6.35 million tons/yr) (Duke 2001). The Catawba ER (Duke 2001) assumes a heat rate[(b)] of 2.7 J fuel/J electricity (9364 Btu/kWh) and a capacity factor[(c)] of 0.8. After combustion, 99.9 percent of the ash (approximately 572,000 MT/yr [630,000 tons/yr) would be collected and disposed of at the plant site. In addition, approximately 304,000 MT/yr (335,000 tons/yr) of scrubber sludge would be disposed of at the plant site (Duke 2001).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the Catawba ER (Duke 2001). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

(a) In a typical wet scrubber, lime (calcium hydroxide) or limestone (calcium carbonate) is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime-based scrubbing solution reacts with sulfur dioxide to form calcium sulfite which precipitates and is removed in sludge form.

(b) Heat rate is a measure of generating station thermal efficiency. In English units, it is generally expressed in British thermal units (Btu) per net kilowatt-hour (kWh). It is computed by dividing the total Btu content of fuel burned for electric generation by the resulting net kWh generation.

(c) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

8.2.1.1 Closed-Cycle Cooling System

For purposes of this SEIS, the staff assumed that a coal-fired plant located at Catawba would use the existing closed-cycle cooling system. The staff also assumed that an alternate greenfield site would use a closed-cycle cooling system.

The overall impacts of the coal-fired generating system are discussed in the following sections and summarized in Table 8-2. The extent of impacts at an alternate greenfield site would depend on the location of the particular site selected.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at Catawba Nuclear Station and an Alternate Greenfield Site Using Closed-Cycle Cooling

	Catawba Nuclear Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE to LARGE	Use of unused portion of Catawba site plus additional offsite, undisturbed land would be needed. Additional offsite land impacts for coal and limestone mining. Degree of impact depends on characteristics of land being converted: MODERATE for a previously disturbed site; LARGE for an undisturbed site.	SMALL to LARGE	Uses up to 700 ha (1700 ac) for plant infrastructure and waste disposal; additional land impacts for coal and limestone mining; possible impacts for transmission line and rail spur. Degree of impact dependent on whether alternate site is previously disturbed: SMALL to MODERATE for a previously disturbed site; LARGE for a greenfield site.
Ecology	MODERATE to LARGE	Uses undeveloped areas at Catawba plus significant amount of previously undisturbed offsite land. Potential for habitat loss and fragmentation and reduced productivity and biological diversity.	SMALL to LARGE	Impact depends on whether site is previously developed (SMALL) or greenfield (MODERATE to LARGE). Factors to consider include location and ecology of the site, surface water body used for intake and discharge, and transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Surface Water Use and Quality	SMALL	Closed-cycle cooling would use existing intake structures; surface water use should remain the same as current uses for Catawba.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body; new intake structures required.

Table 8.2. (contd)

	Catawba Nuclear Station Site			Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**		**Impact**	**Comments**
Groundwater Use and Quality	SMALL	Less groundwater withdrawn for potable use because of smaller workforce.		SMALL to LARGE	Impacts SMALL if groundwater used only for potable water; MODERATE to LARGE if groundwater used as makeup cooling water (impacts would be site/aquifer specific).
Air Quality	MODERATE	Sulfur oxides • 5757 MT (6346 tons/yr) Nitrogen oxides • 7196 MT/yr (7932 tons/yr) Particulates • 288 MT/yr (317 tons/yr) of total suspended particulates which would include 192 MT/yr (212 tons/yr) of PM_{10} Carbon monoxide • 1439 MT/yr (1586 tons/yr) Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials – mainly uranium and thorium.		MODERATE	Potentially same impacts as the Catawba site, although pollution control standards may vary.
Waste	MODERATE	Total waste volume would be approximately 907,300 MT/yr (1 million tons/yr) of ash, spent catalyst, and scrubber sludge requiring approximately 227 ha (560 ac) for disposal during the 40-year life of the plant.		MODERATE	Same impacts as Catawba site; waste disposal constraints may vary.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.		SMALL	Same impact as Catawba site.

Table 8-2. (contd)

Impact Category	Catawba Nuclear Station Site		Alternate Greenfield Site	
	Impact	**Comments**	**Impact**	**Comments**
Socio-economics	SMALL to LARGE	During construction, impacts would be SMALL to MODERATE. Up to 2500 workers during the peak of the 5-year construction period, followed by reduction from current Catawba work-force of 1218 to 250. Tax base preserved. Impacts during operation would be SMALL.	SMALL to LARGE	Construction impacts depend on location, but could be SMALL to LARGE. If plant is located in a rural area impacts could be LARGE. Tax impacts on receiving county could be SMALL to LARGE. York County would experience loss of Catawba tax base and employment with potentially MODERATE to LARGE impacts. Impact to Clover School District (York County) would be LARGE. Impacts during operation would be SMALL.
		Transportation impacts of commuting operating personnel would be SMALL due to a smaller workforce. Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts associated with train trips to and from the plant would be MODERATE to LARGE.		Transportation impacts during operation would be SMALL to MODERATE. Transportation impacts associated with con-struction workers could be MODERATE to LARGE. For rail transportation of coal and lime/limestone, the impact is considered SMALL to MODERATE. For barge transportation, the impact is considered SMALL.
Aesthetics	MODERATE	MODERATE aesthetic impact. Exhaust stacks and stack emissions visible from offsite, would impact residential developments around Lake Wylie. Rail transportation of coal and lime/limestone would have a MODERATE aesthetic impact. Noise impact from plant operations would be MODERATE. Mechanical noise associated with coal handling and plant operation would be audible offsite.	SMALL to LARGE	Impact would depend on the site selected and the surrounding land features and could be LARGE if a greenfield site was selected. If needed, a new transmission line or rail spur would add to the aesthetic impact. Rail transportation impact of coal and lime/limestone would be SMALL to MODERATE, again depending on the characteristics of the alternate site. Barge transportation of coal and lime/limestone would have a SMALL aesthetic impact. Noise impact from plant operations would be MODERATE.

Table 8-2. (contd)

Impact Category	Catawba Nuclear Station Site		Alternate Greenfield Site	
	Impact	**Comments**	**Impact**	**Comments**
Historic and Archaeological Resources	SMALL	Some construction would affect previously developed parts of the Catawba site; cultural resource inventory should minimize any impacts on undeveloped lands. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped land for cultural resources at the existing site.	SMALL	Alternate location would necessitate cultural resource studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on undeveloped sites for cultural resources.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 968 operating jobs at Catawba could reduce employment prospects for minority and low-income populations. Impacts dependent on the economic vitality and expansion of Charlotte and surrounding area, including York County.	SMALL to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site. Could be SMALL to LARGE. York County would lose tax revenue and 673 jobs with SMALL to MODERATE impacts. Clover School District (York County) would be significantly impacted, which may have a MODERATE to LARGE impact on minority and low-income populations.

- **Land Use**

The existing facilities and infrastructure at the Catawba site would be used to the extent practicable. Specifically, the staff assumed that the coal-fired replacement plant alternative would use the existing closed-cycle cooling system, switchyard, offices, and transmission line rights-of-way. Additional land beyond the current Catawba site of 158 ha (391 ac) would be needed to construct a new coal-fired plant while the existing nuclear Units 1 and 2 continue to operate. In the GEIS (NRC 1996), the staff estimates that approximately 700 ha (1700 ac) would be needed to construct a 1000-MW(e) coal plant at a greenfield site. If a coal-fired station with a capacity of more than 2200 MW(e) was built while Catawba was still in operation, the use/conversion of more land than is available at the Catawba site would be required.

The coal-fired generation alternative would require converting a significant quantity of land to industrial use for the plant, coal storage, and landfill disposal of ash, spent selective catalytic reduction catalyst (used for control of nitrogen oxide emissions), and scrubber sludge. It is unlikely that there would be enough land within the present boundary of the existing Catawba site for landfill disposal of all waste products. Disposal of scrubber sludge alone over a 40-year plant life would require approximately 227 ha (560 ac) (Duke 2001). Additional land-use changes would occur offsite in an undetermined coal-mining area to supply fuel for the plant. In the GEIS, the staff estimates that approximately 8900 ha (22,000 ac) would be affected for mining the coal and disposing of the waste to support a 1000-MW(e) coal plant during its operational life (NRC 1996).

A replacement coal-fired plant for Catawba would have a total generating capacity of 2400 MW(e) and would affect proportionately more land. Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for Catawba. In the GEIS, the staff estimates that approximately 405 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant (NRC 1996).

Assume that 700 ha (1700 ac) may be enough to accommodate the expansion and addition of four 600-MW(e) coal fired units at the Catawba site while Units 1 and 2 are still in operation and then decommissioned. Under this scenario, an impact on previously undisturbed lands could occur (Duke 2001). The degree of impact would be dependent on the characteristics of the land being converted. The impact of a coal-fired generating unit on land use at the Catawba site is best characterized as MODERATE to LARGE. The impact would definitely be greater than the OL-renewal alternative.

In the GEIS, the staff estimates that a 1000-MW(e) coal-fired plant would require approximately 700 ha (1700 ac) (NRC 1996). For an alternate greenfield site, Duke believes that 700 ha (1700 ac) is a sufficient size to accommodate a 2400-MW(e), coal-fired generation plant at an alternate site (Duke 2001). Land at the site would be used for an ash and sludge waste area. Additional land could be needed for a transmission line and for a rail spur to the plant site, depending on the infrastructure in existence at the alternate site. This alternative would result in SMALL to LARGE land-use impacts, depending on whether the alternate site had been developed previously or not and what new infrastructure might be required.

