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NUREG-1938, Vol. 1

Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina

Final Report

Office of Federal and State Materials and
Environmental Management Programs

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ABSTRACT

On January 30, 2009, General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) submitted an environmental report to the U.S. Nuclear Regulatory Commission (NRC) for a license to construct and operate the GLE Global Laser Enrichment Facility. GLE submitted the remainder of the license application on June 26, 2009. The proposed GLE Facility would be located in the North-Central Sector of the existing GE property near Wilmington, North Carolina. The proposed GLE Facility, if licensed, would enrich uranium for use in manufacturing nuclear fuel for commercial power reactors. Feed material for the proposed GLE Facility would be comprised of non-enriched uranium hexafluoride (UF_6). GLE would employ a laser-based enrichment process to enrich uranium to up to 8 percent uranium-235 by weight, with an initial planned maximum target production of 6 million separative work units (SWU) per year. GLE could begin preconstruction activities prior to the NRC's licensing decision in 2012. If the license is granted, GLE expects to begin facility construction in 2012, and continue construction activities through 2020. GLE anticipates commencing initial production in 2014 and reaching peak production in 2020. Prior to license expiration in 2052, GLE would seek to renew its license to continue operating the facility, or plan for the decontamination and decommissioning of the facility per the applicable licensing conditions and NRC regulations. The proposed GLE Facility would be licensed in accordance with the provisions of the *Atomic Energy Act*. Specifically, an NRC license under Title 10, "Energy," of the *U.S. Code of Federal Regulations* (10 CFR) Parts 30, 40, and 70 would be required to authorize GLE to possess and use special nuclear material, source material, and byproduct material at the proposed GLE Facility site.

This Environmental Impact Statement (EIS) was prepared in compliance with the *National Environmental Policy Act of 1969,* as amended (NEPA), and the NRC regulations for implementing NEPA (10 CFR Part 51). This EIS evaluates the potential environmental impacts of the proposed action and reasonable alternatives. This EIS also describes the environment potentially affected by GLE's proposal, presents and compares the potential environmental impacts resulting from the proposed action and alternatives, describes GLE's environmental monitoring program and mitigation measures, and evaluates the costs and benefits of the proposed action.

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This NUREG contains and references information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget, approval number 3150-0014, 3150-0017, 3150-0020, 3150-0021, 3150-0151, 3150-0135, 3150-0009 and 3150-0008.

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EXECUTIVE SUMMARY

BACKGROUND

Pursuant to Title 10 of the *U.S. Code of Federal Regulations* (10 CFR) Parts 30, 40, and 70, the U.S. Nuclear Regulatory Commission (NRC) is considering whether to issue a license that would allow General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) to possess and use special nuclear material, source material, and byproduct material at a proposed laser-based uranium enrichment facility near Wilmington, North Carolina. The scope of activities to be conducted under the license would include the construction and operation of the proposed GLE Facility. GLE submitted its Environmental Report (GLE, 2008) to the NRC on January 30, 2009, and the license application was submitted on June 26, 2009. To support its licensing decision on the proposed GLE Facility, the NRC's implementing regulations in 10 CFR Part 51 for the *National Environmental Policy Act* (NEPA) require the preparation of an Environmental Impact Statement (EIS). The development of this EIS is based on the NRC's review of information provided by GLE, the NRC's independent analyses, and consultation with other Federal agencies, American Indian tribes and organizations, State agencies, and local agencies.

The enriched uranium produced at the proposed GLE Facility would be used to manufacture nuclear fuel for commercial nuclear power reactors. Enrichment is the process of increasing the concentration of the naturally occurring and fissionable uranium-235 isotope. Uranium ore usually contains approximately 0.72 percent uranium-235 by weight. To be useful in nuclear power plants as fuel for electricity generation, uranium must be enriched to approximately 3–5 percent uranium-235 by weight.

THE PROPOSED ACTION

The proposed action considered in this EIS is the NRC issuing a license that would allow GLE to construct, operate, and eventually, decommission (under a separate NRC action) a laser-based uranium enrichment facility on existing GE property near Wilmington, North Carolina. The license would authorize GLE to possess and use special nuclear material, source material, and byproduct material at the proposed GLE Facility for a period of 40 years. If the license is granted, the proposed GLE Facility would be located on the North-Central Sector of the GE property.

The proposed GLE Facility would employ a laser-based process to enrich uranium up to 8 percent uranium-235 by weight (although nuclear power reactors normally require 3–5 percent uranium-235 by weight), with an initial planned maximum target production of 6 million separative work units (SWU) per year. GLE could begin preconstruction activities at GE's Wilmington Site prior to the NRC licensing decision in 2012. If the license is approved, GLE expects to begin facility construction in 2012, and continue through 2020. Initial production would commence in 2014 and reach peak production in 2020. Prior to license expiration in 2052, GLE would decide whether or not to renew its operating license, or decontaminate and decommission the facility.

PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed action is for GLE to construct, operate, and decommission a facility to enrich uranium up to 8 percent uranium-235 by weight, with a production capacity of

6 million SWU per year, using laser-based technology at the proposed GLE Facility. This facility would provide an additional domestic source of low-enriched uranium to be used in commercial nuclear power plants.

Nuclear power supplies approximately 20 percent of the nation's electricity. Currently, domestic production of low-enriched uranium accounts for approximately 16 percent of U.S. demand. The United States Enrichment Corporation (USEC) is the primary domestic supplier of low-enriched uranium for nuclear fuel in the United States through its operation of an enrichment plant near Paducah, Kentucky. Under the Megatons-to-Megawatts Program (which is scheduled to expire in 2013), USEC also imports the enriched portion of downblended (diluted) weapons-grade uranium from Russia to supply an additional 37 percent of the U.S. demand. Foreign suppliers, other than Russia, meet the remaining 47 percent of the current U.S. demand for low-enriched uranium.

Commencing in 2013, USEC will import, under a new 10-year agreement, low-enriched uranium from Russia at levels initially expected to reach (in 2015) approximately one-half the level of the Russian downblended, weapons-grade materials. The agreement includes an option to increase the quantities to the same level as the Megatons-to-Megawatts Program. USEC will deliver a portion of this enriched uranium to U.S. utilities.

The Louisiana Energy Services (LES) National Enrichment Facility (NEF, doing business as [d/b/a] URENCO USA) in Lea County, New Mexico, which began initial operations in June 2010, may provide additional enrichment services in the future as construction continues and the facility reaches capacity. USEC's American Centrifuge Plant (ACP) in Piketon, Ohio, and AREVA's Eagle Rock Enrichment Facility (EREF) in Bonneville County, Idaho, may also provide additional domestic enrichment services in the future.

The current dependence on a single U.S. supplier and foreign sources for low-enriched uranium imposes reliability risks for the nuclear fuel supply to U.S. nuclear power plants. The production of enriched uranium at the proposed GLE Facility would be equivalent to about 40 percent of the current and projected demand (15–16 million SWU) for enrichment services within the United States.

ALTERNATIVES

The NRC considered a reasonable range of alternatives, including the no-action alternative, in this EIS. Under the no-action alternative, the proposed GLE Facility would not be constructed. Enrichment services would continue to be performed by existing domestic and foreign uranium enrichment suppliers. Paducah Gaseous Diffusion Plant (GDP) and the NEF would continue to provide enrichment services. The ACP and EREF could also provide enrichment services in the future.

GLE considered 22 sites throughout the United States, evaluating them based on various technical, safety, economic, and environmental criteria. GLE concluded that the site considered in the proposed action met all of the criteria and that none of the other candidate sites were obviously superior to the preferred site near Wilmington, North Carolina. The NRC reviewed the GLE site selection process and determined that it is rational and objective, and that its results are reasonable. Therefore, no other site was evaluated in this EIS.

The NRC considered three alternatives to the proposed action for satisfying domestic enrichment needs, including (1) reactivation of the Portsmouth Gaseous Diffusion Plant near Piketon, Ohio, (2) downblending of high-enriched uranium, and (3) purchase of low-enriched uranium from foreign sources. These alternatives were eliminated from detailed study due to reliability issues, excessive energy consumption, national energy policy objectives, and national energy security concerns.

The NRC also evaluated several alternative technologies to the laser-based enrichment process, including electromagnetic isotope separation, liquid thermal diffusion, gaseous diffusion, atomic vapor laser isotope separation, molecular laser isotope separation, and gas centrifuge. All of these technologies, except gas centrifuge, were eliminated from detailed study due to the fact that some technologies are still in development and/or not economically viable. The environmental impacts of gas centrifuge technology were qualitatively evaluated, relative to those of the proposed laser-based technology. Although gas centrifuge is a technologically and economically viable alternative, it is not obviously superior to the laser-based technology that GLE has chosen to pursue for the proposed action.

The NRC also evaluated alternative conversion and disposition methods for depleted uranium hexafluoride (UF_6), including (1) beneficial use of depleted UF_6 and (2) conversion at facilities other than the new U.S. Department of Energy (DOE) facilities at Portsmouth, Ohio, and Paducah, Kentucky. For the purposes of this analysis, because the current available inventory of depleted uranium exceeds the current and projected demand for the material, the depleted UF_6 generated by the proposed GLE Facility was considered a waste product, and disposition alternatives involving its use as a resource were not evaluated. In addition, existing fuel fabrication facilities are currently not interested in depleted UF_6, and the cost for the conversion could not be estimated. Therefore, this alternative was also eliminated from detailed study. However, International Isotopes, Inc., submitted a license application to the NRC on December 31, 2009, to construct and operate a depleted uranium hexafluoride (UF_6) conversion facility near Hobbs, New Mexico. This facility would deconvert depleted UF_6 into fluoride products (for commercial resale) and depleted uranium oxides (for disposal). On February 23, 2010, the NRC accepted the license application for detailed technical review.

NRC EXEMPTION TO CONDUCT CERTAIN PRECONSTRUCTION ACTIVITIES

The NRC has approved an exemption request from GLE to conduct certain preconstruction activities prior to NRC's decision to issue a license for the construction and operation of the proposed GLE Facility. The exemption covers the following activities and facilities:

- Clearing of 47 hectares (117 acres) for the proposed GLE Facility;
- Site grading and erosion control;
- Installing a stormwater retention system;
- Constructing main access roadways and guardhouse(s);
- Installing utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, and natural gas);

- Constructing parking lots and minor roadways; and
- Constructing administrative building(s).

The NRC granted the exemption on May 8, 2009. This exemption authorizes GLE to conduct the stated activities, provided that none of the facilities or activities subject to the exemption would be components of GLE's Physical Security Plan or its Standard Practice Procedures Plan for the Protection of Classified Matter, or otherwise be subject to NRC review or approval. For the purposes of this EIS, these activities are assumed to occur prior to NRC's decision to grant a license to GLE, and therefore, are assumed to occur under both the proposed action and no-action alternatives.

POTENTIAL ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This EIS evaluates the potential environmental impacts of the proposed action. A standard of significance has been established for assessing environmental impacts based on Council on Environmental Quality (CEQ) terminology for "significantly" (see 40 CFR 1508.27). Since the significance and severity of an impact can vary depending on the proposed action, both "context" and "intensity" as defined in CEQ regulations 40 CFR 1508.27 were considered. Context is the environment surrounding the location where action(s) would occur. Intensity refers to the severity of the impact, in whatever context it occurs. Based on this, the NRC established three levels of significance for potential impacts: small, moderate, and large. The definitions of these three significance levels follow:

- *Small impact*: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
- *Moderate impact*: Environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource.
- *Large impact*: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Land Use

<u>Small Impact.</u> The Wilmington Site is owned by GE and zoned for heavy industrial use; construction of the proposed GLE Facility would be consistent with current zoning. The project area currently consists of mostly mixed-pine forest, and is bordered by existing GE facilities, the Northeast Cape Fear River, and residential development. Preconstruction activities would occur under the proposed action, removing the undeveloped forest. Construction of the proposed GLE Facility would not alter current land use at the Wilmington Site or affect surrounding land use.

Operation of the proposed GLE Facility at the Wilmington Site could affect nearby residential development. However, facility operations would be consistent with other industrial activities at the Wilmington Site. These industrial activities have had no effect on residential development.

Decommissioning would not alter current land use at the Wilmington Site or affect surrounding land use.

Historical and Cultural Resources

Small to Moderate Impact. The location for the proposed GLE Facility (study area) comprises 106 hectares (263 acres). Under the proposed action, preconstruction activities would have an impact on historic and cultural resources. NRC-authorized construction would take place on ground previously disturbed by preconstruction. No construction activities are expected to occur in the portion of the Wilmington Site where historic and cultural resources are known to exist.