- **Ecology**

Locating a coal-fired plant at the Catawba site would alter ecological resources because of the need to convert most of the currently unused land to industrial use for the plant, coal storage, and ash and scrubber sludge disposal. However, some of this land would have

been previously disturbed. Additional offsite, undisturbed land amounting to 405 ha (1000 ac) would need to be converted to industrial use for the plant, coal storage, and ash and scrubber sludge disposal (Duke 2001). Use of the existing closed-cycle cooling and intake/ discharge system would limit operational impacts on the aquatic ecosystem. There could be potential habitat loss and fragmentation, and reduced productivity and biological diversity could result from disturbing previously undisturbed land.

Siting a coal-fired plant at Catawba would have a MODERATE to LARGE ecological impact that would be greater than renewal of the OLs for Units 1 and 2.

At an alternate greenfield site, the coal-fired generation alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts may alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of makeup cooling water from a nearby surface water body could have adverse aquatic resource impacts. If needed, construction and maintenance of a transmission line and a rail spur would have ecological impacts. Overall, the ecological impacts are dependent on whether a site had been previously developed (SMALL) or an undeveloped greenfield site (MODERATE to LARGE impact).

- **Water Use and Quality**

Surface water. The coal-fired generation alternative at the Catawba site is assumed to use a closed-cycle cooling system, which would minimize incremental water use and quality impacts (Duke 2001). Surface water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

For a coal-fired plant located at an alternate site, the staff assumed that a closed-cycle cooling system would be employed (Duke 2001). New intake structures to provide water needs for the facility would have to be constructed. Impacts would be dependent on the volume of water withdrawn for makeup relative to the amount of water available from the intake source and the characteristics of the surface water. Plant discharges would comply with all appropriate permits (Duke 2001). Some erosion and sedimentation would likely occur during construction (NRC 1996). The overall impacts are characterized as SMALL to MODERATE.

Groundwater. The staff assumed that a coal-fired plant located at Catawba would follow the current practice of obtaining cooling and service water from Lake Wylie and potable water

from the Rock Hill Utilities Department (Duke 2001). The three groundwater wells that supply limited special uses at the Catawba site probably would continue to be used. The overall impacts are characterized as SMALL.

Use of groundwater for cooling at a coal-fired plant located at an alternate site is a possibility. Consumptive use is estimated by Duke to be less than 1.5 m^3/s (52.2 cfs), which is based on the evaporation rates at Catawba's existing once through cooling system (Duke 2001). Groundwater withdrawal at an alternate site may require a permit from the appropriate State agency[(a)]. The impacts of withdrawal for the coal-fired plant on the aquifer would be site specific and dependent on aquifer recharge and other withdrawals. The overall impacts could be SMALL to LARGE.

- **Air Quality**

The air-quality impacts of coal-fired generation vary considerably from those of nuclear generation due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide, and hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

The Catawba site is located in the Metropolitan Charlotte Interstate Air Quality Control Region (40 CFR 81.75). This region is designated as in attainment or unclassified for all criteria pollutants in 40 CFR 81.334[(b)]. However, the county is at risk as being classified as nonattainment regarding ozone in the future, pending implementation of a new 8-hour standard.

A new coal-fired generating plant located at Catawba would likely need a prevention of significant deterioration (PSD) permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60, Subpart D. The standards establish limits for particulate matter and opacity (40 CFR 60.42a), SO_2 (40 CFR 60.43a), and NO_x (40 CFR 60.44a). Obtaining air permits for construction of a conventional coal-fired plant potentially could require emission offsets from other Duke generating facilities.

(a) Any withdrawal of water in South Carolina that exceeds approximately 0.004 m^3/sec (0.007 cfs) must be reported to South Carolina Department of Health and Environmental Control (SCDHEC). If the well is located in Beaufort, Jasper, Georgetown, Horry, or Colleton counties, it must be permitted. (Personal communication with Charles Williams, Geologist, Bureau of Water (SCDHEC), December 19, 2001.

(b) Existing criteria pollutants under the Clean Air Act are ozone, carbon monoxide, particulates, sulfur dioxide, lead, and nitrogen oxide.

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR Part 51 Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act. As previously mentioned, York County is classified as attainment or unclassified for criteria pollutants, except ozone.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. EPA issued a new regional haze rule in 1999 (64 FR 35714; July 1,1999 [EPA 1999]). The rule specifies that for each mandatory Class I Federal area located within a state, the state must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period [40 CFR 51.308(d)(1)].

South Carolina has only one area (Cape Romaine Wildlife Area) designated in 40 CFR 81.426 as a mandatory Class I Federal area in which visibility is an important value. There are more Class I areas in the region of the North Carolina-Tennessee border in the Smoky Mountains. None of these Class I areas are within 80 km (50 mi) of the Catawba site.

In 1998, EPA issued a rule requiring 22 eastern states, including South Carolina, to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone. The total amount of NO_x that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 to September 30) is specified in 40 CFR 51.121(e). For South Carolina, the amount is 111,680 MT (123,105 tons). Any new coal-fired plant sited in South Carolina would be subject to this limitation. For North Carolina, the amount is 149,700 MT (165,000 tons).

Impacts for particular pollutants are as follows:

Sulfur oxides. Duke states in the Catawba ER that an alternative coal-fired plant located at the Catawba site would use wet scrubber technology utilizing lime/limestone for flue gas desulfurization (Duke 2001).

A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are

required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative.

Duke estimates that, by using the best technology to minimize SO_2 emissions, the total annual stack emissions from a coal-fired plant would be approximately 5757 MT (6346 tons) of SO_2 (Duke 2001).

Nitrogen oxides. Section 407 of the Clean Air Act establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants specified in 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453 [EPA 1998]), limits the discharge of any gases that contain nitrogen oxides (expressed as NO_2) in excess of 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

Duke estimates that by using low-NO_x burners with overfire air and selective catalytic reduction, the total annual NO_x emissions for a new coal-fired power plant would be approximately 7196 MT (7932 tons; Duke 2001). This level of NO_x emissions would be greater than the OL renewal alternative.

Particulates. Duke estimates that the total annual stack emissions would include 288 MT (317 tons) of filterable total suspended particulates (particulates that range in size from less than 0.1 micrometer (µm) up to approximately 45 µm). The 288 MT would include 192 MT (212 tons) of PM_{10} (particulate matter having an aerodynamic diameter less than or equal to 10 µm). Fabric filters or electrostatic precipitators would be used for particulate control (Duke 2001). In addition, coal-handling equipment would introduce fugitive particulate emissions. Particulate emissions would be greater under the coal alternative than the OL renewal alternative.

Fugitive dust would be generated during construction of a coal-fired plant. In addition, exhaust emissions would come from vehicles and motorized equipment used during construction.

Carbon monoxide. Duke estimates that the total carbon monoxide emissions would be approximately 1439 MT (1586 tons) per year (Duke 2001). This level of emissions is greater than the OL renewal alternative.

Hazardous air pollutants including mercury. In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam generating units (EPA 2000a). EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000a). EPA concluded that mercury is the hazardous air pollutant of greatest concern. EPA, also found that (1) there is a link between coal use and mercury emissions; (2) electric utility steam-generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (EPA 2000a). Accordingly, EPA added coal- and oil-fired electric utility steam-generating units to the list of source categories under Section 112(c) of the Clean Air Act for which emission standards for hazardous air pollutants will be issued (EPA 2000a).

Uranium and thorium. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that a typical coal-fired plant released roughly 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium in 1982 (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

A coal-fired plant also would have unregulated carbon dioxide emissions that could contribute to global warming.

Siting a coal-fired generation plant at a site other than Catawba would not significantly change air-quality impacts, although it could result in installing more or less stringent pollution-control equipment to meet applicable local requirements. Therefore, the impacts are deemed similar to those utilizing the existing Catawba site, or MODERATE.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air impacts would be substantial. The analysis in the GEIS also mentioned global warming from unregulated carbon dioxide emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health effects, such as cancer and emphysema, have been associated with the products of coal combustion. The appropriate characterization of air impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Siting a coal-fired generation plant at a site other than Catawba would not significantly change air-quality impacts, although it could result in installing more or less stringent pollution-control equipment to meet applicable local requirements. Therefore, the impacts are deemed similar to those utilizing the existing Catawba site, or MODERATE.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction catalysts, and scrubber sludge. Four 600-MW(e) coal-fired plants would generate approximately 907,300 MT (1 million tons) of this waste annually. The waste would be disposed of onsite, accounting for approximately 227 ha (560 ac) of land area over the 40-year plant life. There would not be sufficient space on the existing Catawba site for disposal of this quantity of waste. Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses. Construction-related debris will also be generated during construction activities.

In May 2000, EPA issued a “Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels” (EPA 2000b). EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could present danger to human health and the environment under certain conditions; (2) EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (3) present disposal practices are such that, in 1995, these wastes were being managed in 40 to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and (4) gaps in State oversight of coal combustion wastes have been identified. Accordingly, EPA announced its intention to issue regulations for disposal of coal combustion waste under subtitle D of the Resource Conservation and Recovery Act (RCRA).

For all of the preceding reasons, the appropriate characterization of impacts from waste generated from burning coal is MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

Siting the coal fired plant at a site other than Catawba would not alter waste generation, although other sites might have more constraints on disposal locations. Therefore, the impacts would be MODERATE.