GLE Facility operations would have the potential to affect historic and cultural resources. While GLE has no plans to alter the site during operations, there is a high potential for additional historic and cultural resources to be discovered during routine maintenance activities. The Wilmington Site is located within a region containing high concentrations of historic and cultural resources. Operational impacts would depend largely on procedures employed to protect historic and cultural resources. The Middle Woodland archaeological site 31NH801 would not be affected by facility operations. The North Carolina State Historic Preservation Office (SHPO) requested that GLE develop procedures to protect site 31NH801. In response, the NRC proposed a license condition that would require GLE to consider the potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed areas of the GLE Facility site. GLE also developed Common Procedure CP-24-201 to address the unanticipated discovery of human remains or artifacts. The SHPO concurred that a determination of “no adverse effect” is appropriate with the inclusion of the proposed license condition. Based on this information, the NRC determined that the impact level would be SMALL to MODERATE given the close proximity of significant historic and cultural resources and high potential for additional historic and cultural resource materials to be discovered during routine operations. The NRC's determination is based on the license containing the proposed license condition.

Decommissioning impacts on historic and cultural resources are expected to occur primarily during ground-disturbing activities; the need to clear previously undisturbed land is not expected as a part of decommissioning activities.

Visual and Scenic Resources

Small Impact. The project area has low scenic quality and the environment in the project area is not unique for the area. Under the proposed action, preconstruction activities would include clearing vegetation. The proposed GLE Facility would be located adjacent to existing industrial facilities and would be consistent with the existing industrial character of the Wilmington Site. Likewise, the project area is not in a location that is sensitive to visual intrusions.

Construction activities would be limited to the Wilmington Site. The greatest visual impacts would occur from increased truck and worker traffic, but these impacts would be temporary. The main project area is surrounded by a vegetation barrier, so construction activities would be largely screened. Construction cranes would be visible from greater distances, but this impact would be temporary.

The two most visible (i.e., tallest) structures would be the water tower and a portion of the operations building referred to as the operations building tower. The operations building tower will have front and side profiles of 37 meters (120 feet) by 200 meters (660 feet), and could reach up to 49 meters (160 feet) above grade. The proposed water tower is the same height as the existing Wilmington Site water tower, the top of which is visible from south of Interstate 140

(I-140). Although the operations building tower could be 10 meters (30 feet) taller than the existing water tower, it would be visible primarily from Castle Hayne Road and the residential subdivision to the northeast, because it would be further from I-140 than the existing water tower. The water tower, facility, and operations building tower would not represent a major alteration of the existing visual environment. Portions of the proposed facility may be visible from I-140, and the planting of additional vegetation may minimize visual impacts.

Decommissioning impacts on visual and scenic resources would be minimal and of short duration. Temporary visual impacts could result from the use of heavy equipment and the increase in worker traffic. Once decommissioning is complete, most of the visual impacts would cease. The vegetation screen surrounding the Wilmington Site would make changes imperceptible to all but the closest residences.

Air Quality

<u>Small to Moderate Impact.</u> Under the proposed action, preconstruction activities would have an impact on ambient air quality conditions at the Wilmington Site. Air quality impacts would be the highest during preconstruction activities (not a part of the proposed action) and the initial two years of GLE Facility construction. Criteria pollutants, volatile organic compounds (VOCs), greenhouse gases, hazardous air pollutants (HAPs), fugitive dust emissions, and engine exhaust emissions would be released during these activities. Emissions of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) would have a SMALL impact on ambient air quality (well below applicable standards). Impacts from lead and ozone-precursor emissions from GLE Facility construction are expected to be negligible and would have SMALL impacts on surrounding areas.

Total 24-hour concentrations of particulate matter equal to or smaller than 10 micrometers (PM_{10}) and particulate matter equal to or smaller than 2.5 micrometers ($PM_{2.5}$), mostly resulting from fugitive dust emissions, are predicted to exceed air quality standards during preconstruction and construction phases. Since preconstruction and construction activities would last about nine months and two years, respectively, the potential air quality impacts during the preconstruction phase would be MODERATE but temporary. Aggressive dust control measures would be implemented during the preconstruction and construction phases to reduce the impact.

Because the proposed GLE Facility would not employ any continuous combustion activities during operation, emission rates for criteria pollutants and HAPs would be SMALL. Uranium-related and/or hydrogen fluoride (HF) stack emissions would be minimal, and emissions from diesel fuel handling would be very low. Fugitive dust emissions would be minimal, as most working areas and roads would be paved. Potential impacts from GLE Facility operations on regional ozone would also be SMALL.

Decontamination activities would mostly occur inside GLE Facility buildings, where emission controls would minimize atmospheric releases. Standard dust suppression techniques could be employed during the demolition of structures and other hard surface areas to control dust emissions. Work areas would be monitored for airborne dust, and a small, temporary shelter or tent with portable high-efficiency particulate air (HEPA) filtration could be used to minimize the release of contaminated dust. The number of workers would be fewer than those required during construction or operations, but truck traffic on the North access road would be

comparable to that experienced during GLE Facility construction. Air emission rates and associated air quality impacts of decontamination and decommissioning activities at the proposed GLE Facility would be comparable to or less than those experienced during construction.

Geology and Soils

Small Impact. Under the proposed action, preconstruction activities would have an impact on soil conditions at the Wilmington Site. Approximately 91 hectares (226 acres) of land would be disturbed under the proposed action, including the proposed GLE Facility site, support structures, and road construction. Construction vehicles and equipment could leak fuel, oil, or grease to site soils. Construction activities would include soil excavation, soil storage and removal, and stormwater management. Construction would not impact geologic resources because the site lacks significant geologic resources.

Soil disturbance during GLE Facility operations would continue at reduced levels, as some construction would continue after start-up. Impervious surfaces such as roads, parking lots, and roofs would increase stormwater runoff, increasing erosion potential. Large storm events could create erosion along drainages or at culverts, requiring maintenance or drainage system improvement. Vehicles and equipment used in unpaved areas during facility operations could leak fuel, oil, or grease to site soils. Groundwater pumping is expected to have a minimal effect on groundwater levels, and the associated degree of subsidence is expected to be negligible. Other geologic hazards (e.g., volcano, tsunami, landslides, radon gas, methane gas, subsidence due to mining) to the site are not anticipated.

Foundations, roads, and utility lines would likely be undisturbed during decontamination and decommissioning. Erosion may increase, as portions of the site are disturbed by heavy equipment.

Surface Water Resources

Small Impact. Under the proposed action, preconstruction activities would have an impact on water quality in streams located on the Wilmington Site. Excavation during construction could affect surface water quality. The access road for the proposed GLE Facility would require a new stream crossing and possibly change a jurisdictional channel, which could lead to erosion and increased sediment load. Construction vehicles and equipment pose the possibility of leaks or spills of fuels, oil, or grease, which could run off and impact nearby surface water. However, it is unlikely that a minor spill would reach the Northeast Cape Fear River or Prince George Creek. Infiltration into site soil would likely reduce or eliminate the potential for runoff.

Process wastewater effluent would be discharged at an existing outfall during GLE Facility operations, increasing the site's process wastewater volume by about 7 percent. Liquid radioactive waste would be pretreated to reduce uranium to acceptable levels before transfer to the existing wastewater treatment facility. Treatment would produce an effluent similar to current process wastewaters. Treated sanitary wastewater effluent would be reused in site cooling towers.

No consumption of surface water would occur during GLE Facility operations. Stormwater runoff would collect in a State-permitted detention basin before discharge and would be

regulated by a National Pollutant Discharge Elimination System (NPDES) permit. Stormwater runoff from the UF_6 cylinder storage pads would collect in a lined retention pond. If monitoring demonstrates a lack of radioactivity, pond effluent would be discharged to the stormwater detention basin and ultimately, to the effluent channel. Any increase in turbidity and sediment loading to streams as a result of construction would subside during GLE Facility operations. Oil, grease, metals, and other automotive-related contaminants would be present in limited quantities due to onsite vehicular traffic. Herbicides used in landscaped areas of the Wilmington Site would also be present.

GLE Facility process wastewater flow would cease during decontamination and decommissioning, but decontamination effluent could be generated. If the Wilmington Site treatment and industrial reuse facility could not receive sanitary discharge during the decontamination and decommissioning of the proposed GLE Facility, portable toilets would be required for workers. The collection, treatment, monitoring, and discharge of decontamination water would be designed to avoid significant environmental impact. Erosion may increase as portions of the site are disturbed by heavy equipment, and BMPs would reduce the impact.

Groundwater Resources

Small Impact. Under the proposed action, preconstruction activities would have an impact on groundwater quality in shallow aquifers at the Wilmington Site. Implementation of best management practices (BMPs) during the construction of the proposed GLE Facility would reduce the potential for leaks of fuel, oil, and grease to soil and groundwater. The use of portable toilets during construction would eliminate sanitary system impacts on groundwater. Tanker trucks would provide potable and nonpotable construction water.

During GLE Facility operations, stormwater collected from the UF_6 cylinder storage pad is expected to have no more than trace amounts of radiological contaminants, and the liner is expected to limit infiltration to groundwater. Discharge at site outfalls would be from process and sanitary wastewater. Some portion of these effluents may potentially infiltrate the Peedee sand aquifer. However, treatment and monitoring are expected to result in no significant contaminant concentrations in the effluent channel. The proposed facility will obtain additional groundwater for potable purposes from existing production wells at the Wilmington Site. Water level data show these wells to be cross-gradient of the overall Wilmington Site, and they do not result in significant drawdown. Groundwater will also be needed as a source of process water for the proposed GLE Facility. A small amount of increased drawdown is expected, without significant effect on flow directions, water quality, or availability for offsite users. Diesel tanks at the facility would have appropriate leak detection equipment. In addition, a groundwater monitoring plan would be developed after the facility is constructed.

The removal of structures, utilities, materials, and products during the decommissioning of the proposed GLE Facility is not expected to have an impact on site groundwater resources.

Ecological Resources

Small to Moderate Impact. Under the proposed action, most impacts on ecological resources would occur during preconstruction activities and would be SMALL to MODERATE. Preconstruction impacts on wetlands, environmentally sensitive areas, and aquatic biota would be SMALL. Most construction activities would occur in areas that would have already been

disturbed by preconstruction activities. Impacts on vegetation would occur primarily from vegetation clearing, habitat fragmentation, alteration of topography, changes in drainage patterns, and soil compaction. Remaining potential impacts on vegetation include decline or mortality of trees near the construction boundary, effects related to hydrologic changes, deposition of dust and other particulate matter, introduction of invasive plant species, and accidental releases of hazardous materials (e.g., fuel spills).

Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. No wetlands would be directly impacted by construction of the proposed facility, but three jurisdictional wetlands and one isolated wetland occur within the corridor for the revised entrance and roadway. It is probable that the isolated wetland would be directly impacted, resulting in a wetland loss. However, impacts on, or loss of, this wetland would not be significant, given the apparent low value of the wetland under State rating guidelines. Indirect impacts on wetlands could occur from increased stormwater runoff, decreased groundwater recharge, disconnected hydrologic conductivity, or changes in groundwater or surface water flow patterns. Impacts from increased or decreased runoff are expected to be negligible.

Except for the probable impact on wetlands, no environmentally sensitive areas would be directly impacted by construction. Only minor, localized indirect impacts on environmentally sensitive areas may occur from erosion and sedimentation or from changes in drainage patterns.

Impacts on wildlife from construction would include habitat disturbance, wildlife disturbance, and injury or mortality of wildlife. Habitats within the footprint disturbed by construction would be reduced or altered, and construction activities would result in habitat fragmentation. Construction would cause a loss of habitat, which could result in a long-term reduction in wildlife abundance and richness. Although habitats adjacent to the proposed facility site would mostly remain unaffected, wildlife might make less use of these areas due to disturbance (indirect habitat loss). Habitat disturbance, including roads, could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent offsite habitats. If exposure of wildlife to fugitive dust was of sufficient magnitude and duration, the effects could be similar to those on humans. A more probable effect would be the dusting of plants, which could make forage less palatable. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a long-term reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials.

No aquatic habitats are located within the footprint of the areas that will be cleared for the proposed facility, and no significant adverse impacts on aquatic biota are expected from construction activities.

No impacts would be expected on any Federally listed threatened, endangered, or other special status species from construction activities. Similarly, no impacts would be expected on any State-listed species.

During operation, impacts on vegetation would include moving, hand-cutting, and chemical control of vegetation around the proposed facility, support facilities, utility corridors, and access road. No effects on vegetation would be expected from the cooling tower or air emissions, wastewaters, and solid wastes generated during operation. It is unlikely that radionuclide releases would have adverse effects on ecological resources. Facility operation would not encroach upon or have any other adverse effect on wetlands. Impervious surfaces generally result in increased runoff and reduced infiltration, but routing drainage to the stormwater detention and retention basins would minimize the potential for wetland water-level fluctuations. No environmentally sensitive areas would be impacted by operations. Potential impacts on wildlife from operations would include ongoing habitat disturbance (i.e., reduction, alteration, and fragmentation of habitat), and wildlife injury or mortality.

No natural water bodies occur within the immediate area of the proposed facility. During operations, aquatic habitats and biota could be affected by continued erosion and sedimentation and exposure to contaminants. Increased liquid effluent discharges could increase turbidity and sedimentation until the stream channel adjusts. Wastewater would be treated to meet NPDES permit requirements, so aquatic biota would not be adversely impacted. The potential exists for toxic materials (e.g., fuel, lubricants, and herbicides) to be accidentally introduced into aquatic habitats, but an uncontained spill would probably affect only a limited area, and lubricants and fuel would not be expected to enter wetlands or waterways (due to soil infiltration and the distance from the main work area to drainages). Only trace levels of radiological contamination would be released to surface waters during operation, so adverse radiological impacts on aquatic biota would not be expected.

No adverse impacts on threatened, endangered, or other special status species would be expected from facility operations due to the lack of suitable habitats within the immediate project area.

Most decontamination activities would occur inside buildings, so large-scale ecological resource impacts are not expected. Removal of facilities could impact vegetation adjacent to the facilities and cause offsite erosion and sedimentation. The plant community established where facilities are removed would depend on subsequent use of the project area, and revegetation of the removed facility areas could increase wildlife habitat diversity. Decommissioning activities are not expected to directly impact wetlands or environmentally sensitive areas. There would be a temporary increase in disturbance to wildlife associated with vehicle, equipment, and worker activities. Other potential impacts would include the disposal of solid wastes and hazardous materials and the remediation of any contaminated soils. After decommissioning is complete, there would be no fuel or chemical spills associated with the facility.

Impacts on wildlife from decommissioning are expected to be similar to those experienced during construction. Removal of wildlife habitat (primarily landscaped lawns) would have minor impacts on wildlife populations. There would be a temporary increase in noise and visual disturbance associated with the removal and subsequent restoration of facilities. Removal of the impervious areas would decrease runoff and discharge, ceasing impacts on aquatic biota. Decommissioning would not directly impact threatened, endangered, or other special status species.

Noise

Small to Moderate Impact. Under the proposed action, noise impacts associated with preconstruction activities would be short-term and limited to the immediate vicinity of the proposed GLE Facility site. During construction, vehicular traffic to and from the proposed GLE Facility would generate intermittent noise along local roadways. However, the noise contribution from these sources would be limited to the immediate vicinity of the Wilmington Site. Major activities would include building construction and equipment installation. Potential noise impacts on the nearest subdivision would be moderate but temporary in nature when road construction (a preconstruction activity) occurs.

During GLE Facility operations, exterior equipment, such as pumps, heat pumps, transformers, and cooling towers, would generate noise. Other sources of noise would include commuter vehicular and delivery truck traffic. Noise levels at the fenceline nearest to the Wooden Shoe residential subdivision would be below day and night ambient sound levels that correspond to the New Hanover County Noise Ordinance.

Most decontamination activities would occur inside the GLE Facility buildings. If decommissioning includes demolition, heavy construction equipment may be required. Salvaged materials and waste/debris would be hauled offsite by truck. Noise from truck traffic on site access roads would be comparable to that experienced during construction. Noise levels at the fenceline from truck traffic on the North access road nearest the Wooden Shoe subdivision are expected to be below the New Hanover County Noise Ordinance.

Transportation

Small to Moderate Impact. Under the proposed action, preconstruction activities would have an impact on traffic conditions. These impacts would be short-term and limited to site access roads and roads in the vicinity of the Wilmington Site. Construction traffic would involve the movement of personnel, equipment, and material to and from the proposed GLE Facility site, and the removal of construction debris and waste. The number of truck shipments would vary over the course of construction. Construction activities are estimated to add an average of approximately 35 trucks per day, with a small impact on local traffic. Prior to start-up, an average increase of up to 1428 daily trips by construction personnel is anticipated, with the heaviest traffic occurring in the immediate vicinity of the site entrance. Impacts on roads in the vicinity of the Wilmington Site could be SMALL to MODERATE; regional impacts would be SMALL. Impacts would be reduced if shift changes do not coincide with peak traffic volume periods.

GLE Facility operations would overlap with the construction period for 5–6 years, during which time vehicular traffic from commuting operations personnel would be combined with traffic from construction workers and shipments. An average of approximately six additional truck shipments per day to and from the Wilmington Site would occur during GLE Facility operations. The average number of workers (construction and operations personnel) commuting on a daily basis during start-up and construction completion is anticipated to be 590, with about 350 permanent operations personnel employed over the remainder of the operational period. The average number of additional daily vehicle trips from facility activities will increase by about 1239 at the Wilmington Site during the period of construction and operations overlap. Once construction is complete, the average number of daily trips associated with operations

personnel is estimated to be approximately 735. The range of additional daily vehicle trips from facility operations (735 to 1239) would have a MODERATE impact on the local road network. However, the impact on regional traffic flow would be SMALL.

Operations of the proposed GLE Facility would require the shipment (by truck) of various radioactive materials to and from the facility. Vehicle-related risks result from a vehicle moving from one location to another (independent of cargo characteristics), while cargo-related risk refers the risk from the cargo being shipped. In the case of the uranium, cargo-related risks would include exposure to ionizing radiation during normal transportation and accident conditions, as well as chemical hazards during accident conditions. Less than one latent cancer fatality is anticipated for the public and transportation crews from all shipments on an annual basis. No latent fatalities from vehicle emissions are anticipated on an annual basis.

Overall annual transportation accident impacts from the proposed action are expected to be SMALL. Chemical impacts would be negligible, as past analyses of depleted UF_6 shipments have shown the estimates of irreversible adverse effects to be approximately 1 to 3 orders of magnitude lower than the estimates of public latent cancer fatalities from radiological accident exposure. No fatalities are expected from accidents (direct physical trauma) on an annual basis.

Initial decommissioning activities during the last year of operations would increase the total number of workers. The number of truck shipments to offsite locations during this period is expected to be approximately the same as during construction. Local and regional transportation impacts would be SMALL after operations cease due to the decrease in workers during decommissioning. Radioactive waste from decommissioning would be sent to the appropriate storage, treatment, and disposal facilities. Impacts from radioactive waste shipments would be SMALL due to the low levels of external radiation and the low number of shipments.

Public and Occupational Health

Small Impact. Occupational exposures during preconstruction activities would be minor and minimized using work practices and personal protective equipment. Preconstruction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust. Occupational exposures during construction of the proposed GLE Facility would be minor and minimized using work practices and personal protective equipment. Construction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust.

Construction activities would not generate radiological contamination but could disturb areas previously contaminated by past and current operations. Construction workers could also be exposed to emissions from the proposed GLE Facility during the overlap of construction and operation. The maximum possible dose would be a small fraction of background radiation exposure and less than 1 millisievert per year (100 millirem per year). Dose to the offsite public would be significantly less, as there is no potential for measurable exposure from existing site contamination.

A total of 324 total recordable incidents, 197 lost workday incidents, and less than one fatal injury are projected for 38 years of GLE Facility operation. Lasers would normally be operated within enclosures and equipped with interlocks to prevent inadvertent worker exposure.

The greatest potential for occupational exposure in the main process building would be from connecting and disconnecting UF_6 cylinders. Airborne concentrations of HF and uranyl fluoride inside facilities are expected to be insignificant, and workers would use ventilation equipment to minimize exposures. Concentrations near the release point could be as high as 10 percent of the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit and would be limited by ventilation equipment. Large volumes of UF_6 would be present as feed and product material, but there would be no routine exposures to solid or liquid UF_6. Exposure to industrial chemicals would be limited by minimizing airborne releases and use of protective equipment.

Potential long-term, low-level HF and uranium exposure to the public would be the primary offsite chemical exposures of concern. However, only minor quantities of UF_6 or HF would escape the facility ventilation system, and the quantity of HF passing through the emissions control devices would be below levels established in the facility air permit and protective of public health. UF_6 and HF levels at the site boundary and the location of the nearest resident would be lower than onsite levels. HF concentrations at all exposure locations are far below the most stringent state or Federal ambient air quality standards for the general public. No criteria air pollutants would be produced by the enrichment process.

Facility operation could result in radiation exposure to the public via uranium releases or direct external radiation exposure. UF_6 gas released in the main process building would pass through a ventilation system to minimize external release. Liquid effluents would be treated and sampled to limit releases. Direct exposure to the public could occur from onsite uranium and transportation both onsite and offsite. Direct radiation and skyshine from airborne releases would be undetectable at offsite areas. The NRC public release limits for uranium in air and liquid effluents would be met.

Radioactive materials at the proposed GLE Facility would present the possibility for onsite members of the public to receive a direct radiation dose. Because of cylinder shielding and the distance to receptors, stored cylinders of depleted uranium are expected to have only a minor effect on the exposure rate at the site boundary.

Radioactive process wastewater would be collected and sampled before routing to a liquid effluent treatment system. Treated liquid effluent would be discharged to the existing final process lagoon facility. Water from the lagoon facility would be discharged through a permitted outfall to the site effluent channel. Sanitary wastewater would be treated in the existing sanitary wastewater treatment facility, and treated effluent would replace cooling tower blowdown. Stormwater runoff would drain into a stormwater wet detention basin before discharge. A separate holding pond would collect stormwater runoff from the UF_6 storage pads, where the runoff would be monitored before discharge to the wet detention basin. Discharges from all liquid effluent streams would be released into the Wilmington Site effluent channel and flow to the Northeast Cape Fear River through Unnamed Tributary #1.

There are no public water intakes on the Northeast Cape Fear River downstream of the discharge point, so the only exposure pathways of concern are fish ingestion and those relating

to recreational water use. Calculated doses to a maximally exposed individual and the surrounding population from liquid effluent releases are well below 1 millisievert per year.

Decommissioning plans would involve decontamination of structures and selected facilities to free-release levels before allowing them to remain in place for future use. Leaving the buildings would minimize the number of workers required for decommissioning, which would reduce the number of injuries compared to building removal. Occupational injuries would be reduced in number in accordance with the reduced effort required for decommissioning. Residual contamination would be decontaminated to free-release levels or removed from the site and disposed of in a low-level radioactive waste facility.

The annual occupational dose during decontamination and decommissioning is expected to be in the range of 0.05–1.5 millisievert (5–150 millirem), which is comparable to the average dose from the operating fuel facilities (1.3–1.5 millisievert [130–150 millirem]). Therefore, the occupational dose during decontamination and decommissioning would be bounded by potential exposures during operations. Similar uranium handling would be involved during operations that purge the laser-enrichment lines. Once this decontamination is completed, the remaining quantity of UF_6 would be residual and significantly less than handled during operations. Because systems containing residual UF_6 would be opened, decontaminated, and dismantled, an active environmental monitoring and dosimetry (external and internal) program would be conducted to maintain doses as low as reasonably achievable (ALARA). Chemical exposures would be similarly limited.

Waste Management

Small Impact. Under the proposed action, preconstruction activities would occur and generate construction-related waste streams. Solid nonhazardous wastes generated during construction would be similar to wastes from other industrial construction sites and transported offsite to an approved local landfill. Construction activities would generate less than 2 percent of the waste that the New Hanover County Landfill receives annually from all other sources. Small quantities of organic solvent-based residuals could be used and may require management as hazardous waste. Hazardous wastes from construction would be packaged and shipped offsite to licensed facilities.

Facility operations would result in the generation of wastewaters that would be treated onsite before discharge and solid wastes that would be treated (onsite or offsite) and shipped for disposal offsite. Sanitary wastewater would be collected by a sewer system connected to the existing Wilmington Site sanitary wastewater treatment facility, increasing the load on the existing system by about one-third. Treated sanitary wastewater effluent could be used as makeup water in onsite cooling towers. Should discharges to surface waters be necessary, the existing NPDES discharge permit would be adequate to cover the additional effluent volume. Cooling tower blowdown would be sent to the Wilmington Site's final process lagoons. Radioactive process wastewater from facility operations would be collected and treated to remove uranium, other metals, and fluoride. The treated effluent would be discharged to the process wastewater aeration basin and final process lagoon facility. Impacts from radiological exposure to depleted UF_6 in the cylinder storage pad would be SMALL, and impacts from the conversion of depleted UF_6 generated by the proposed GLE Facility would be SMALL.

The waste management facilities used during operations would also be used during decontamination and decommissioning. With the decrease in workers from operations to decommissioning, sanitary wastewater treatment volumes would decline. Materials and equipment eligible for recycling or nonhazardous disposal would be sampled or surveyed to ensure that contaminant levels are below release limits. Buildings and other structures would be decontaminated and the debris shipped offsite for disposal. Radioactive material from decontamination and contaminated equipment would be packaged and shipped offsite to an appropriately licensed disposal facility. Staging and laydown areas would be segregated and managed to prevent contamination of the environment and creation of additional wastes.

Socioeconomics

Small Impact. Under the proposed action, preconstruction activities would increase the number of onsite construction workers and could result in a short-term increase in the demand for rental housing and public services in the vicinity of the Wilmington Site. Two types of jobs would be created by the proposed action: (1) construction and start-up related jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) operations-related jobs in support of the proposed GLE Facility operations, which have the greater potential for permanent, long-term socioeconomic impacts within the socioeconomic region of influence (ROI). The ROI covers three counties in North Carolina – Brunswick County, New Hanover County, and Pender County. During the peak year of construction (2012), 680 construction workers would be at the proposed GLE Facility site and there would be an additional 3131 indirect jobs created in the ROI. Construction activities would generate $139.8 million in income in the ROI, including $1.7 million in State income taxes and $1.2 million in State sales taxes. The number of construction workers relocating from outside the region could cause a short-term increase in the demand for temporary (rental) housing and services in the ROI.