- **Human Health**

Coal-fired power generation exposes workers to risks from coal and limestone mining, worker and public risks from coal and lime/limestone transportation, worker and public risks from disposal of coal combustion wastes, and public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

In the GEIS, the staff states that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from coal-fired plants, but did not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including EPA and State agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. As discussed previously, EPA has recently concluded that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal are characterized as SMALL.

- **Socioeconomics**

Construction of the coal-fired alternative would take approximately 5 years. The staff assumed that construction would take place while Catawba continues operation and would be completed by the time Units 1 and 2 permanently cease operations. The workforce would be expected to vary between 1200 and 2500 workers during the 5-year construction period (NRC 1996). These workers would be in addition to the 1218 workers employed at Catawba. During construction of the new coal-fired plant, communities near Catawba would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered because Catawba is in an urban area and workers could commute to the site from many communities. Nearby communities to Catawba would be impacted by the loss of the construction jobs once construction is completed. Duke estimates that the completed coal plant would employ approximately 250 workers (Duke 2001).

If the coal-fired replacement plant were constructed at the Catawba site and Units 1 and 2 were decommissioned, there would be a loss of 968 permanent high-paying jobs (1218 for

the two nuclear units down to 250 for the coal-fired plant), with a commensurate reduction in demand on socioeconomic resources and contribution to the regional economy. These impacts may be offset by nearness to the Charlotte metropolitan area and the overall economic growth taking place in York County. The coal-fired plant would provide a new tax base to offset the loss of tax base associated with decommissioning of the nuclear units. For all of these reasons, the appropriate characterization of nontransportation socioeconomic impacts for operating a coal-fired plant constructed at the Catawba site is considered SMALL.

Construction of a replacement coal-fired power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. York County, and particularly the Clover School District, would bear the brunt of Catawba operational job losses and would lose a large amount of its tax base. These losses could have potentially SMALL to MODERATE socioeconomic impacts to the county but LARGE impacts to the Clover School District. Communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of approximately 250 workers. In the GEIS, the staff states that socioeconomic impacts at a rural site would be larger than at an urban site, because more of the peak construction workforce would need to move to the area to work (NRC 1996). Alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at a rural site could be MODERATE to LARGE, depending on the relative location of the site to towns and cities which might be able to accommodate such impacts.

For transportation related to commuting of plant operating personnel, the impacts are considered SMALL. The maximum number of plant operating personnel would be approximately 250 compared to the current commuting workforce of 1218. Therefore, traffic impacts associated with plant personnel commuting to a coal-fired plant would be expected to be SMALL compared to the current impacts from Catawba operations.

However, during the 5-year construction period of the replacement coal-fired units, up to 2500 construction workers would be working at the site in addition to the 1218 workers at Catawba. The addition of these workers could place significant traffic loads on existing highways near the Catawba site. Such impacts would be MODERATE to LARGE.

At Catawba, coal and lime/limestone would likely be delivered by trains of approximately 115 cars each on the site's rail spur. Each open-top rail car holds about 90 MT (100 tons) of coal. Additional rail cars would be needed for lime/limestone delivery. In all, approximately 550 trains per year would deliver the coal and lime/limestone for the 4 coal-fired units. An average of roughly 22 train trips per week would occur, because for each full train delivery, there would be an empty return train. On several days per week, there could be

three trains per day using the rail spur to the site. Socioeconomic impacts associated with rail transportation, such as delays at rail crossings, would likely be MODERATE to LARGE.

Transportation-related impacts associated with commuting construction workers at an alternate site are site dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site dependent, but can be characterized as SMALL to MODERATE due to a smaller workforce.

At an alternate site, coal and lime/limestone would likely be delivered by rail, although barge delivery is feasible for an alternate coastal location. Socioeconomic impacts associated with rail transportation would likely be SMALL in a rural area and MODERATE in a more crowded suburban area.

- **Aesthetics**

The four coal-fired power plant units could be as much as 60 m (200 ft) tall and would be visible in daylight hours over many miles. The four exhaust stacks would be as much as 185 m (600 ft) high (Duke 2001). The stacks would likely be highly visible in daylight hours for distances up to 16 km (10 mi). Emissions from the stack would be a factor not present with the current nuclear units. The new stacks, and the associated stack emissions, would have a significant impact for the Lake Wylie community surrounding the Catawba site.

The plant units and associated stacks would also be visible at night because of outside lighting. The Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 61 m (200 ft) above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). Visual impacts of a new coal-fired plant could be mitigated by landscaping and color selection for buildings that is consistent with the environment.

Visual impact at night could be mitigated by reduced use of lighting, provided the lighting meets FAA requirements, and appropriate use of shielding. Overall, the addition of the coal-fired units and the associated exhaust stacks at the Catawba site would have a MODERATE aesthetic impact.

Coal-fired generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operations are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone

delivery, use of outside loudspeakers, and the commuting of plant employees. The incremental noise impacts of a coal-fired plant compared to existing Catawba operations are considered to be MODERATE.

At an alternate site, there would be an aesthetic impact from the buildings and exhaust stacks. This impact could be LARGE if a greenfield site is selected. There would also be an aesthetic impact if a new transmission line and/or rail spur is needed. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. In a more suburban location, the impacts are considered MODERATE. This is due to the frequency of train transport, the fact than many people are likely to be within hearing distance of the rail route, and the impacts of noise on residents in the vicinity of the facility and rail line. At a more rural location, the impacts could be SMALL. Noise and light from the plant would be detectable offsite. Noise associated with barge transportation of coal and lime/limestone would be SMALL. Aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities. Overall the aesthetic impacts associated with locating at an alternate site can be categorized as SMALL to LARGE, depending on the characteristics of the site.

- **Historic and Archaeological Resources**

At the Catawba site or an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands acquired to support the existing Catawba site would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at Catawba or at an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission line rights-of-way, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and as such are considered SMALL for both the existing Catawba site (and land purchased to support the site) or at an alternate greenfield site.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the Catawba site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of Catawba would result in a decrease in employment of approximately 968 operating employees. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, Catawba is located in an urban area with many employment possibilities. Overall, impacts are expected to be SMALL to MODERATE.

  Impacts at other sites would depend upon the site chosen and the nearby population distribution. If a replacement coal-fired plant were constructed at an alternate site, York County, and in particular the Clover School District, would experience a loss of tax revenue that could affect their ability to provide services and programs. York County would also lose 673 jobs. These impacts would be SMALL to MODERATE for York County and MODERATE to LARGE for the Clover School District. Impacts at the alternate site would vary between SMALL to LARGE, depending on the population makeup and distribution and the economy.

8.2.1.2 Once-Through Cooling System

This section discusses the environmental impacts of constructing a coal-fired generation system at an alternate site using a once-through cooling system. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a coal-fired plant using the closed-cycle cooling system. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

Table 8-3. Summary of Environmental Impacts of Coal-Fired Generation at an Alternate Greenfield Site with Once-Through Cooling

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Reservoir or other sufficient cooling source required
Ecology	Impact dependent on ecology at the site
Surface Water Use and Quality	Increased water withdrawal and more thermal load on receiving body of water
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Elimination of cooling towers
Historic and Archaeological Resources	No change
Environmental Justice	No change

8.2.2 Oil and Natural-Gas-Fired (Combined Cycle)

The environmental impacts of the oil and natural-gas-fired alternative are examined in this section for both the Catawba site and an alternate site.[a] For this alternative, Duke considered two variations on the natural gas theme: (1) an oil and natural gas combined-cycle and (2) natural gas alone in a combined-cycle plant.

The staff reviewed the environmental impacts of each option described in the Catawba ER and independently verified Duke's conclusions, and concurred. The staff decided to report on its findings for the oil and natural gas (combined-cycle) option because the environmental and socioeconomic impacts of both options are almost identical. Two exceptions were identified. The first exception is the oil storage tank, which would be needed at either the Catawba or the

(a) Duke does not consider fuel oil a viable, stand-alone fuel because it is not price competitive when natural gas is readily available. Duke views the fuel oil option as an emergency, backup fuel source during the winter season and is likely to ensure adequate fuel supplies, especially where baseload generation is required (Duke 2001). As such, Duke does not consider the air emissions from fuel oil in their analysis. Aesthetics and other potential impacts from oil transmission lines and oil storage are considered.

alternate site. The second exception is the need to construct an oil pipeline to the Catawba site. Whether an oil pipeline would be required at an alternate site would depend on the characteristics and infrastructure at the site.

For the Catawba site, the staff assumed that the plant would use the closed-cycle cooling system. The plant would consist of five 482-MW(e) combined-cycle units to replace the current power generated by Units 1 and 2. The total generation from the replacement power source would be 2410 MW(e) and, as such, would slightly overestimate the impacts from an exact replacement of Catawba's 2258 MW(e) generating capacity (Duke 2001).

The Catawba site is not located near a natural gas pipeline capable of supplying the quantities of gas required to operate the new gas-fired units. The nearest interstate pipeline is TRANSCo, which is located 26 km (16 mi) from the site. However, a new pipeline would likely be needed to supply the gas capacities required for a replacement baseload gas-fired plant located at Catawba (Duke 2001).

If a new natural-gas-fired plant were built elsewhere to replace Catawba, a new transmission line may be needed to connect to existing lines. In addition, construction or upgrade of a natural gas pipeline from the plant to a supply point where an adequate and reliable supply of gas would be available also may be required. One potential source of natural gas is liquefied natural gas (LNG) imported to either the Cove Point facility in Maryland or the Elba Island facility in Georgia. Both facilities are expected to be reactivated in 2002 (DOE/ EIA 2001a). LNG imported to either facility would need to be vaporized and transported to the South Carolina location via pipeline.

It is assumed that a replacement natural-gas-fired plant would use combined-cycle combustion turbines (Duke 2001). The following assumptions are made for the oil and natural-gas-fired plants (Duke 2001):

- five 482-MW(e) units, each consisting of two 172-MW combustion turbines and a 138-MW heat recovery boiler
- natural gas with an average heating value of 56 MJ/kg (23,882 Btu/lb) as the primary fuel
- use of low-sulfur No. 2 fuel oil as backup fuel
- heat rate of 2 J fuel/J electricity (6,800 Btu/kWh)

- capacity factor of 0.8

- gas consumption of 3.2 billion m^3/yr (113 billion ft^3/yr).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.2 are from the Catawba ER (Duke 2001). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the natural-gas-fired alternative for 40 years is considered a reasonable projection of the operating life of the plant.

8.2.2.1 Closed-Cycle Cooling System

The overall impacts of the combined-cycle fuel oil/natural-gas-generating system are discussed in the following sections and summarized in Table 8-4. The extent of impacts at an alternate site will depend on the location of the particular site selected.

Table 8-4. Summary of Environmental Impacts of Oil and Natural-Gas-Fired Generation at Catawba and an Alternate Greenfield Site Using a Closed-Cycle Cooling System

	Catawba Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Catawba site sufficient to accommodate new plant. Use existing infrastructure to maximum extent possible. Construction of both oil and gas pipelines required. Up to 235 ha (582 ac) potentially disturbed for each right-of-way. Impacts would be less if pipelines are constructed in existing rights-of-way.	MODERATE to LARGE	81 ha (200 ac) for power-block, offices, roads, switchyard, and parking areas required. Additional land (up to 1500 ha [3600 ac]) possibly impacted for transmission line, oil and natural-gas pipelines, and rail spur. Use of previously undeveloped greenfield site increases impacts.
Ecology	SMALL to MODERATE	Uses undeveloped areas at Catawba site plus land for a new oil and gas pipeline.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and possible transmission and oil/gas pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity. Undeveloped greenfield site may increase impacts.

Table 8-4. (contd)

Impact Category	Catawba Site Impact	Catawba Site Comments	Alternate Greenfield Site Impact	Alternate Greenfield Site Comments
Water Use and Quality (Surface Water)	SMALL	Uses existing closed-cycle cooling system including existing intake and discharge structures. Surface water use should be less than current uses at Catawba.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body. New intake and discharge structures required.
Water Use and Quality (Groundwater)	SMALL	Less groundwater withdrawn for potable use because of smaller workforce.	SMALL to LARGE	Impacts SMALL if groundwater used only for potable purposes; MODERATE to LARGE if groundwater employed as makeup cooling water. Impacts would be site/aquifer specific.
Air Quality	MODERATE	Sulfur oxides • 31 MT/yr (34 tons/yr) Nitrogen oxides • 469 MT/yr (517 tons/yr) Carbon monoxide • 437 MT/yr (482 tons/yr) PM_{10} particulates • 260 MT/yr (287 tons/yr) Some hazardous air pollutants.	MODERATE	Potential impacts are the same as for the Catawba site, although pollution control standards may vary.
Waste	SMALL	Minimal waste products from fuel combustion.	SMALL	Minimal waste products from fuel combustion. Impacts from combustion of No. 2 fuel oil as a backup are considered SMALL.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.

Table 8-4. (contd)

Impact Category	Catawba Site Impact	Catawba Site Comments	Alternate Greenfield Site Impact	Alternate Greenfield Site Comments
Socio-economics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 800 additional workers during the peak of the 2- to 3-year construction period, followed by reduction from the current 1218 Catawba workforce to 150. Tax base pre-served. Impacts during operation would be SMALL to MODERATE, due to loss of employ-ment in York County, which may be offset by proximity to Charlotte economy. Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be MODERATE. Up to 800 additional workers during the peak of the 2- to 3-year construction period in addition to workers currently employed at Catawba.	SMALL to LARGE	Impacts depend on site characteristics. During construction, impacts would be SMALL to MODERATE. Tax impacts on receiving county could be SMALL to LARGE. Up to 800 additional workers during the peak of the 3-year construction period. York County would experience loss of Catawba tax base and employment with potentially MODERATE to LARGE impacts. Clover School District in York County would be significantly impacted. Transportation impacts associated with construction workers would be SMALL to LARGE and would be dependent on population density and road infrastructure at alternate site. Impacts during operation would be SMALL due to smaller workforce.

Table 8-4. (contd)

Impact Category	Catawba Site Impact	Catawba Site Comments	Alternate Greenfield Site Impact	Alternate Greenfield Site Comments
Aesthetics	SMALL to MODERATE	Lake Wylie area impacted. SMALL to MODERATE aesthetic impact from plant and stacks, fuel oil storage tanks, lighting, and mechanical noise associated with operation.	SMALL to LARGE	SMALL if previously developed site and site disturbance minimal. Impacts increased to strongly MODERATE with construction of a transmission line and oil/gas pipeline to previously developed site. LARGE impact if a greenfield site used.
Historic and Archaeological Resources	SMALL	Any potential impacts can be effectively managed.	SMALL	Same as Catawba site; any potential impacts can be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction. Loss of 1016 operating jobs at Catawba could reduce employment prospects for minority and low-income populations. Nearness to Charlotte economic area may mitigate impacts.	SMALL to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site could be SMALL to LARGE. York County would lose tax revenue and jobs, which could have a MODERATE impact. Impact on Clover School District would be LARGE. Nearness to Charlotte economic area may mitigate impacts.

- **Land Use**

The Catawba site is adequate to support a combined-cycle facility (Duke 2001). For siting at Catawba, existing facilities and infrastructure would be used to the extent practicable, thus limiting the amount of new construction that would be required. Specifically, the staff assumed that the oil/natural-gas-fired replacement plant alternative would use the existing closed-cycle cooling system, switchyard, offices, and transmission line rights-of-way. Additional land-use impacts could come from gas and oil construction rights-of-way. Up to 235 ha (582 ac) could be potentially disturbed for each right-of-way. The nearest trunk oil line is 24 km (15 mi) from the Catawba site. The nearest interstate gas pipeline (TRANSCo) is located 26 km (16 mi) from the Catawba site. Land-use impacts from the

construction of the pipelines is considered SMALL to MODERATE and would depend on whether the pipelines can use existing rights-of-way or not. If new land has to be disturbed, then the impacts could be MODERATE.

For construction at an alternate site, Duke assumed that less than 81 ha (200 ac) would be needed for the plant and associated infrastructure (Duke 2001). Additional land could be impacted for construction of a transmission line and natural gas and oil pipelines to serve the plant. In the GEIS, the staff estimates that approximately 1500 ha (3600 ac) would be needed for a 1000 MW(e) plant (NRC 1996). As reported by Duke in the Catawba ER (DOE 2001), "the environmental impacts of providing both gas and fuel oil for a very large baseload facility would be substantial." If legislation requiring reduction of CO_2 levels were passed, conversion of combustion facilities to natural gas would be required to meet the new standards. Natural gas may not be available in the quantities that would be required to offset CO_2 emissions from coal-fired-gas generation. The present interstate natural gas pipeline system in the Duke service area is not capable of supporting the quantities of gas required by this size station operating at 90 percent capacity factor.

Selection of a greenfield site also would increase the impact of the new facility. Partially offsetting these offsite land use requirements would be the elimination of the need for uranium mining to supply fuel for Catawba. In the GEIS, the staff estimates that approximately 400 ha (1000 ac) would be affected for mining and processing the uranium during the operating life of a 1000 MW(e) nuclear power plant (NRC 1996). Overall, land-use impacts at an alternate location would be MODERATE to LARGE.

- **Ecology**

At the Catawba site, there would be ecological, land-related impacts for siting of the gas-fired plant; however, the impacts would be SMALL considering the smaller footprint of the new facility (compared to the existing nuclear facilities) and the fact that land at the site is previously disturbed. Significant ecological impacts could be associated with bringing a new underground gas and oil pipeline to the Catawba site. Impacts could include wildlife habitat loss and reduced productivity, and habitat fragmentation and local reduction in biological diversity. The degree of impact would depend on where and how the pipelines are constructed and the ecological state of the areas through which the pipelines traverse (e.g., existing or new rights-of-way, above or belowground). Potential impacts are rated SMALL to MODERATE.

Ecological impacts at an alternate site would depend on the nature of the land converted for the plant and the possible need for a new transmission line and oil and gas pipelines. Construction of a transmission line and an oil and gas pipeline to serve the plant would be expected to have temporary ecological impacts. Ecological impacts are the same as with

the existing Catawba site and could be exacerbated if threatened or endangered species were involved. A previously undisturbed greenfield site may only heighten the impacts. At an alternate site, the cooling water intake and discharge could have aquatic resource impacts. Overall, the ecological impacts of this alternative are considered MODERATE to LARGE.

- **Water Use and Quality**

Surface water. The gas-fired generation alternative at the Catawba site is assumed to use a closed-cycle cooling system, which would minimize incremental water use and quality impacts (Duke 2001). Modifications to meet EPA requirements for altered cooling systems would be undertaken. Water requirements for combined-cycle generation are much less than for conventional steam electric generators, and evaporation from combined cycle cooling towers would be less than from the existing Catawba units (Duke 2001). There also would be sediment impacts to adjacent waters during construction. Surface water impacts are expected to remain SMALL.