Facility start-up activities would create 200 new jobs in the ROI. Start-up activities would generate $28.0 million in income in the ROI, including $1.3 million in State income taxes and $0.92 million in State sales taxes. Again, the number of start-up workers relocating from outside the region could cause a short-term increase in the demand for temporary (rental) housing and services in the ROI.

GLE Facility operations would create 350 new jobs in the ROI. GLE Facility operations would generate $51.5 million in income in the ROI, including $2.3 million in State income taxes and $1.7 million in State sales taxes. The number of operations workers relocating from outside the region could affect local housing markets and increase the demand for public services. However, the relatively small number of operations workers (161 to 210) estimated to relocate to the ROI would limit the impact.

Decontamination and decommissioning activities in the first year would create 50 new jobs at the GLE Facility site. Decommissioning would generate $6.1 million in income in the ROI in the first year. Facility decommissioning would produce less than $0.3 million in direct State income taxes and less than $0.2 million in direct State sales taxes. Decommissioning activities would constitute less than 1 percent of total ROI employment in the first year.

Environmental Justice

Under the proposed action, preconstruction activities would result in impacts on minority and low-income populations, mostly consisting of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts would be short-term and limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased commuter vehicle traffic during shift changes. Increased demand for rental housing could disproportionately affect low-income populations. However, due to the short duration of preconstruction activities and the availability of rental housing, impacts to minority and low-income populations would be short-term and limited.

The majority of environmental impacts associated with the construction and operation of the proposed GLE Facility would be SMALL to MODERATE (SMALL for all resource areas during decommissioning) and would generally be mitigated. Because impacts to the general population within 4 miles of the proposed facility would be SMALL to MODERATE, the various phases of facility development are not expected to result in disproportionately high and adverse impacts on low-income or minority residents.

Even when environmental impacts are anticipated to be SMALL for the general population, some population groups, such as those participating in subsistence hunting and fishing, could experience disproportionate exposure. However, air and liquid radiological releases from the proposed GLE Facility are projected to be extremely low, and exposure through fish consumption would be even lower. Preconstruction, construction, operation, and decommissioning of the proposed GLE Facility is not expected to result in disproportionately high and adverse impacts to minority, low-income, or subsistence consumption populations.

Accidents

Small Impact. Representative accident scenarios vary in severity from intermediate- to high-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. Two of the accidents involve criticality and the other three involve the release of UF_6. If the higher-consequence-criticality accident were to occur, the consequence for a worker in close proximity would be high (fatality), but GLE has committed to various preventive and mitigating measures to significantly reduce these consequences. Worker health consequences are low for scenarios involving the release of UF_6. Worker health consequences are low to high for scenarios involving HF exposure. Worker health consequences are intermediate to high for scenarios involving uranium chemical exposure. Radiological consequences to a maximally exposed individual at the Controlled Area Boundary are low for the criticality accidents and all UF_6 release scenarios. Risk to the offsite public in the direction of highest exposure is estimated to be less than one lifetime cancer fatality for all accident scenarios. Plant design, passive and active engineered controls, and administrative controls would reduce the likelihood of accidents. Therefore, the probability-weighted consequence (or risk) from accidents under these conditions is expected to be SMALL. No facility accidents would occur after the cessation of operations, so there would be no potential for facility accidents during decommissioning.

POTENTIAL ENVIRONMENTAL IMPACTS OF THE NO-ACTION ALTERNATIVE

This EIS also considers the potential environmental impacts of the no-action alternative, which are summarized below. Preconstruction activities are assumed to take place under both the proposed action and the no-action alternative, regardless of the NRC decision to issue a license for the proposed GLE Facility.

Under the no-action alternative, enrichment services would continue to be performed by existing domestic and foreign uranium enrichment suppliers. Paducah GDP and the NEF would continue to provide enrichment services. The ACP and EREF may also provide enrichment services in the future. Impacts from these other domestic enrichment facilities have been evaluated in other NRC environmental reviews.

Land Use

Small Impact. Under the no-action alternative, preconstruction activities would occur even if the proposed GLE Facility is not constructed. Preconstruction would alter the undeveloped forest within the Wilmington Site but is not expected to affect surrounding land use. Other uses of the land at the Wilmington Site would not be precluded.

Historical and Cultural Resources

Small Impact. Under the no-action alternative, ground disturbance caused by preconstruction activities could impact historic and cultural resources at the Wilmington Site. Since the proposed GLE Facility would not be constructed under the no-action alternative, no further impacts on historic and cultural resources would occur.

Visual and Scenic Resources

Small Impact. Under the no-action alternative, preconstruction activities would include clearing vegetation. The vegetation screen along the northern part of the Wilmington Site would not be altered by preconstruction activities. Since the proposed GLE Facility would not be constructed under the no-action alternative, the visual appearance of the Wilmington Site would not change.

Air Quality

Small Impact. Under the no-action alternative, preconstruction activities would have an impact on ambient air quality conditions at the Wilmington Site. Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no further impacts on air quality.

Geology and Soils

Small Impact. Under the no-action alternative, preconstruction activities would have an impact on soil conditions at the Wilmington Site. Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no further impacts to geologic and soils conditions at the site.

Surface Water Resources

Small Impact. Under the no-action alternative, preconstruction activities would have an impact on water quality in streams located on the Wilmington Site. Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no further impacts on surface water resources on or near the Wilmington Site.

Groundwater Resources

Small Impact. Under the no-action alternative, preconstruction activities would have an impact on groundwater quality in shallow aquifers at the Wilmington Site. Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no further impacts on groundwater resources on or near the Wilmington Site.

Ecological Resources

Small Impact. Under the no-action alternative, most impacts on ecological resources would occur during preconstruction activities. Preconstruction impacts on wetlands, environmentally sensitive areas, and aquatic biota would be SMALL. Impacts on Federally threatened and endangered species and impacts on the Federal species of concern or State-listed species that occur within New Hanover County would also be SMALL (i.e., no adverse impacts on these species would result from the no-action alternative). Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no further impacts on ecological resources on or near the Wilmington Site.

Noise

Small Impact. Under the no-action alternative, noise impacts associated with preconstruction activities would be short-term and limited to the immediate vicinity of the proposed GLE Facility site. Since the proposed GLE Facility would not be constructed under the no-action alternative, noise from existing GE operations at the Wilmington Site would remain unchanged.

Transportation

Small Impact. Under the no-action alternative, preconstruction activities would have an impact on traffic conditions. These impacts would be short-term and limited to site access roads and roads in the vicinity of the Wilmington Site. Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no further traffic-related impacts on site access roads and roads in the vicinity of the Wilmington Site.

Public and Occupational Health

Small Impact. Occupational exposures during preconstruction activities would be minor and minimized using work practices and personal protective equipment. Preconstruction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust. Since the proposed GLE Facility would not be constructed under the no-action alternative, public and occupational health risks to onsite workers and the general public would remain unchanged.

Waste Management

Small Impact. Under the no-action alternative, preconstruction activities would occur and generate construction-related waste streams. Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no additional waste generated at the Wilmington Site beyond that generated by existing GE activities.

Socioeconomics

Small Impact. Under the no-action alternative, preconstruction activities would increase the number of onsite construction workers and could result in a short-term increase in the demand for rental housing and public services in the vicinity of the Wilmington Site. Since the proposed GLE Facility would not be constructed under the no-action alternative, population and employment in the ROI would change in accordance with current projections. Activities completed prior to the no-action alternative (i.e., preconstruction activities) would not have a noticeable effect on county services.

Environmental Justice

Under the no-action alternative, preconstruction activities would result in impacts to minority and low-income populations, mostly consisting of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts would be short-term and limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased commuter vehicle traffic during shift changes. Increased demand for rental housing could disproportionately affect low-income populations. However, due to the short duration of preconstruction activities and the availability of rental housing, impacts to minority and low-income populations would be short-term and limited. Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no further impacts to minority and low-income populations residing in the vicinity of the Wilmington Site

Based on this information, there would be no disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the Wilmington Site as a result of the no-action alternative.

Accidents

Small Impact. Under the no-action alternative, the proposed GLE Facility would not be constructed. Therefore, no accidents would result from GLE Facility operations or decommissioning.

COSTS AND BENEFITS OF THE PROPOSED ACTION

While there are national energy security and fiscal benefits associated with the proposed action, and local socioeconomic benefits in the ROI in which the proposed GLE Facility would be located, there are also direct costs associated with the construction, operation, and decommissioning phases of the proposed action, as well as impacts associated with the proposed action on various resource areas. However, these impacts are estimated to be small in magnitude and small in comparison to the local and national benefits of the proposed action.

In addition, many of the impacts on environmental resources associated with the proposed action relate to preconstruction activities at the proposed site, and would also occur under the no-action alternative. The principal socioeconomic impact or benefit of the proposed GLE Facility would be an increase in employment and income in the ROI. Although the majority of the costs, and most of the socioeconomic impacts, of the various phases of GLE Facility development would occur in the ROI, there would be economic, fiscal, and, in particular, energy security benefits, which would occur at both the local and national levels.

Employment created in the ROI in the peak construction year (2012) is estimated at 3811 direct and indirect jobs, and State income tax revenues would be approximately $0.5 million per year during construction. During the GLE operations phase (2020 to 2051), 732 direct and indirect jobs would be created. During this period, the State would benefit from $2.3 million annually in income taxes and $8.7 million annually in property taxes. Although it can be assumed that some portion of State sales and income taxes paid would be returned to the ROI under revenue-sharing arrangements between each county and State government, the exact amount that would be received by each county cannot be determined. Although there are economic and fiscal benefits associated with the proposed action in the ROI, these beneficial impacts are expected to be SMALL.

The direct costs associated with the proposed action may be categorized by the following life-cycle stages: construction, facility operation, depleted uranium disposal, and decommissioning. In addition to the costs of the proposed action, costs would be incurred for preconstruction activities under both the proposed action and no-action alternatives. In addition to monetary costs, the proposed action would result in impacts on various resource areas, which are summarized above. For all resource areas, the impact of the proposed action is estimated to be SMALL or SMALL to MODERATE.

The proposed action would result in the annual production, in peak years, of six million SWU of enriched uranium, which would augment the supply of enriched uranium and, along with other planned new enrichment facilities, would meet the national energy security need for increased domestic supplies of enriched uranium. Thus, the proposed action would generate national and regional benefits and costs. The national benefit would be an increase in domestic supplies of enriched uranium that would assist the national energy security need. The regional benefits would be increased employment, economic activity, and tax revenues in the ROI. Costs associated with the proposed project are, for the most part, limited to the resource areas in the ROI.

COMPARISON OF THE PROPOSED ACTION AND THE NO-ACTION ALTERNATIVE

Under the no-action alternative, the proposed GLE Facility would not be constructed. However, preconstruction activities, such as land clearing, grading, and construction of support structures, would occur on the proposed site. These activities could affect some resource areas, including historic and cultural resources, air quality, ecological resources, noise, and transportation. Since the proposed GLE Facility would not be constructed, no further impacts on these resource areas would occur as a result of the no-action alternative. Under the no-action alternative, the costs and benefits of constructing, operating, and decommissioning the proposed GLE Facility would not occur. Denying the license would result in no further land disturbance or activity related to the proposed action at the Wilmington Site; therefore, no further impacts would occur for any resource area.

Under the no-action alternative, the Paducah GDP in Paducah, Kentucky, would remain the primary source of domestically generated low-enriched uranium for U.S. commercial nuclear power plants (supplying 16 percent of U.S. demand). The NEF in Lea County, New Mexico (d/b/a URENCO USA), which is operational but still under construction, the ACP, and the EREF may provide enrichment services in the future. Foreign enrichment sources from the downblending of highly enriched uranium under the Megatons-to-Megawatts Program and other foreign sources would be expected to continue to supply approximately 84 percent of the U.S. demand.

Under the proposed action (construction, operation, and eventual decommissioning of the proposed GLE Facility), there would be SMALL impacts on land use, visual and scenic resources, geology and soils, water resources, socioeconomic conditions, minority and low-income populations, public and occupational health, and waste management. The proposed action would have SMALL to MODERATE adverse impacts on historic and cultural resources, air quality, ecological resources, noise, and transportation; these impacts would be largely attributable to preconstruction activities. Impacts from the most serious accidents that might occur under the proposed action are expected to be SMALL. If constructed, the proposed GLE Facility would provide additional domestic uranium enrichment capacity.

CUMULATIVE IMPACTS

This EIS also considers cumulative impacts that could result from the proposed action when added to other past, present, and reasonably foreseeable future actions (Federal, non-Federal, or private). Identified activities include planned facilities and new processes at the Wilmington Site, as well as offsite industrial development. Two projects for the Wilmington Site include the recently constructed Advanced Technology Center II complex and the planned Tooling Development Center. Offsite projects include the Carolinas Cement Company manufacturing plant, the River Bluffs residential development, and the North Carolina International Terminal.

Impacts from preconstruction activities for the proposed GLE Facility are addressed as cumulative impacts in this EIS, as these actions are not part of the proposed action. In this sense, preconstruction activities would be considered past activities for the purposes of cumulative impacts. These impacts are presented alongside similar impacts from construction of the facility that are included in the proposed action. With the exception of socioeconomic impacts (i.e., local job creation), cumulative impacts associated with the no-action alternative would generally be less than those for the proposed action, except in terms of local job creation.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Preconstruction activities and the proposed action would result in unavoidable adverse impacts on the environment. These impacts would generally be small, and would, in most cases, be mitigated. The disturbed area would be cleared of vegetation and would lead to the displacement of some local wildlife populations. There would be temporary impacts from the construction of new facilities, including increased fugitive dust, increased potential for soil erosion and stormwater pollution, and increased vehicle traffic and emissions. Water consumption from onsite wells during the proposed action would be relatively small and the risk for significant adverse impacts on neighboring residential wells or public supply wells is expected to be small. During operations, workers and members of the public could be exposed to radiation and chemicals.

This EIS defines short-term uses as generally affecting the present quality of life for the public (i.e., the 40-year license period for the proposed GLE Facility); and long-term productivity as affecting the quality of life for future generations on the basis of environmental sustainability. Preconstruction and the proposed action would necessitate short-term commitments of resources and would permanently commit certain other resources (such as energy and water). The short-term use of resources would result in potential long-term socioeconomic benefits to the local area and the region.

Workers, the public, and the environment would be exposed to increased amounts of hazardous and radioactive materials over the short term from operations of the proposed GLE Facility. Construction and operation would require a long-term commitment of terrestrial resources, such as land, water, and energy. Short-term impacts would be minimized by the application of appropriate mitigation measures. Upon the closure of the proposed GLE Facility, GLE would decontaminate and decommission the buildings and equipment and restore them for unrestricted use. Continued employment, expenditures, and tax revenues generated during the proposed action would directly benefit the local, regional, and State economies.

Irreversible commitment of resources refers to resources that are destroyed and cannot be restored, whereas an irretrievable commitment of resources refers to material resources that once used cannot be recycled or restored for other uses by practical means. The proposed action would include the commitment of land, water, energy, raw materials, and other natural and human-generated resources. Following decommissioning, the land occupied by the proposed facility would likely remain industrial beyond license termination. Water required during preconstruction and the proposed action would be obtained from existing wells at the Wilmington Site and would be replenished through natural mechanisms. Wastewaters would be treated to meet applicable standards and released to local receiving surface waters. Energy used in the form of electricity, natural gas, and diesel fuel would be supplied through existing systems in the Wilmington area. The specific types of construction materials and the quantities of energy and materials used cannot be determined until final facility design is completed, but it is not expected that these quantities would strain the availability of these resources.

Even though the land used to construct the proposed GLE Facility would be returned to other productive uses after the facility is decommissioned, there would be some irreversible commitment of land at offsite locations used to dispose of solid wastes generated by the facility. In addition, wastes generated during the conversion of depleted UF_6 produced by the facility and the depleted uranium oxide conversion product from the conversion of depleted UF_6 would be disposed at an offsite location. Land used for disposal of these materials would represent an irreversible commitment of land. No solid wastes or depleted uranium oxide conversion product originating from the proposed GLE Facility would be disposed of at the Wilmington Site. When the facility is decommissioned, some building materials would be recycled and reused. Other materials would be disposed of in a licensed and approved offsite location, and the amount of land used to dispose of these materials would be an irretrievable land resource.

During operation of the proposed GLE Facility, natural UF_6 would be used as feed material, requiring the mining of uranium and several other operational steps in the uranium fuel cycle. This use of uranium would be an irretrievable resource commitment.

ACRONYMS AND ABBREVIATIONS

AADT	annual average daily traffic
AAL	Acceptable Ambient Level
ac	acre
ACHP	Advisory Council on Historic Preservation
ACP	American Centrifuge Plant
ADAMS	Agencywide Documents Access and Management System
ADT	average daily vehicle trips
AE/SCO	Aircraft Engines/Services Components Operation
AEA	*Atomic Energy Act*
AEGL	Acute Exposure Guideline Level
AERMOD	AMS/EPA Regulatory MODel
AES	AREVA Enrichment Services, LLC
ALARA	As Low As Reasonably Achievable
AMA	American Medical Association
ANSI	American National Standards Institute
AQRV	air quality-related value
ASA	Acoustical Society of America
ATC II	Advanced Technology Center
ATSDR	Agency for Toxic Substances and Disease Registry
AVLIS	atomic vapor laser isotope separation
BLM	U.S. Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	best management practice
BOD	biochemical oxygen demand
C	Celsius
CAA	*Clean Air Act*
CAB	Controlled Area Boundary
CAL/EPA	California Office of Environmental Health Hazard Assessment
CAMA	Coastal Area Management Act
CaOH	lime
CAS	Chemical Abstracts Service
CAST	Horticultural Crops Research Station (Castle Hayne, NC)
CBA	cost-benefit analysis
cDCE	cis-1,2 dichloroethylene
CDC	Centers for Disease Control and Prevention
CaF_2	calcium fluoride
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFC	chlorofluorocarbon
CFR	U.S. *Code of Federal Regulations*
CH_4	methane
Ci	Curie

ACRONYMS AND ABBREVIATIONS (Cont.)

CO	carbon monoxide
COL	combined license
COLA	combined license application
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPC	Center for Plant Conservation
CSC	Coastal Services Center
CWA	*Clean Water Act*
CZM	Coastal Zone Management
D&D	decontamination and decommissioning
dB	decibel
dBA	A-weighted decibel
d/b/a	doing business as
dbh	diameter at breast height
DC	design certification
DCE	dichloroethylene
DCF	dose conversion factor
DCM	Division of Coastal Management
DCP	dry conversion process
DDE	deep dose equivalent
DEIS	Draft Environmental Impact Statement
DFP	decommissioning funding plan
DMT	Dundalk Marine Terminal
DNA	deoxyribonucleic acid
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day-night average noise level
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DU	depleted uranium
DUF_4	depleted uranium tetrafluoride
DUF_6	depleted uranium hexafluoride
DWQ	Division of Water Quality
EA	environmental assessment
EAC	Early Action Compact
EF	Enhanced Fujita
EHS	Environmental, Health, and Safety
EIA	Energy Information Administration
EIS	environmental impact statement
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ER	Environmental Report

ACRONYMS AND ABBREVIATIONS (Cont.)

EREF	Eagle Rock Enrichment Facility
ESA	*Endangered Species Act*
ESI	Environmental Services, Inc.
F	Fahrenheit; Fujita
FAA	Federal Aviation Administration
FCO	Fuel Components Operation
FBI	Federal Bureau of Investigation
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FLM	Federal Land Manager
FMO/FMOX	Fuel Manufacturing Operation
FPLTF	Final Process Lagoon Treatment Facility
FR	*Federal Register*
ft	foot/feet
FTE	full-time equivalent
FWS	U.S. Fish and Wildlife Service
g	gram
gal	gallon
GDP	Gaseous Diffusion Plant
GE	General Electric
GEH	General Electric-Hitachi
GHG	greenhouse gas
GLE	GE-Hitachi Global Laser Enrichment LLC
GNEP	Global Nuclear Energy Partnership
GNF-A	Global Nuclear Fuel-Americas
gpd	gallons per day
GWh	gigawatt-hour
GWP	global warming potential
H_2O	water vapor
ha	hectare
HAP	hazardous air pollutant
HDDV	heavy-duty diesel vehicle
HEGA	high-efficiency gas absorption
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HF	hydrogen fluoride or hydrofluoric acid
HFC	hydrofluorocarbon
HFC-23	trifluoromethane
HMTA	*Hazardous Materials Transportation Act*
HNO_3	nitric acid
HVAC	heating, ventilation, and air conditioning
HUD	U.S. Department of Housing and Urban Development
HWS	Hazardous Waste Section
Hz	hertz

ACRONYMS AND ABBREVIATIONS (Cont.)

I	Interstate
ICRP	International Commission of Radiological Protection
IDLH	Immediately Dangerous to Life and Health
IHSB	Inactive Hazardous Sites Branch
IMPLAN	Impact Analysis for Planning
in.	inch(es)
IROF	item relied upon for safety
ISA	integrated safety analysis
ITE	Institute of Transportation Engineers
kHz	kilohertz
km	kilometer
l	liter
lb	pound
LCF	latent cancer fatality
LDGV	light-duty gasoline vehicle
L_{dn}	day-night maximum average sound level
L_{eq}	equivalent sound level
$L_{eq(24)}$	24-hour equivalent sound level
LEDPA	least environmentally damaging practicable alternative
LES	Louisiana Energy Services, LLC
LEU	low-enriched uranium
LLRW	low-level radioactive waste
lpd	liters per day
LSA	low specific activity
m	meter
MDC	minimum detectable concentration
MEI	maximally exposed individual
mg	milligram
mi	mile(s)
mg/m^3	milligrams per cubic meter
MLIS	molecular laser isotope separation
MMt	million metric tons
MNA	monitored natural attenuation
MOX	mixed oxide fuel
mph	miles per hour
mrem	millirem
m/s	meters per second
MSA	Metropolitan Statistical Area
MSL	mean sea level
mSv	millisievert
MSW	municipal solid waste
MT/yr	metric tons per year
MWe	megawatt electric

ACRONYMS AND ABBREVIATIONS (Cont.)

MWh	megawatt-hour
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NaOH	sodium hydroxide
NC	North Carolina
NCAC	*North Carolina Administrative Code*
NCDAQ	North Carolina Division of Air Quality
NCDC	National Climatic Data Center
NCDENR	North Carolina Department of Environment and Natural Resources
NCDEHNR	North Carolina Department of Health, Environment, and Natural Resources
NCDMF	North Carolina Division of Marine Fisheries
NCDOL	North Carolina Department of Labor
NCDOT	North Carolina Department of Transportation
NCDWQ	North Carolina Division of Water Quality
NCES	National Center for Education Statistics
NCGS	*North Carolina General Statutes*
NCIT	North Carolina International Terminal
NCNHP	North Carolina Natural Heritage Program
NCOSBM	North Carolina Office of State Budget and Management
NCRP	National Council on Radiation Protection and Measurements
NCWRC	North Carolina Wildlife Resources Commission
NEF	National Enrichment Facility
NELAC	National Environmental Laboratory Accreditation Conference
NEMA	National Electric Manufacturers Association
NEPA	*National Environmental Policy Act*
NERC	North American Reliability Corporation
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHC	National Hurricane Center
NHPA	National Institute for Occupational Safety
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NLCD92	National Land Cover Data 1992 archives
NMFS	National Marine Fisheries Service
NMSS	Office of Nuclear Materials Safety and Safeguards
NMTOC	nonmethane total organic compound
NMVOC	nonmethane volatile organic compound
NO_2	nitrogen dioxide
NO_x	nitrogen oxide, oxide of nitrogen
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOV	Notice of Violation
NPCR	National Program of Cancer Registries
NPDES	National Pollutant Discharge Elimination System

ACRONYMS AND ABBREVIATIONS (Cont.)

NRC	U.S. Nuclear Regulatory Commission
NRCS	U.S. Natural Resources Conservation Service
NRHP	*National Register of Historic Places*
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
O_3	ozone
OSHA	Occupational Safety and Health Administration
OSTV	onsite transfer vehicle
PA	Programmatic Agreement
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PFC	perfluorocarbon
PM	particulate matter
$PM_{2.5}$	particulate matter equal to or smaller than 2.5 micrometers in diameter
PM_{10}	particulate matter equal to or smaller than 10 micrometers in diameter
PMT	Portsmouth Marine Terminal
ppm	parts per million
PSD	Prevention of Significant Deterioration
PWR	pressurized water reactor
RAI	Request for Additional Information
RCRA	*Resource Conservation and Recovery Act*
RCW	red-cockaded woodpecker
rem	roentgen equivalent man
RLETS	Radiological Liquid Waste Treatment System
ROI	region of influence
ROW	right-of-way
RPS	North Carolina Radiation Protection Section
RSL	Regional Screening Level
RTI	Research Triangle Institute
RVP	Reid vapor pressure
SAAQS	State Ambient Air Quality Standards
SAM	Social Accounting Matrix
SCONC	State Climate Office of North Carolina
SER	Safety Evaluation Report
SF_6	sulfur hexafluoride
SHPO	State Historic Preservation Office(r)
SILEX	separation of isotopes by laser excitation
SNF	spent nuclear fuel
SO_2	sulfur dioxide
SO_x	sulfur oxide
SPCC	Spill Prevention Control and Countermeasure

ACRONYMS AND ABBREVIATIONS (Cont.)