For a gas-fired plant located at an alternate site, it is assumed that a closed-cycle cooling system would be employed (Duke 2001). New intake structures to provide water needs for the facility would need to be constructed. Impacts would be dependent on the volume of water withdrawn for makeup relative to the amount of water available from the intake source and the characteristics of the surface water. Plant discharges would comply with all appropriate permits (Duke 2001). Some erosion and sedimentation probably would occur during construction (NRC 1996). The overall impacts to surface water quality are characterized as SMALL to MODERATE.

Groundwater. The staff assumed that a gas-fired plant located at Catawba would follow the current practice of obtaining cooling and service water from Lake Wylie and potable water from the Rock Hill Utilities Department (Duke 2001). The three groundwater wells that supply limited special uses at the Catawba site probably would continue to be used. The overall impacts are characterized as SMALL.

A natural-gas-fired plant at an alternate site may use groundwater. Consumptive use is estimated by Duke to be considerably less than the 63,515 m^3/day (16.8 mgd), which is based on the evaporation rates at Catawba's existing cooling system for conventional steam electric generation (Duke 2001). Groundwater withdrawal at an alternate site may require a State permit. The impacts of such a withdrawal rate on an aquifer would be site specific and dependent on the recharge rate and other withdrawal rates from the aquifer. The overall impacts could be SMALL to LARGE.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Hence, it would be subject to the same type of air quality regulations as a coal-fired plant.

A new gas-fired generating plant located at Catawba would likely need a PSD permit and an operating permit under the Clean Air Act. A new combined-cycle, natural-gas power plant would also be subject to the new source performance standards for such units at 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x. York County is at risk of being in ozone nonattainment. Obtaining air permits for construction of a combined-cycle plant would potentially require emission offsets from other Duke generating facilities.

Duke projects the following emissions for the natural-gas-fired alternative (Duke 2001):

- sulfur oxides - 31 MT/yr (34 tons/yr)
- nitrogen oxides - 469 MT/yr (517 tons/yr)
- carbon monoxide - 437 MT/yr (482 tons/yr)
- PM_{10} particulates - 260MT/yr (287 tons/yr).

A natural-gas-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). Natural-gas-fired power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal and oil-fired plants, EPA did not determine that regulation of emissions of hazardous air pollutants from natural-gas-fired power plants should be regulated under Section 112 of the Clean Air Act.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

The preceding emissions would likely be the same at Catawba or at an alternate site. Impacts from the above emissions would be clearly noticeable but would not be sufficient to destabilize air resources as a whole. The overall air-quality impact for a new oil/natural-gas-fired generating plant sited at Catawba or at an alternate site is considered MODERATE.

- **Waste**

  A small amount of solid waste (i.e., ash), will result from burning natural gas fuel. Duke expects to produce approximately 42 m^3 (1500 ft^3) of spent SCR catalyst used for NO_X control (Duke 2001). In the GEIS, the staff concludes that waste generation from gas-fired technology would be minimal (NRC 1996). Gas firing results in very few combustion by-products because of the clean nature of the fuel. Waste generation at an operating gas-fired plant would be largely limited to typical office wastes. Construction-related debris would also be generated during construction activities. Overall, the waste impacts would be SMALL for a natural-gas-fired plant sited at Catawba or at an alternate site; impacts would be so minor that they would not noticeably alter any important resource attribute.

  In the winter, it may become necessary for the replacement baseload natural-gas-fired plant to operate on fuel oil due to lack of gas supply. Combustion of No. 2 fuel oil generates minimal waste products. Overall, the waste impacts associated with fuel oil combustion at a combined cycle plant are expected to be SMALL as well.

- **Human Health**

  In the GEIS, the staff identifies cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contributes to health risks. NO_x emissions from the plant would be regulated by the SCDNR or comparable agency in another state. Human health effects are not expected to be detectable or would be sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Overall, the impacts on human health of the natural-gas-fired alternative sited at Catawba or at an alternate site are considered SMALL.

- **Socioeconomics**

  Construction of an oil and natural-gas-fired plant would take approximately 2 to 3 years. Peak employment could be as many as 800 workers (Duke 2001). The staff assumed that construction would take place while Catawba Units 1 and 2 continue operation and would be completed by the time they permanently cease operations. During construction, the communities immediately surrounding the Catawba site would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from cities and towns comprising the Charlotte metropolitan area. After construction, the communities would be impacted by the loss of jobs. The current Catawba workforce (1218 workers) would decline through the decommissioning period to a minimal maintenance size. The new natural-gas-fired plant would replace the nuclear plant tax base at Catawba in York

County. Approximately 1068 jobs would be lost because only 150 workers would be needed to operate the gas plant. The impacts would be SMALL to MODERATE and could be moderated by Catawba's location in the economically prosperous Charlotte area.

At an alternate or greenfield site, construction would take approximately 2 to 3 years, take place while the existing nuclear plant continued operation, and would be completed by the time the Catawba reactors cease operations (Duke 2001). The size of the construction and operational personnel remain the same as at the Catawba site. Siting at an alternate site would result in the loss of tax revenue and employment in York County with potentially MODERATE to LARGE socioeconomic impacts. Impacts to the Clover School District in York County would be particularly significant. Socioeconomic impacts from locating the facilities at an alternate site would be dependent on the characteristics of the site. Impacts of construction could range between SMALL to MODERATE. Impacts during plant operation would be SMALL (fewer employees) and the tax impacts could be SMALL to LARGE, depending on the relative proportion of taxes paid by the plant to total county taxes at the new location. In the GEIS (NRC 1996), the staff concludes that socioeconomic impacts from constructing a natural-gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology. Compared to the coal-fired and nuclear alternatives, socio-economic impacts would be mitigated by the smaller size of the construction workforce, the shorter construction time frame, and the smaller size of the operational workforce.

Overall, socioeconomic impacts resulting from construction of a natural-gas-fired plant at Catawba would be SMALL to MODERATE, and may be offset by the continued growth of the economy in the Charlotte and surrounding area. For construction at an alternate site, socioeconomic impacts would be SMALL to LARGE, depending on the characteristics of the alternate site.

Transportation impacts associated with construction and operating personnel commuting to Catawba would be SMALL to MODERATE. The impacts can be classified as SMALL to LARGE for siting at an alternate site and would be dependent on the characteristics of the alternate site, including transportation infrastructure.

- **Aesthetics**

The five power plant units with their stacks (approximately 60-m [200-ft] tall) would be visible for several miles in the vicinity of Lake Wylie. Visual impacts from stack emissions also would be present. Fuel oil storage tanks also would be visible offsite, and noise and light from the plant would be detectable offsite (Duke 2001). Construction of the required gas and oil pipelines would also contribute to aesthetic impacts. At Catawba, these impacts would result in a SMALL to MODERATE aesthetic impact.

At an alternate site, the buildings and stacks could be visible offsite. Aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities. Overall, the aesthetic impacts associated with a replacement natural-gas-fired plant at an alternate site are categorized as SMALL. The impacts would be greater if new transmission lines and oil/gas pipelines had to be constructed to the alternate site. These impacts are considered MODERATE. The impacts could be LARGE if a greenfield site is developed.

- **Historic and Archaeological**

At both the Catawba site and at an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been surveyed previously. Other lands, if any, that are acquired to support the plant also would likely need an inventory of field cultural resources, an identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the Catawba plant site.

Before construction at an alternate site, similar studies would likely be needed and undertaken. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated rights-of-way where new construction would occur (e.g., roads, transmission lines, pipeline, or other rights-of-way). Hence, impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL at either the existing Catawba or at an alternative site.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement natural-gas-fired plant were built at Catawba. Some impacts on housing availability and prices during construction might occur in York County, which could disproportionately affect minority and low-income populations. Closure of Catawba would result in a decrease in employment of approximately 1068 permanent operating employees at the site. Resulting economic conditions could reduce employment prospects for minority or low-income populations in York County. The impacts could be offset by projected economic growth and the ability of affected workers to commute to other jobs in the county or nearby Charlotte. Overall, impacts are expected to be SMALL to MODERATE.

Impacts at an alternate site would depend upon the site chosen and the nearby population distribution. Low-income and minority populations at the alternate site could benefit from the plant's relocation, through improvements in job prospects and increased tax base enabling more services to be provided to these populations. These impacts could be

SMALL to LARGE. However, if a replacement natural-gas-fired plant were constructed at an alternate site, York County would experience a loss of property tax revenue, as well as approximately 670 jobs of Catawba workers living in the county. This could affect the county's ability to provide services and programs. The Clover School District would experience a significant loss of tax revenue that could affect their ability to provide services and programs to low-income and minority children. Impacts to minority and low-income populations in York County could be MODERATE to LARGE, again potentially offset by other economic growth in the area not related to Catawba.

8.2.2.2 Once-Through Cooling System

This section discusses the environmental impacts of constructing a natural-gas-fired generation system at an alternate location using a once-through cooling system. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a natural-gas-fired plant using closed-cycle cooling. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8.5 summarizes the incremental differences.

Table 8-5. Summary of Environmental Impacts of Oil and Natural-Gas-Fired Generation at an Alternate Site with a Once-Through Cooling System

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Reservoir or other sufficient cooling source required
Ecology	Impact would depend on ecology at the site
Surface Water Use and Quality	Increased water withdrawal and higher thermal load on receiving body of water
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Elimination of cooling towers
Historic and Archaeological Resources	No change
Environmental Justice	No change

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). All of these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent escalation in prices of natural gas and electricity have made new nuclear power plant construction more attractive from a cost standpoint. Consequently, construction of a new nuclear power plant at the Catawba site using the existing closed-cycle cooling system and at an alternate site using both closed- and open-cycle cooling are considered in this section. The staff assumed that the new nuclear plant would have a 40-year lifetime.

NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs sited at Catawba or an alternate site. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect replacement of Catawba, Units 1 and 2, which have a total capacity of 2258 MW(e). The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on NEPA issues for license renewal of nuclear power plants in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using closed-cycle cooling is presented in Section 8.2.3.1 and using once-through cooling in Section 8.2.3.2.

8.2.3.1 Closed-Cycle Cooling System

The overall impacts of the nuclear generating system are discussed in the following sections. The impacts are summarized in Table 8-6. The extent of impacts at an alternate site will depend on the location of the particular site selected.

Table 8-6. Summary of Environmental Impacts of New Nuclear Generation at Catawba and at an Alternate Greenfield Site Using Closed-Cycle Cooling

	Catawba Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Requires approximately 200 ha (500 ac) for the plant.	MODERATE to LARGE	Requires approximately 200 to 400 ha (500 to 1000 ac) for the plant. Possible additional land if a new transmission line is needed. MODERATE impact for previously disturbed alternate site; LARGE impact for a greenfield site.
Ecology	MODERATE	Uses undeveloped areas at current Catawba site plus additional offsite land. Potential habitat loss and fragmentation and reduced productivity and biological diversity on offsite land.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality (Surface Water)	SMALL	Uses existing closed-cycle cooling system.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Water Use and Quality (Groundwater)	SMALL	Total water usage similar to current Catawba use.	SMALL to LARGE	Impacts SMALL if groundwater used only for potable purposes; MODERATE to LARGE if groundwater employed as makeup cooling water. Impacts would be site/aquifer specific.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amount of emissions from diesel generators and possibly other sources during operation. Emissions are similar to current releases from Catawba.	SMALL	Same impacts as at Catawba.

Table 8-6. (contd)

Impact Category	Catawba Site Impact	Catawba Site Comments	Alternate Greenfield Site Impact	Alternate Greenfield Site Comments
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Debris would be generated and removed during construction.	SMALL	Same impacts as at Catawba.
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impacts as at Catawba.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 2500 workers during the peak of the 5-year construction period. Operating workforce assumed to be similar to Catawba. Tax base preserved. Transportation impacts associated with construction and ongoing operating personnel of Catawba Units 1 and 2 could be MODERATE to LARGE. Transportation impacts of commuting plant operating personnel considered SMALL.	SMALL to LARGE	Construction impacts depend on location. Impacts at a rural, greenfield location could be LARGE. York County would experience loss of tax base and employment with MODERATE to LARGE impacts, possibly offset by economic growth in the Charlotte metropolitan area. Transportation impacts associated with commuting construction workers could be MODERATE to LARGE. Impacts during operation would be SMALL to MODERATE.
Aesthetics	SMALL	No exhaust stacks or cooling towers would be needed. Daytime visual impact could be mitigated by landscaping and appropriate color selection for buildings. Visual impact at night could be mitigated by reduced use of lighting and appropriate shielding. Noise impacts would be relatively small and could be mitigated.	SMALL to LARGE	Impacts would depend on the characteristics of the alternate site. Impacts would be SMALL if the plant is located adjacent to an industrial area. New transmission lines would add to the impacts and could be MODERATE. If a greenfield site is selected, the impacts could be LARGE.
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be managed effectively.	SMALL	Any potential impacts can likely be managed effectively.

Table 8-6. (contd)

Impact Category	Catawba Site Impact	Catawba Site Comments	Alternate Greenfield Site Impact	Alternate Greenfield Site Comments
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction.	SMALL to LARGE	Impacts will vary depending on population distribution and makeup at the site. Impacts to minority and low-income residents of York County associated with closure of Catawba could be MODERATE to LARGE. Impacts to receiving County is site specific and could range from SMALL to LARGE.

- **Land Use**

The existing facilities and infrastructure at Catawba would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that a replacement nuclear power plant would use the existing cooling system, switchyard, offices, and transmission line rights-of-way. A replacement nuclear power plant at Catawba would require approximately 200 ha (500 ac) of new land some of which may be previously underdeveloped land. Additional land beyond the current Catawba site boundary may be needed to construct a new nuclear power plant while the existing Units 1 and 2 continue to operate.

There would be no net change in land needed for uranium mining because land needed for the new nuclear plant would offset land needed to supply uranium for fuel for the existing Catawba reactors.

The impact of a replacement nuclear generating plant adjacent to the existing Catawba site is best characterized as SMALL to MODERATE. The impact would be greater than the OL renewal alternative.

Land-use requirements at an alternate greenfield site would be approximately 200 to 400 ha (500 to 1000 ac) plus the possible need for a new transmission line (NRC 1996). In addition, it may be necessary to construct a rail spur to an alternate site to deliver equipment during construction. Depending on new transmission line routing, siting a new nuclear plant at an alternate site could result in MODERATE to LARGE land-use impacts, and probably would be LARGE for a previously undisturbed greenfield site.

- **Ecology**

Locating a replacement nuclear power plant at the Catawba site would alter ecological resources because of the need to convert additional land to industrial use. Potential habitat loss and fragmentation and reduced productivity and biological diversity could result. Some of this land, however, may have been previously disturbed. Siting at Catawba would have a MODERATE ecological impact that would be greater than renewal of the OLs for the existing reactors.

At an alternate site, there would be construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts could alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface water body could have adverse impacts on aquatic resources. Construction and maintenance of a new transmission line could also have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE.

- **Water Use and Quality**

Surface water. A replacement nuclear plant alternative at the Catawba site would most likely use the existing closed-cycle cooling system. Thus, the environmental impacts would be similar to the existing Catawba Nuclear Station. For a new nuclear plant, water makeup requirements due to evaporative losses in the cooling towers would be comparable to that currently experienced at Catawba (Duke 2001). There would be sediment impacts to adjacent waters during construction. Surface water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

For a replacement nuclear plant located at an alternate site, the staff assumed that a closed-cycle cooling system would be employed (Duke 2001). New intake structures to provide water needs for the facility would need to be constructed. Impacts would depend on the volume of water withdrawn for makeup relative to the amount of water available from the intake source and the characteristics of the surface water. Plant discharges would comply with all appropriate permits (Duke 2001). Some erosion and sedimentation would likely occur during construction (NRC 1996). The overall impacts are characterized as SMALL to MODERATE.

Groundwater. The staff assumed that a replacement nuclear plant located at Catawba would follow the current practice of obtaining cooling and service water from Lake Wylie and potable water from the Rock Hill Utilities Department (Duke 2001). The three groundwater

wells that supply limited special uses at the Catawba site would also likely continue to be used. The overall impacts to groundwater are characterized as SMALL.

A nuclear power plant sited at an alternative site may use groundwater. Consumptive use is estimated by Duke to be 63,500 m^3/day (16.8 mgd), which is based on the evaporation rates at Catawba's existing cooling system (Duke 2001) for conventional steam electric generation. Groundwater withdrawal at an alternate site may require a permit from the SCDHEC or comparable agency in another state. The impacts of such a withdrawal rate on an aquifer would be site specific and dependent on aquifer recharge and other withdrawal rates from the aquifer. The overall impacts could be SMALL to LARGE.

- **Air Quality**

Construction of a new nuclear plant sited at the Catawba or alternate site would result in fugitive emissions during the construction process. Exhaust emissions also would come from vehicles and motorized equipment used during the construction process. An operating nuclear plant would have minor air emissions associated with diesel generators. Emissions would be regulated by the SCDENR or comparable agency in another state. Overall, emissions and associated impacts are considered SMALL.

- **Waste**

The waste impacts associated with operation of a nuclear power plant are set out in Table B-1 of 10 CFR Part 51 Subpart A, Appendix B, Table B-1. Construction-related debris generated during construction activities would be removed to an appropriate disposal site. Overall, impacts from waste are considered to be SMALL.

Siting the replacement nuclear power plant at a site other than Catawba would not alter waste generation. Therefore, the impacts for that alternative also would be SMALL.

- **Human Health**

Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51 Subpart A, Appendix B, Table B-1. Overall, human health impacts are considered SMALL.

Siting the replacement nuclear power plant at a site other than Catawba would not alter human health impacts. Therefore, the impacts would be SMALL.

- **Socioeconomics**

The construction period and the peak workforce associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). The staff assumed that in the absence of quantified data, a construction period of 5 years and a peak of workers of 2500 would be employed. This workforce would be in addition to the 1218 individuals already employed at the plant. The staff assumed that construction would take place while the existing Catawba reactors continue operation and would be completed by the time the existing reactors permanently cease operations. During construction, the communities surrounding the Catawba site would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from the cities and towns comprising the Charlotte metropolitan area. After construction, the communities would be impacted by the loss of the construction jobs.

Alternate plant sites would need to be analyzed on a case-by-case basis. In the GEIS (NRC 1996), the staff notes that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work. Construction of a replacement nuclear power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. York County would still experience the impact of Catawba operational job loss and loss of tax base, and the communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of up to 1218 workers. For the Clover School District (York County), the socio-economic impacts could be MODERATE to LARGE. The socioeconomic impacts to the county at the alternate location could be SMALL to LARGE depending on the degree of economic development, the proportion of the County's property tax base represented by the new plant, etc.

During the 5-year construction period, up to 2500 construction workers would be working at the Catawba site in addition to the 1218 workers already employed there. The addition of the construction workers could place significant traffic loads on existing highways, particularly those leading to the site. Such impacts would be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of the existing reactors and are considered SMALL.

Transportation-related impacts associated with commuting construction workers at an alternate location are site dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site dependent, but can be characterized as SMALL to MODERATE.

- **Aesthetics**

The containment buildings for a replacement nuclear power plant and other associated buildings sited at Catawba would likely be visible in daylight hours over many miles. Visual impacts could be mitigated by landscaping and by selecting a building color that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed. Cooling towers would be visible assuming a closed-cycle cooling system is used.

Noise inputs from operations at a replacement nuclear power plant potentially could be heard offsite under calm wind conditions or when the wind is blowing in the direction of the listener. Mitigation measures, such as reduced or non-use of outside loudspeakers, can be employed to reduce the noise level and keep the impact SMALL.

At an alternate site, there would be an aesthetic impact from the buildings. There would also be a significant aesthetic impact if a new transmission line is needed. Noise and light from the plant would be detectable offsite. The impact of noise and light would be mitigated if the plant is located in an industrial area adjacent to other power plants, or industrial facilities, in which case the impact is SMALL. The impact could be MODERATE if a transmission line needs to be built to the alternate site. The impact could be LARGE if a greenfield site is selected.

- **Historic and Archaeological Resources**

At both Catawba and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at Catawba or another site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated line corridors where new construction would occur (e.g., roads, transmission line rights-of-way, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement nuclear plant were built at Catawba. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. However, this situation is expected to be mitigated by Catawba's proximity to Charlotte. After completion of construction, it is possible that the ability of the local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the minority and low-income populations. However, the economic health of York County and the Clover School District should improve as the tax base of the older nuclear units are replaced by the new, higher valued (i.e., less depreciated) plant. Hence, the ability of the county to provide social services should improve because of the higher tax base, assuming assessment rates remain stable. Overall, socioeconomic impacts are expected to be SMALL.

  Impacts at an alternate site would depend upon the site chosen and the nearby population distribution. If a replacement nuclear plant were constructed at an alternate site, York County and the Clover School District would experience a significant loss of property tax revenue which could affect their ability to provide services and programs. Impacts to minority and low-income populations in York County could be MODERATE to LARGE, but potentially could be offset by other related economic growth in the area. Impacts to the receiving county could be SMALL to LARGE depending on the relative increase to the tax base resulting from the new plant's construction.

8.2.3.2 Once-Through Cooling System

This section discusses the environmental impacts of constructing a nuclear power plant at an alternate site using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a nuclear power plant using the closed-cycle system. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences.

Table 8-7. Summary of Environmental Impacts of a New Nuclear Power Plant Sited at an Alternate Greenfield Site with Once-Through Cooling

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	Reservoir or other cooling source required
Ecology	Impact would depend on ecology at the site
Surface Water Use and Quality	Increased water withdrawal and more thermal load on receiving body of water
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Elimination of cooling towers
Historic and Archaeological Resources	No change
Environmental Justice	No change

8.2.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the Catawba OLs. Duke currently purchases power from other generators, but because there is no certainty that imported power will be available, it does not consider the power-purchase option to be a reasonable replacement for the license renewal alternative (Duke 2001).

Duke includes future power purchases in its Annual Power Plan (Duke 2000). The Plan indicates how Duke will meet customers' energy needs through existing generation, customer demand-side options, short-term purchase power transactions, and new generating resources constructed by Duke. The 2000 Plan shows power purchases of 1243 MW for the summer of 2001, gradually decreasing to 121 MW in the winter of 2006 (Duke 2000).

Imported power from Canada or Mexico is unlikely to be available for replacement of Catawba generating capacity. In Canada, 62 percent of the country's electricity capacity is derived from renewable energy sources, principally hydropower (DOE/EIA 2001b). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale

projects (DOE/EIA 2001b). Canada's nuclear generation is projected to increase by 1.7 percent by 2020, but its share of power generation in Canada is projected to decrease from 14 percent currently to 13 percent by 2020 (DOE/EIA 2001b). EIA projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 47.9 billion kWh in year 2000 to 66.1 billion kWh in year 2005, and then will decrease gradually to 47.4 billion kWh in year 2020 (DOE/EIA 2001b). Consequently, it is unlikely that electricity imported from Canada or Mexico would be able to replace the Catawba generating capacity.

If power to replace Catawba generating capacity were to be purchased from sources within the United States or a foreign country, the generating technology would likely be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the purchased electrical power alternative to renewal of the Catawba OLs. Thus, the environmental impacts of imported power would still occur, but would be located elsewhere within the region, the nation, or another country.

8.2.5 Other Alternatives

Other generation technologies are discussed in the following subsections.

8.2.5.1 Oil-Fired Generation

EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States from 2000 to 2020 because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). Oil-fired operation is more expensive than nuclear or coal-fired operation. Future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has prompted a steady decline in its use for electricity generation. In Section 8.3.11 of the GEIS, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 50 ha (120 ac). Additionally, operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

8.2.5.2 Wind Power

Most of South Carolina is in a wind power Class 1 region (average wind speeds at 10-m [30-ft] elevation of 0 to 4.4 m/s [0 to 9.8 mph]). Class 1 has the lowest potential for wind energy generation (DOE 2001a). Wind turbines are economical in wind power Classes 4 through 7 (average wind speeds of 5.6 to 9.4 m/s [12.5 to 21.1 mph]; DOE 2001a). Aside from the coastal areas and exposed mountains and ridges of the Appalachians, there is little wind energy potential in the East Central region of the United States for current wind turbine applications (Elliott et al. 1986). Wind turbines typically operate at a 30 to 35 percent capacity

factor compared to 90 to 95 percent for a power plant (NWPPC 2000). Nine offshore wind power projects are currently operating in Europe. The European plants together provide approximately 90 MW, which is far less than the electrical outputs of Catawba (British Wind Energy Association 2002). For the preceding reasons, the staff concludes that locating a wind-energy facility on or near the Catawba site or offshore would not be economically feasible given the current state of wind energy generation technology.

8.2.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies, photovoltaic and thermal, currently cannot compete with conventional fossil-fueled technologies in grid-connected applications due to higher capital costs per kilowatt of capacity. The average capacity factor of photovoltaic cells is about 25 percent (NRC 1996), and the capacity factor for solar thermal systems is about 25 percent to 40 percent (NRC 1996). Energy storage requirements limit the use of solar-energy systems as baseload electricity supply.

There are substantial impacts to natural resources (wildlife habitat, land-use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS (NRC 1996), land requirements are high—14,000 ha (35,000 ac) per 1000 MW(e) for photovoltaic and approximately 6000 ha (14,000 ac) per 1000 MW(e) for solar thermal systems. Neither type of solar-electric system would fit at the Catawba site, and both would have LARGE environmental impacts at a greenfield site.

The Catawba site receives approximately 4 to 5 kWh of direct normal solar radiation per square meter per day compared to 7 to 8 kWh of solar radiation per square meter per day in areas of the western United States, such as California, which are most promising for solar technologies (DOE/EIA 2000c). Because of the natural-resource impacts (land and ecological), the area's relatively low rate of solar radiation, and its high system cost, solar power is not considered to be a feasible baseload alternative to renewal of the Catawba OLs. Some onsite generated solar power (e.g., from rooftop photovoltaic applications) may substitute for electric power from the grid. Implementation of solar generation on a scale large enough to replace Catawba's generating capacity would likely result in LARGE environmental impacts.

8.2.5.4 Hydropower

South Carolina has an estimated 1133 MW of undeveloped hydroelectric resource (INEEL 1997). This amount is less than the amount needed to replace the 2258 MW(e) capacity of Catawba. As stated in Section 8.3.4 of the GEIS, hydropower's percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration

of natural river courses. In the GEIS (NRC 1996), the staff estimates that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per 1000 MW(e). Replacement of Catawba generating capacity would require flooding more than this amount of land. Due to the relatively low amount of undeveloped hydropower resource in South Carolina and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace Catawba, the staff concludes that local hydropower is not a feasible alternative to renewal of the Catawba OLs. Any attempts to site hydroelectric facilities large enough to replace Catawba would result in LARGE environmental impacts.

8.2.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload generation due to the limited geographical availability of the resource and the immature status of the technology (NRC 1996). As illustrated by Figure 8.4 in the GEIS, geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent. There is no feasible eastern location for geothermal capacity to serve as an alternative to Catawba. The staff concludes that geothermal energy is not a feasible alternative to renewal of the Catawba OLs.

8.2.5.6 Wood Waste

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a base-load generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and high inefficiency, the staff has determined that wood waste is not a feasible alternative to renewing the Catawba OLs.

8.2.5.7 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2001). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001c). Mass burning technologies are most commonly used in the United States. This group of technologies process raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. Because of the need for specialized waste-separation and waste-handling equipment for municipal solid waste, the initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities (NRC 1996).

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills; (2) the 1994 Supreme Court decision (*C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001c).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters and/or scrubbers (DOE/EIA 2001c).

Currently, there are approximately 102 waste-to-energy plants operating in the United States. These plants generate approximately 2800 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2001). The staff concludes that generating electricity from municipal solid waste would not be a feasible alternative to replace the 2258 MW(e) baseload capacity of Catawba and, consequently, would not be a feasible alternative to renewal of the Catawba OLs.