SUV	sport-utility vehicle
Sv	Sievert
SVOC	semivolatile organic compound
SWU	separative work unit
TAP	toxic air pollutant
TCE	trichloroethylene
TEDE	total effective dose equivalent
Tg	teragram
TLD	thermoluminescent dosimeter
TSDF	treatment, storage, and disposal facility
TSP	total suspended particulates
TSS	total suspended solids
TWA	time-weighted average
U_3O_8	triuranium octaoxide
UO_2	uranium dioxide
UO_2F_2	uranyl fluoride
UF_6	uranium hexafluoride
UNFCCC	United Nations Framework Convention on Climate Change
USACE	U.S. Army Corps of Engineers
U.S.C.	*United States Code*
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USEC	United States Enrichment Corporation
USGCRP	United States Global Change Research Program
USGS	U.S. Geological Survey
UV	ultraviolet
VC	vinyl chloride
VMT	vehicle miles traveled
VOC	volatile organic compound
VRM	visual resource management
WFSC	Wilmington Field Services Center
WMA	Wildlife Management Area
WSA	Wilderness Study Area
WWTF	Wastewater Treatment Facility
μg	microgram
μm	micrometer

1 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) prepared this Environmental Impact Statement (EIS) in response to an application submitted by General Electric-Hitachi Global Laser Enrichment LLC (GLE), for a license that would allow the construction and operation of a laser-based uranium enrichment facility near Wilmington, North Carolina (Figures 1-1 and 1-2). The proposed facility is called the Global Laser Enrichment (GLE) Facility. GLE submitted its Environmental Report on January 30, 2009 (GLE, 2008a) and its license application on June 26, 2009 (GLE, 2009a).

The NRC's Office of Federal and State Materials and Environmental Management Programs prepared this EIS as required by Title 10, "Energy," Part 51, of the U.S. *Code of Federal Regulations* (10 CFR Part 51). In particular, 10 CFR 51.20 (b)(10) states that issuance of a license for a uranium enrichment facility requires the NRC to prepare an EIS or a supplement to an EIS. NRC's regulations under 10 CFR Part 51 implement the requirements of the *National Environmental Policy Act of 1969* (NEPA), as amended (Public Law 91-190). The Act requires Federal agencies to assess the potential impacts of their actions affecting the quality of the human environment.

1.2 The Proposed Action

The proposed action is the NRC issuing a license that would allow GLE to construct and operate, and eventually, decommission (under a separate NRC licensing action) a laser-based uranium enrichment facility near Wilmington, North Carolina. If the NRC issues a license to GLE under the provisions of the *Atomic Energy Act*, the license would authorize GLE to possess and use special nuclear material, source material, and by-product material at the proposed GLE Facility for a period of 40 years, in accordance with the NRC's regulations in 10 CFR Parts 70, 40, and 30, respectively. The scope of activities to be conducted under the license would include the construction and operation of the proposed GLE Facility.

The applicant has proposed to build the proposed GLE Facility on existing General Electric Company (GE) property near Wilmington, North Carolina. Two of GE's principal manufacturing operations – the Global Nuclear Fuel-Americas (GNF-A) Fuel Manufacturing Operation (FMO) facility and the GE Aircraft Engines/Services Components Operation (AE/SCO) facility – are located at the Wilmington Site. The proposed GLE Facility would be constructed in the North-Central Sector of the site. Some of the existing infrastructure at the site, such as the waste treatment facilities, would also be used by the proposed facility.

Preconstruction and construction of the proposed GLE Facility would take place from 2012 to 2020, with commencement of facility operations in 2014.[1] A 4-year start-up period would run concurrently with construction activities, with the facility expected to reach full production capacity in 2020. Decommissioning or potential license renewal activities would begin in advance of scheduled license expiration (anticipated to be 2052). GLE intends that the

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[1] As described in Section 1.4.1, certain activities, referred to as "preconstruction" activities in this document, are explicitly excluded from the definition of construction in 10 CFR 51.4. Preconstruction activities are not considered a part of the proposed action.

proposed GLE Facility help fulfill needs for domestic enriched uranium capacity for nuclear electrical generation requirements and contribute to national energy security, as well as contribute to deployment of advanced uranium enrichment technologies (GLE, 2008a). This purpose and need are discussed in greater detail in Section 1.3.

Natural uranium ore usually contains approximately 99.3 percent uranium-238 and 0.72 weight percent uranium-235. In order to be used in fuel for nuclear power plants in the United States, the percentage of uranium-235 must be increased to 3–5 weight percent. Enrichment is the process of increasing the percentage of the naturally occurring and fissile uranium-235 isotope and decreasing the percentage of uranium-238. Enrichment is one of the steps of the nuclear fuel cycle (Figure 1-3).

Through its license application, GLE is seeking NRC authorization to produce enriched uranium up to 8 percent by weight of uranium-235. Although there is currently no demand for enrichment greater than 5 weight percent, GLE believes that there is potential for future demand to change (GLE, 2009j). Enriched uranium from the proposed GLE Facility would be used in commercial nuclear power plants and is called low-enriched uranium (LEU). Uranium used in military reactors and nuclear weapons has a much greater percentage of uranium-235 by weight and is called high-enriched uranium (HEU).

GLE has requested a license for a production capacity of 6 million separative work units (SWU)[2] per year. A SWU represents the level of effort or energy required to raise the concentration of uranium-235 to a specified level.

1.3 Purpose and Need for the Proposed Action

As discussed in Section 1.2, the proposed action is for GLE to construct and operate, and eventually, decommission a commercial facility to enrich uranium up to 8 percent by weight of uranium-235, with an initial planned maximum target annual production capacity of 6 million SWU. The proposed facility would use the GLE laser-based technology and would be constructed on the existing GE property near Wilmington, North Carolina. The proposed action is intended to provide an additional domestic source of low-enriched uranium to be used in commercial nuclear power plants.

In this EIS, the need for the proposed GLE Facility is organized by:

- the need for enriched uranium to fulfill electricity generation requirements
- the need for domestic supplies of enriched uranium for national energy security

[2] A separative work unit (SWU) is a unit of measurement used in the nuclear industry, pertaining to the process of enriching uranium for use as fuel for nuclear power plants. It describes the effort needed to separate uranium-235 and uranium-238 atoms in natural uranium to create a final product that is richer in uranium-235 atoms. For 114 kilograms (251 pounds) of natural uranium, it takes about 70 SWU to produce 10 kilograms (22 pounds) of uranium enriched to 5 percent uranium-235. It takes on the order of 100,000 SWU of enriched uranium to fuel a typical 1000-megawatt commercial nuclear reactor for a year (USEC, 2009).

Figure 1-1 Location of the Proposed GLE Facility (GLE, 2008a)

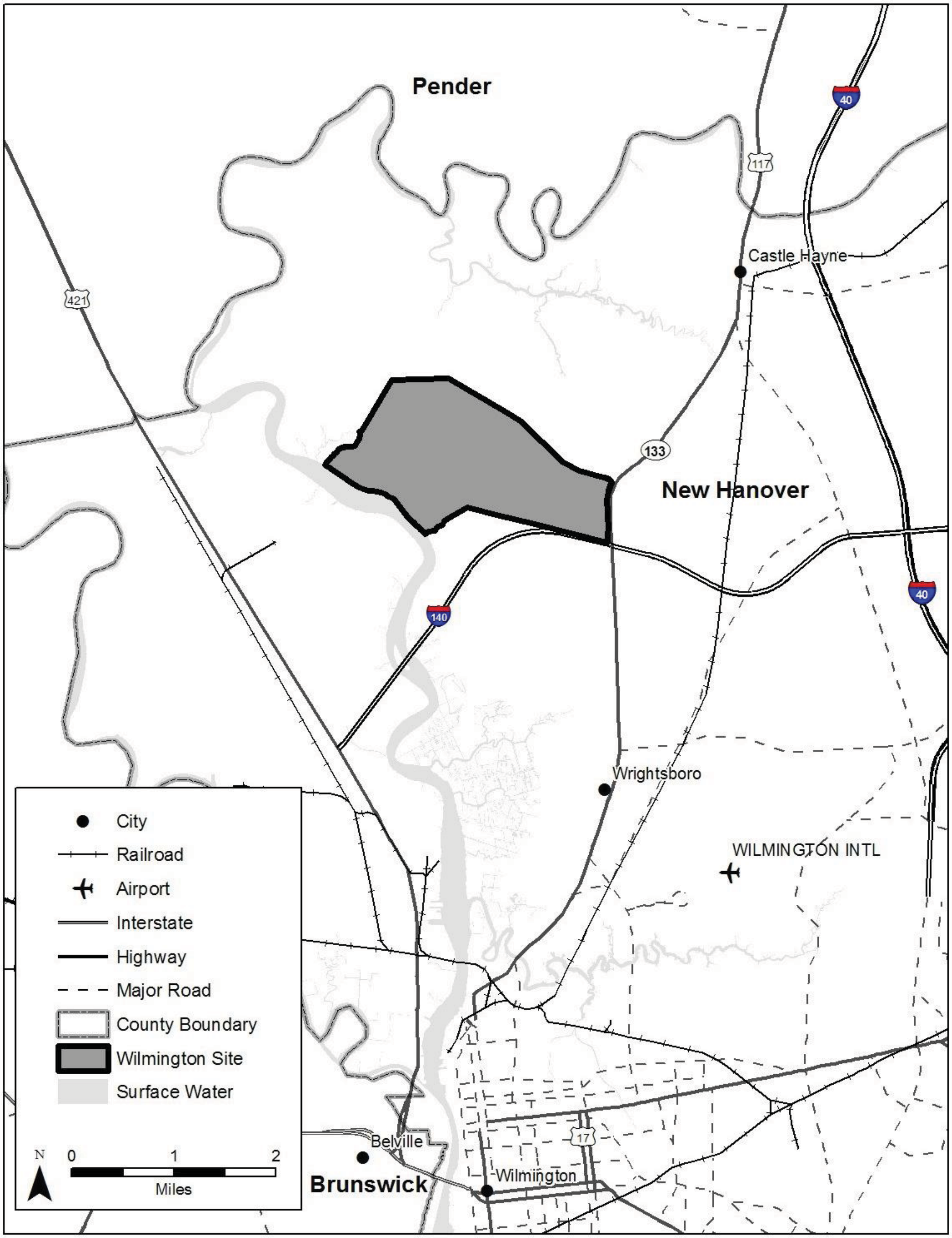
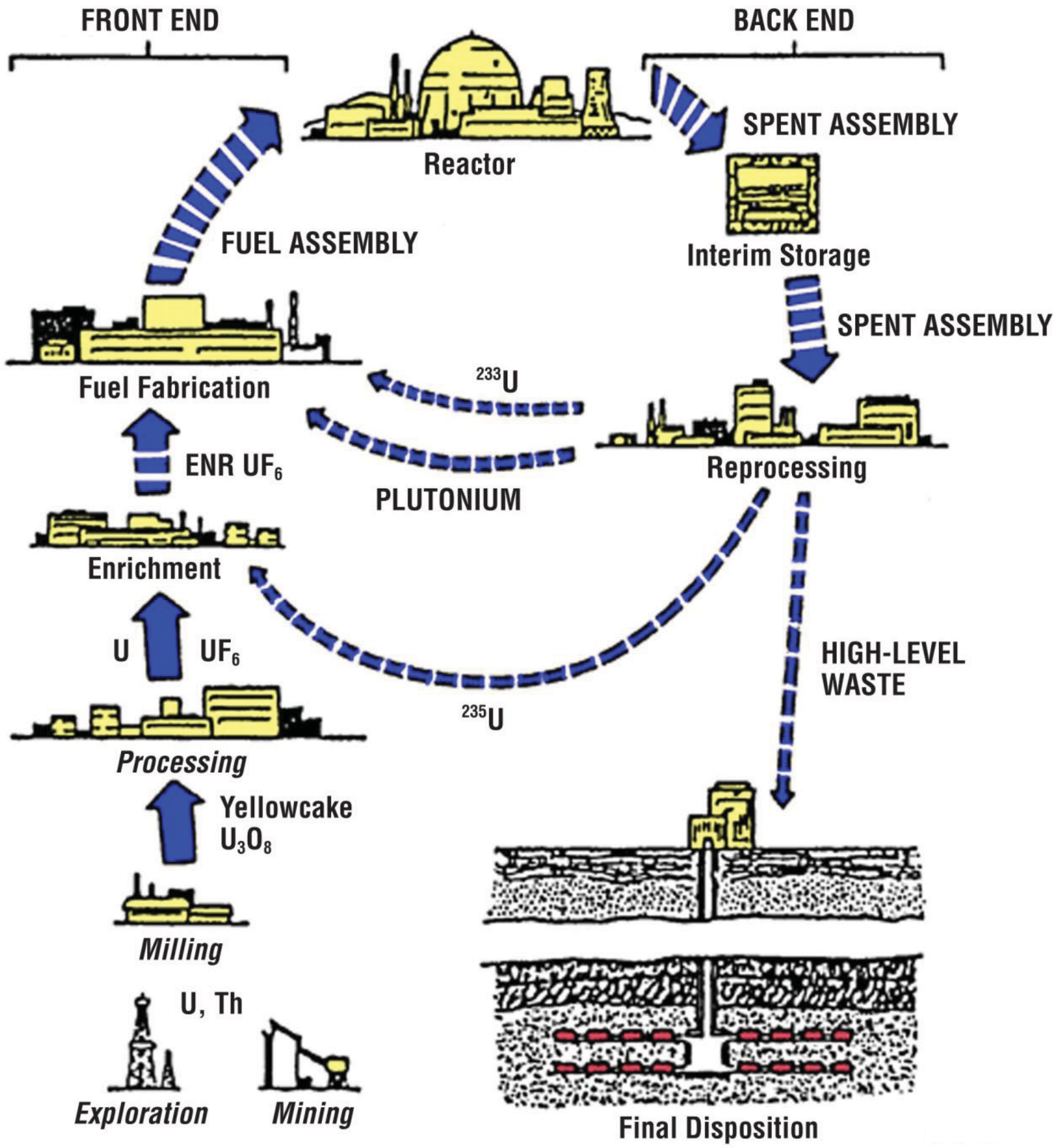


Figure 1-2 Wilmington Site and Vicinity (GLE, 2008a)



Note: Reprocessing of high-level waste is currently not done in the United States. Neither a reprocessing facility nor a Federal waste repository is currently approved (licensed) in the United States, and spent fuel is in interim storage.