8.2.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol,

and gasifying crops (including wood waste). In the GEIS, the staff states that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as Catawba (NRC 1996). For these reasons, such fuels do not offer a feasible alternative to renewal of the Catawba OLs.

8.2.5.9 Fuel Cells

Fuel cells work without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Phosphoric acid fuel cells are generally considered first-generation technology. Higher-temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

DOE projects that by 2003, two second-generation fuel cell technologies using molten carbonate and solid oxide technology, respectively, will be commercially available in sizes up to 2 MW at a cost of $1000 to $1500 per kW of installed capacity (DOE 2001b). For comparison, the installed capacity cost for a natural-gas-fired combined-cycle plant is on the order of $500 to $600 per kW (NWPPC 2000). As market acceptance and manufacturing capacity increase, natural-gas-fueled fuel cell plants in the 50- to 100-MW range are projected to become available (DOE 2001b). At the present time, however, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Consequently, fuel cells are not a feasible alternative to renewal of the Catawba OLs.

8.2.5.10 Delayed Retirement

Through the year 2014, Duke projects that 23 of its generating units with a total capacity of 584 MW will be retired (Duke 2000). Delayed retirement of these 23 units would not come close to replacing the 2258 MW(e) capacity of Catawba. For this reason, delayed retirement of Duke generating units would not be a feasible alternative to renewal of the Catawba OLs.

8.2.5.11 Utility-Sponsored Conservation

Duke has developed residential, commercial, and industrial programs to reduce both peak demands and daily energy consumption. These programs are commonly referred to as demand-side management (DSM). The effects of the DSM programs are captured in the customer load forecast in the Duke Power Plan (Duke 2000).

Duke currently has two residential DSM programs (Duke 2000). The water heater program allows a customer to be billed at a lower rate for all water heating energy consumption in exchange for allowing Duke to control the water heater. The special needs energy products loan program provides loans for heat pumps, central air conditioning systems, and energy-efficiency measures such as insulation, tune-ups of heating and air conditioning systems, and sealing of duct systems. The two residential programs are reflected in Duke's plan for meeting customer loads (Duke 2000). Because these DSM savings are part of the long-range plan for meeting projected demand, they are not available offsets for Catawba.

Duke operates two programs for commercial and industrial customers to provide a source of interruptible capacity (Duke 2000). Participants in the standby generator control program contractually agree to transfer electrical loads from Duke to their standby generators when requested by Duke. Participating customers receive payments for capacity and/or energy based on the amount of capacity and/or energy transferred to their generator. Participants in the interruptible power service program agree to reduce their electrical loads to specified levels when requested by Duke. The two programs are not reflected in Duke's customer load forecast because load control contribution depends upon actuation (Duke 2000).

The staff concludes that additional DSM, by itself, would not be sufficient to replace the 2258 MW(e) capacity of Catawba and that it is not a reasonable replacement for the OL renewal alternative.

8.2.6 Combination of Alternatives

Even though individual alternatives to Catawba might not be sufficient on their own to replace the Catawba generating capacity due to the small size of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost-effective.

As discussed in Section 8.2, Catawba has a combined average net capacity of 2258 MW(e). There are many possible combinations of alternatives to replace that power. Table 8-8 contains a summary of the environmental impacts of an assumed combination of alternatives consisting of 1928 MW(e) of combined-cycle oil/natural-gas-fired generation at Catawba, using four 482-MW(e) combined-cycle, natural gas units. The existing closed-cycle cooling system would be used at the Catawba site. Closed-cycle cooling would also be employed at an alternate location. Purchases from other power generators could account for 165 MW(e) of power, and 165 MW(e) could be gained from additional DSM measures. The impacts associated with the combined-cycle, oil/natural-gas-fired units are based on the gas-fired generation impact assumptions discussed in Section 8.2.2, adjusted for the reduced generating capacity. While the DSM measures would have few environmental impacts, operation of the new gas-fired plant would result in increased emissions and environmental impacts. The environmental impacts associated with power purchased from other generators would still occur, but would be located

elsewhere within the region, nation, or another country as discussed in Section 8.2.4. The environmental impacts associated with purchased power are not shown in Table 8-8. The staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the Catawba OLs.

Table 8-8. Summary of Environmental Impacts for an Assumed Combination of Generating and Acquisition Alternatives

	Catawba Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Catawba site is sufficient to accommodate new plant (16 ha [40 ac] needed for power block, roads, and parking area). Possible additional impact for construction of an underground oil/gas pipeline—235 ha (582 ac) potentially disturbed for rights-of-way.	MODERATE to LARGE	50 ha (130ac) for power-block, offices, roads, switchyard, and parking areas. Additional land (up to 705 ha [1742 ac]) possibly impacted for transmission line and for natural gas pipeline—MODERATE. Use of previously undeveloped greenfield site increases impacts to LARGE.
Ecology	SMALL to MODERATE	Uses undeveloped areas at Catawba site, plus land for a new gas pipeline.	SMALL to LARGE	Impact depends on whether greenfield or previously developed site. Impact also depends on ecology of the site, surface water body used for intake and discharge, and possible transmission and oil/gas pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity. Use of undeveloped greenfield site increases impacts.

Table 8-8. (contd)

	Catawba Nuclear Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Water Use and Quality (Surface Water)	SMALL	Uses existing closed-cycle cooling system existing intake structures. Surface water use should be less than current uses with Catawba, Units 1 and 2.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body. New intake and discharge structures required.
Water Use and Quality (Groundwater)	SMALL	Less groundwater withdrawn for potable use because of smaller workforce.	SMALL to LARGE	Impacts SMALL if groundwater used only for potable purposes. Impacts MODERATE to LARGE if groundwater employed as makeup cooling water. Impacts would be site/aquifer specific.
Air Quality	SMALL	Sulfur oxides • 25 MT/yr (27 tons/yr) Nitrogen oxides • 375 (410 tons/yr) Carbon monoxide • 350 MT/yr (382 tons/yr) PM_{10} particulates • 208 MT/yr (227 tons/yr) Some hazardous air pollutants.	SMALL	Potentially same impacts as at the Catawba site, although pollution control standards may vary.
Waste	SMALL	Minimal waste product from fuel combustion.	SMALL	Minimal waste product from fuel combustion.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.

Table 8-8. (contd)

	Catawba Nuclear Station Site		Alternate Greenfield Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 640 additional workers during the peak of the 3-year construction period, followed by reduction from current Catawba Units 1 and 2 workforce by 1098 to around 120 workers; tax base preserved. Impacts during operation would be SMALL to MODERATE, due to loss of employment in York County which may be offset by proximity to Charlotte economy.	SMALL to LARGE	Impacts depend on site characteristics. During construction, impacts would be SMALL to MODERATE. Tax impacts on receiving county could be SMALL to LARGE. Up to 640 additional workers during the peak of the 3-year construction period. York County would experience loss of Catawba Units 1 and 2 tax base and employment with potentially MODERATE to LARGE associated impacts.
		Transportation impacts associated with construction workers would be SMALL to MODERATE. Transportation impacts during operation would be SMALL due to smaller workforce. During construction, impacts would be MODERATE. Up to 640 additional workers during the peak of the 2- to 3-year construction period in addition to workers currently employed at Catawba. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.		Transportation impacts associated with construction workers would be SMALL to LARGE and would depend on population density and road infrastructure at alternate site. Impacts during operation would be SMALL due to smaller workforce.

Table 8-8. (contd)

Impact Category	Catawba Nuclear Station Site		Alternate Greenfield Site	
	Impact	**Comments**	**Impact**	**Comments**
Aesthetics	SMALL to MODERATE	Lake Wylie area impacted. SMALL to MODERATE aesthetic impact from plant and stacks, fuel oil storage tanks, lighting, and mechanical noise associated with operation.	SMALL to LARGE	SMALL if previously developed site is used and site disturbance is minimal. Impacts increase to strongly MODERATE with construction of a transmission line and oil/gas pipeline to previously developed site. LARGE if greenfield site developed.
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be managed effectively.	SMALL	Same as at Catawba; any potential impacts can likely be managed effectively.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction. Loss of approximately 1098 operating jobs at Catawba could reduce employment prospects for minority and low-income populations. Nearness to Charlotte economic area may mitigate impacts.	SMALL to LARGE	Impacts at alternate site vary depending on population distribution and makeup at site could be SMALL to LARGE. Loss of tax revenue for York County could have a MODERATE impact. Impact to Clover School District would be LARGE. Nearness of York County to Charlotte economic area may mitigate impacts.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, renewal of the Catawba OLs, are SMALL for all impact categories (except collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned). Several alternative actions were considered — no-action (discussed in Section 8.1), new generation alternatives (from coal, oil/natural gas, and nuclear discussed in Sections 8.2.1 through 8.2.3,

respectively), purchased electrical power (discussed in Section 8.2.4), alternative technologies (discussed in Section 8.2.5), and the combination of alternatives (discussed in Section 8.2.6).

The no-action alternative would require the replacing of electrical generating capacity by (1) DSM and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than Catawba, or (4) some combination of these options, and would result in decommissioning Catawba. For each of the new generation alternatives (coal, natural gas, and nuclear), the environmental impacts would not be less than the impacts of license renewal. For example, the land-disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of Catawba. The impacts of purchased electrical power would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the OLs for Catawba.

The staff concludes that the alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

8.4 References

10 CFR 50. Code of Federal Regulations, Title 10*, Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Functions."

10 CFR 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR 50. Code of Federal Regulations, Title 40 *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

40 CFR 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

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