Figure 1-3 Nuclear Fuel Cycle (NRC, 2008)

The purpose of the proposed action is to fulfill these needs. The following sections discuss these needs and how each is addressed by the proposed action.

1.3.1 Need for Enriched Uranium to Fulfill Electricity Requirements

Enriched uranium from the proposed GLE Facility would be used in U.S. commercial nuclear power plants. According to the Energy Information Administration (EIA), these plants currently supply approximately 20 percent of the nation's electricity requirements (EIA, 2010). As future demand for electricity increases, the need for enriched uranium to fuel nuclear power plants is also expected to increase (EIA, 2010).

For the case based on established policies and current trends (the reference case), the EIA estimates that nuclear capacity in the United States will increase from 100,600 megawatts in 2008 to 112,900 megawatts by 2035, including 4000 megawatts of expansion at existing plants and 8400 megawatts of new capacity (EIA, 2010). The EIA also estimates that nuclear generation in the United States will increase from 806 billion kilowatt hours in 2008 to between 882 and 951 billion kilowatt hours in 2035, depending on the low- or high-growth scenarios.

How Much Is a Megawatt?

One megawatt roughly provides enough electricity for the demand of 400 to 900 homes. The actual number is based on the season, time of day, region of the country, power plant capacity factors, and other factors.

Source: Bellemare, 2003.

The NRC expects to license the next generation of nuclear power plants using 10 CFR Part 52. Part 52 governs the issuance of standard design certifications, early site permits (ESPs), and combined licenses (COLs) for nuclear power plants. Since 2007, the NRC has received 17 new reactor COL and ESP applications and expects 3 new submittals in 2012. Two COL application reviews have recently been completed by the NRC. If the Commission determines that licensing requirements have been met, the agency could issue the first COLs as early as in the first half of 2012.

The EIA forecasts of nuclear generating capacity, combined with applications from the industry for construction and operation of new plants, suggest a continuing, if not increasing, demand for enriched uranium. The EIA forecasts that the annual demand for enrichment services may vary between 12.9 million and 15.7 million SWU from 2006 through 2025 (EIA, 2003).

The demand for enriched uranium in the United States is currently being fulfilled by three main categories of supply:

- *Domestic production of enriched uranium provides about 16 percent of U.S. demand* (EIA, 2011). The primary uranium enrichment facility currently operating in the United States is the Paducah Gaseous Diffusion Plant (GDP) in Paducah, Kentucky, operated by USEC Inc.'s subsidiary, the United States Enrichment Corporation. USEC's former Portsmouth GDP in Piketon, Ohio, ceased production in May 2001, and will no longer produce enriched uranium. The plant has been placed in cold shutdown (a condition whereby the plant is undergoing preparation for decommissioning and decontamination) (DOE, 2010a) and the first buildings have been de-leased back to the U.S. Department of

Energy (DOE) for decommissioning (NRC, 2010a). In October 2011, the Certificate of Compliance for Portsmouth GDP was terminated by NRC (NRC, 2011c). The National Enrichment Facility (NEF) in Lea County, New Mexico, operated by Louisiana Energy Services LLC (LES), began initial operations in June 2010. The NEF's full, NRC-licensed capacity of approximately 3 million SWU per year will not be achieved until after 2012. An expansion to 5.9 million SWU per year is being considered by LES (Urenco, 2008), but an application for the expansion has not yet been submitted to the NRC.

- *The Megatons-to-Megawatts Program provides about 37 percent of U.S. demand* (EIA, 2011). Under this program, the United States Enrichment Corporation implements the 1993 government-to-government agreement between the United States and Russia that calls for Russia to convert 500 metric tons (550 tons) of HEU from dismantled nuclear warheads into LEU (DOE, 2010b). This is equivalent to about 20,000 nuclear warheads. The United States Enrichment Corporation purchases the enriched portion of the "downblended" material, tests it to make sure it meets specifications, adjusts the enrichment level if needed, and then sells it to its electric utility customers for fuel in commercial nuclear power plants. All program activities in the United States now take place at the Paducah plant (NRC, 2006a). Between 2005 and 2009, under the Megatons to Megawatts program, USEC supplied an average of approximately 5.5 million SWU to U.S. customers (USEC, 2010). This program is scheduled to expire by 2013 (DOE, 2010b).

- *Other foreign sources provide about 47 percent of U.S. demand*. Other countries that produce and export enriched uranium to the United States include China, France, Germany, the Netherlands, and the United Kingdom (EIA, 2011).

The current 5-year average U.S. demand for enriched uranium is approximately 14 million SWU per year (EIA, 2011). As noted, recent forecasts indicate that this demand could reach 15 to 16 million SWU by 2025, depending on the rate of nuclear generation growth in the United States (EIA, 2003). Currently, about 84 percent (37 percent from the Megatons-to-Megawatts Program plus 47 percent from other foreign sources) of U.S. demand is supplied by foreign sources.

As discussed, the Megatons-to-Megawatts Program is set to end in 2013. In March 2011, USEC Inc., signed an agreement with a Russian corporation, JSC "Techsnabexport" (TENEX), for LEU to be supplied to USEC from Russian commercial enrichment activities (USEC, 2011a). Under the terms of the agreement, the supply of LEU to USEC will begin in 2013, with the expectation that by 2015, the level of supplied LEU will be approximately one-half the current level supplied under the Megatons-to-Megawatts Program. The level of supplied LEU could eventually meet that supplied under the Megatons-to-Megawatts Program under options in the agreement. Deliveries under the agreement are expected to continue through 2022 (USEC, 2011a; USEC, 2011b.)

In 2007, DOE projected that gaseous diffusion enrichment operations in the United States would cease in 2012 due to the higher cost of aging facilities (DOE, 2007). The Megatons-to-Megawatts Program is scheduled to expire by 2013 (DOE, 2010b). As noted above, these two sources meet about half (53 percent) of the current U.S. demand for LEU. LEU supplied through USEC Inc.'s new contract with TENEX would likely meet a reduced portion of this current U.S. demand.

To help fill the anticipated supply deficit, other potential future domestic sources of supply have emerged in recent years. In addition to the NEF, the NRC has issued licenses to USEC Inc., to construct and operate the American Centrifuge Plant (ACP) in Piketon, Ohio (NRC, 2005a; NRC, 2006a), and AREVA Enrichment Services, LLC (AES), to construct and operate the Eagle Rock Enrichment Facility (EREF) in Bonneville County, Idaho (AES, 2008; NRC, 2011b). All three of these facilities are based on the gaseous centrifuge technology. When the ACP was licensed, it was expected to produce 3.5 million SWU annually. However, USEC, Inc., subsequently indicated that it expects performance improvements will lead to peak production of 3.8 million SWU (USEC, 2007). The EREF is licensed to produce up to 6.6 million SWU per year.All three of these facilities are based on the gaseous centrifuge technology.

If all of the enrichment facilities and the proposed GLE Facility are constructed and operated at their maximum rated or anticipated production limits and the Paducah GDP is shut down, the total projected domestic enrichment capacity in the United States would equal 22.3 million SWU annually. Based on the projected need for LEU by existing domestic reactors and proposed new reactors, this enrichment capacity would exceed the projected annual demand (approximately 16 million SWU) by about 6 million SWU. However, given the uncertainties in future development and/or potential expansion of the proposed projects, this projected level of extra capacity would provide needed assurance that enriched uranium would be reliably available when needed for domestic nuclear power production. These three facilities and the proposed facility are summarized in Table 1-1.

1.3.2 Need for Domestic Supplies of Enriched Uranium for National Energy Security

As discussed previously, approximately 84 percent of U.S. demand for enriched uranium comes from foreign sources, with the remaining 16 percent originating from domestic production primarily from the Paducah GDP, and to a lesser extent, from the NEF. This situation creates a reliability risk in U.S. domestic enrichment capacity. Any disruption in the supply of enriched

Table 1-1 Licensed and Proposed Domestic Sources of Uranium Enrichment

Facility	Location	Owner	Production Capacity (million SWU/year)	Current Status
National Enrichment Facility (NEF)	Lea County, New Mexico	Louisiana Energy Services, LLC (LES)	3.0[a]	Licensed June 23, 2006; operating since June 2010 and still under construction
American Centrifuge Plant (ACP)	Piketon, Ohio	USEC, Inc.	3.8	Licensed April 13, 2007
Eagle Rock Enrichment Facility (EREF)	Bonneville County, Idaho	AREVA Enrichment Services, LLC (AES)	6.6	Licensed October 12, 2011
Global Laser Enrichment Facility (GLE)	Wilmington, North Carolina	General Electric-Hitachi Global Laser Enrichment, LLC	6.0	Application submitted June 26, 2009; under review

[a] The NRC expects to receive a request to increase licensed NEF production to 5.9 million SWUs.

uranium for domestic commercial nuclear reactors could have a detrimental impact on national energy security because nuclear reactors supply approximately 20 percent of the nation's electricity requirements. The proposed GLE Facility could play an important role in assuring the nation's ability to maintain a reliable and economical domestic source of enriched uranium.

In a letter to NRC regarding general policy issues raised by the LES license application, DOE stated that uranium enrichment is a critical step in the production of nuclear fuel and noted the decline in domestic enrichment capacity (DOE, 2002). In its 2002 letter, DOE also referenced comments made by the U.S. Department of State indicating that "Maintaining a reliable and economical U.S. uranium enrichment industry is an important U.S. energy security objective" (DOE, 2002). DOE reaffirmed this position during congressional hearings in June 2010, stating that it (DOE) has made available $4 billion in loan guarantees for the deployment of advanced enrichment technology in the United States in order to increase the domestic uranium enrichment market (DOE, 2010c; U.S. Congress, 2010). The proposed GLE Facility could contribute to the attainment of national energy security policy objectives by providing an additional domestic source of enriched uranium. This additional capacity would lessen U.S. dependence on foreign sources of enriched uranium.

At present, gaseous diffusion is the primary technology in commercial use in the United States. Gaseous diffusion technology has relatively large resource requirements that make it less attractive than gas centrifuge technology, from both an economic and environmental perspective (NRC, 2006a). Gas centrifuge technology, which is used at the NEF, and to be used at the ACP and EREF, is known to be more efficient and substantially less energy-intensive than gaseous diffusion technology. The GLE laser-based technology that would be deployed at the proposed GLE Facility is still under development, newer than gas centrifuge technology and, according to GLE, offers certain advantages over both the gaseous diffusion and gas centrifuge processes (GLE, 2008a). For example, GEH considers laser-based technology to have lower operating costs and lower capital costs than either the gaseous diffusion or the gas centrifuge technology. GLE further projects the GLE laser-based technology to have advantages of two earlier-generation laser-excitation technologies in terms of anticipated high separation factors, low energy intensity, low cooling water requirements, small footprint, and low capital and operating costs (GLE, 2008a). Section 2.3.3 provides information about earlier-generation laser-excitation technologies, as well as competing technologies.

1.4 Scope of the Environmental Analysis

To fulfill its responsibilities under NEPA, the NRC has prepared this EIS to analyze the potential environmental impacts (i.e., direct, indirect, and cumulative impacts) of the proposed GLE Facility as well as reasonable alternatives to the proposed action. The scope of this EIS includes consideration of both radiological and nonradiological (including chemical) impacts associated with the proposed action and the reasonable alternatives. In addition, this EIS identifies resource uses, monitoring, potential mitigation measures, unavoidable adverse environmental impacts, the relationship between short-term uses of the environment and long-term productivity, and irreversible and irretrievable commitments of resources.

The development of this EIS was based on (1) the NRC's review of the GLE license application (GLE, 2009a) and its supporting Environmental Report (GLE, 2008a), Environmental Report supplements (GLE, 2009b; GLE, 2009c), responses to Requests for Additional Information

(RAI) (GLE, 2009d–i), and supplemental information (GLE, 2011; GLE, 2012); (2) the NRC's independent verification and analyses; (3) public and agency comments received during the scoping and the Draft EIS public comment periods; and (4) the NRC's consultations with other Federal agencies, Native American Tribes, and State and local government agencies. In addition, the development of this EIS was closely coordinated with the NRC's Safety Evaluation Report (SER). The SER documents the results of the NRC's safety review.

1.4.1 Scope of the Proposed Action

For the purposes of this EIS, the scope of the proposed action consists of the construction, operation, and decommissioning of the proposed GLE Facility. Therefore, all activities associated with these actions must be considered. A distinction between preconstruction and facility construction is made because of an exemption request submitted by GLE as discussed below. Preconstruction activities consist of land clearing and access road construction; facility construction consists of erecting buildings and structures concerned with uranium enrichment. Operation activities include those involved in the enrichment of uranium (shipment, receipt, storage, and processing of natural uranium and storage and shipment of enriched and depleted uranium). Decommissioning activities include those involved in facility shutdown, such as equipment and building decontamination for disposal or reuse, as well as management and disposal of depleted uranium.

On December 8, 2008, GLE submitted a request for exemption (GLE, 2008b) from specific NRC requirements governing "Commencement of Construction" as specified under 10 CFR 70.4, 70.23(a)(7), 30.4, 30.33(a)(5), 40.4, and 40.32(e). This exemption was approved by the NRC on May 8, 2009 (NRC, 2009c). The exemption allows GLE to proceed with certain activities that are considered outside of NRC regulatory purview (they are not related to radiological health and safety or the common defense and security) without an NRC license to construct and operate the proposed GLE Facility. These activities, discussed further in Section 2.1.5, are referred to as "preconstruction" activities, because they are not considered construction activities as defined in NRC regulations. See 10 CFR 51.4 (defining "construction"), 10 CFR 70.4 (defining "commencement of construction"), and the NRC final rule on Licenses, Certifications, and Approvals for Materials Licensees in the *Federal Register* (76 FR 56951). Specifically, 10 CFR 51.4 states, in relevant part, that "construction" does not include the following activities:

i. Changes for temporary use of the land for public recreational purposes;

ii. Site exploration, including necessary borings to determine foundation conditions or other preconstruction monitoring to establish background information related to the suitability of the site, the environmental impacts of construction or operation, or the protection of environmental values;

iii. Preparation of a site for construction of a facility, including clearing of the site, grading, installation of drainage, erosion and other environmental mitigation measures, and construction of temporary roads and borrow areas;

iv. Erection of fences and other access control measures;

v. Excavation;

vi. Erection of support buildings (such as construction equipment storage sheds, warehouse and shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and office buildings) for use in connection with the construction of the facility;

vii. Building of service facilities, such as paved roads, parking lots, railroad spurs, exterior utility and lighting systems, potable water systems, sanitary sewerage treatment facilities, and transmission lines;

viii. Procurement or fabrication of components or portions of the proposed facility occurring at other than the final, in-place location at the facility;

ix. Manufacture of a nuclear power reactor under a manufacturing license under Subpart F of Part 52 of this chapter to be installed at the proposed site and to be part of the proposed facility; or

x. With respect to production or utilization facilities, other than testing facilities and nuclear power plants, required to be licensed under Section 104.a or Section 104.c of the Act, the erection of buildings which will be used for activities other than operation of a facility and which may also be used to house a facility (e.g., the construction of a college laboratory building with space for installation of a training reactor).

As indicated in (iii) of the list above, site preparation is one component of preconstruction. As used in this document, the term "site preparation" includes the items specifically listed in (iii) above (i.e., clearing of the site, grading, installation of drainage, erosion and other environmental mitigation measures, and construction of temporary roads and borrow areas).

The NRC's decision to grant the exemption request to GLE was based on the NRC finding that the request to perform certain preconstruction activities is authorized by law, will not endanger life or property or common defense and security, and is in the public interest (NRC, 2009b). The exemption covered the following activities and facilities:

- clearing of approximately 40 hectares (100 acres)[3]
- site grading and erosion control
- stormwater retention ponds
- main access roadways and guardhouses

[3] Due to minor adjustments in the facility layout, the proposed GLE Facility is currently estimated to encompass approximately 47 ha (117 ac). For consistency within this EIS and with the GLE Environmental Report (GLE, 2008), it continues to be referred to as the approximately 40-ha (100-ac) proposed GLE Facility. However, the impact analyses performed in this EIS consider the larger area. In addition to the 47-ha site footprint, the GLE study area includes 106 ha (263 ac), of which 91 ha (226 ac) would be disturbed through clearing and grading.

- utilities
- parking lots
- administrative buildings not used to process, handle, or store classified information

The authorization to conduct the listed activities or construct the listed facilities prior to the NRC licensing decision was based on the condition that none of the facilities or activities subject to the exemption will be, at a later date, a component of GLE's Physical Security Plan or its Standard Practice Procedures Plan for the Protection of Classified Matter or otherwise subject to NRC review or approval. Approval of the exemption request does not indicate that a licensing decision has been made by the NRC. Preconstruction activities would be completed by GLE with the risk that a license may not be issued.

GLE indicated that the activities it undertakes under the exemption request may include all of the above-listed activities (GLE, 2009d). GLE also indicated that the actual work to be completed and the schedule are uncertain at this time, due to various business factors. In its RAI response, GLE stated that some of the activities could be up to 75 percent complete, whereas others may be only 10 percent complete by the time the NRC decides whether or not to grant a license. Thus, although the activities covered by the NRC's May 8, 2009, exemption (NRC, 2009c) are referred to in this document as "preconstruction" activities, some of these activities may continue after the commencement of construction, if a license is issued. In addition, GLE indicated that if for any reason the proposed GLE Facility project does not reach fruition, the decision to continue to develop the area referred to as the 40-hectare (100-acre) proposed GLE Facility would be made by GE senior management. GE may continue to develop the land to construct administrative facilities (i.e., office space) if there is a future expansion of the Wilmington Site workforce. If the land would not be used in the immediate future following the decision to cancel the proposed GLE Facility project, GE would consider replanting all or a portion of the area with native trees, in accordance with then-current Wilmington Site forest management activities (GLE, 2009d).

The activities authorized under the exemption are expected to occur whether or not the license is granted. As a result, the NRC does not consider these activities as part of the proposed action or the no action alternative. However, because they are related to the construction of the proposed GLE Facility, the NRC analyzed their impacts in Chapter 4 as part of the impacts considered under "Preconstruction and Construction." However, the staff also attempted, to the extent possible, to separate the impacts from site preparation and construction activities into those that would occur as a result of preconstruction activities and those that would occur as a result of construction activities as defined in 10 CFR 70.4 and 10 CFR 51.4. In September 2011, the Commission amended the regulations by revising the provisions applicable to the licensing and approval processes for byproduct, source, and special nuclear materials licenses, as well as irradiators (see 76 FR 56951). The changes clarified the definitions of ''construction'' and ''commencement of construction'' with respect to materials licensing actions conducted under the NRC's regulations. The staff also considered all of the impacts that would be expected to occur under preconstruction and construction in evaluating the cumulative impacts of the proposed action.

In addition to construction, the scope of the proposed action also includes the activities associated with the operation and decontamination and decommissioning of the proposed GLE Facility. These impacts are discussed in Chapter 4.

1.4.2 Scoping Process and Public Participation Activities

The NRC regulations in 10 CFR Part 51 contain requirements for conducting a scoping process prior to the preparation of an EIS. Scoping was used to help identify the relevant issues to be discussed in detail and to help identify issues that are beyond the scope of this EIS, which do not warrant a detailed discussion, or are not directly relevant to the assessment of potential impacts from the proposed action.

On April 9, 2009, the NRC published a Notice of Intent (NOI) in the *Federal Register* (74 FR 16237) to prepare an EIS for the construction, operation, and decommissioning of the proposed GLE Facility and to conduct the scoping process for the EIS. The NOI summarized the NRC's plans to prepare the EIS and presented background information on the proposed GLE Facility. For the scoping process, the NOI invited comments on the proposed action and announced a public scoping meeting to be held concerning the project.

On July 14–17, 2008, and May 18–20, 2009, the NRC met with State and local officials and toured the proposed GLE Facility site. On July 17, 2008, the NRC held a public information meeting to provide background information about the NRC's safety and environmental review processes and to notify the public to the upcoming public scoping period. On May 19, 2009, the NRC held two public scoping meetings in Wilmington, North Carolina. During the scoping meetings, a number of individuals provided oral comments to the NRC concerning the proposed GLE Facility and the development of the EIS. In addition, the NRC received written comments during the public scoping period that was to end on June 8, 2009. The NRC subsequently extended the scoping period to August 31, 2009, to allow members of the public to examine GLE's license application, which was submitted on June 26, 2009. The NRC reviewed and identified substantive scoping comments (both oral and written). These comments were then consolidated and categorized by topical areas.

After the scoping period, the NRC issued the *Environmental Scoping Summary Report: Proposed GE-Hitachi Global Laser Enrichment Facility in Wilmington, North Carolina* in November 2009 (see Appendix A). The report identifies categories of issues to be analyzed in detail and issues determined to be beyond the scope of the EIS.

1.4.3 Issues Studied in Detail

As stated in the NOI, the NRC identified issues to be studied in detail as they relate to implementation of the proposed action. The public identified additional issues during the subsequent public scoping process. Issues identified by the NRC and the public that could have short- or long-term impacts from the potential construction, operation, and decommissioning of the proposed GLE Facility include:

- need for the facility
- compliance with applicable regulations
- alternatives
- decommissioning
- air quality
- noise
- historic and cultural resources
- visual and scenic resources

- cumulative impacts
- land use
- transportation
- accidents
- geology and soils
- water resources
- ecological resources
- socioeconomic impacts
- public and occupational health
- waste management
- depleted uranium disposition
- environmental justice
- costs and benefits
- resource commitments

1.4.4 Issues Eliminated from Detailed Study

No issues were eliminated from detailed study as a result of the public scoping process. However, some issues are analyzed in detail in the NRC's Safety Evaluation Report and are only summarized in the EIS. For example, within the area of safety and security, the Safety Evaluation Report analyzes the probabilities and consequences of various accidents at the proposed GLE Facility, as well as measures to prevent those accidents and mitigate their effects. This EIS does not go into the same level of detail, but summarizes, in Section 4.2.15, the accident analysis from the Safety Evaluation Report for the purpose of assessing the potential environmental impacts of accidents. Alternatives considered but not analyzed in detail are discussed in Section 2.3.

1.4.5 Issues Outside the Scope of the EIS

The following issues raised during the scoping process have been determined to be outside the scope of the EIS (see Appendix A):

- nonproliferation
- GE's pursuit of boiling water reactors
- terrorism

The term "Nuclear Proliferation Assessment Statement" is used in the Atomic Energy Act of 1954 (AEA) as amended, in the context of U.S. agreements for cooperation with a foreign nation under Sections 123 and 131 of the AEA. Pursuant to those provisions, the NRC participated in the Nuclear Proliferation Assessment that allowed the Silex technology to be transferred from Australia to the U.S. under the "Agreement for Cooperation between the United States of America and Australia Concerning Technology for the Separation of Isotopes of Uranium by Laser Excitation."

Separately, the AEA grants the NRC broad regulatory latitude to protect public health and safety, common defense and security in its domestic licensing activities. NRC safety regulations regarding information, physical security, and material control adequately address non-proliferation concerns as part of a comprehensive regulatory infrastructure and an integrated set of activities. These regulations and activities are directed against activities that are inimical to the public health and safety and common defense and security, including the unauthorized disclosure of information and technology and the diversion of nuclear materials. Key NRC regulations in this area (10 CFR Parts 73, 74, and 95) provide comprehensive requirements governing the control of, and access to, information, physical security of materials and facilities, and material control and accounting. As appropriate, the NRC may supplement

these requirements by order consistent with its statutory obligation under the AEA to protect the common defense and security and public health and safety. While the AEA does not prescribe that NRC explicitly consider nuclear proliferation as a prerequisite to domestic licensing, the NRC's security requirements related to information and material control address nonproliferation concerns.

In a matter regarding the Louisiana Energy Services Facility (LES), the Commission noted the Supreme Court's decision (Department of Transp. v. Public Citizen, 541 U.S. 752, 767 (2004)) that NEPA requires a "reasonably close causal relationship" between the alleged environmental effect and the alleged cause, and found that nuclear nonproliferation issues "span a host of factors far removed from" and "far afield from our decision whether to license the facility..." (NRC, 2005b). Following LES, the Commission, in USEC Inc. (American Centrifuge Plant), reiterated that position. The Commission held that nuclear nonproliferation issues are outside of the scope NRC's environmental analysis because they do not have a close causal relationship with an NRC licensing decision and instead are "dependent upon the actions and decisions of the President, Congress, international organizations, and officials of other nations," are "issues of international policy unrelated to the NRC's licensing criteria ..." (NRC, 2006b).

Given the NRC's comprehensive regulatory framework, ongoing oversight, and active inter-agency cooperation, it is the NRC's current view that a nuclear nonproliferation assessment is not necessary to ensure the protection of the common defense and security.

NRC regulations require that information submitted as part of a license application be complete and accurate in all material respects (e.g., see 10 CFR 70.9). The general business interests of an applicant are not an issue the NRC addresses in an EIS. Rather, the NRC evaluates the submitted application based on its merits and performs an independent verification of the proposal in the application. Therefore, GE's pursuit of boiling water reactors is not within the scope of the EIS.

Similar to the nuclear proliferation issues, the Commission has ruled in a series of adjudicatory decisions that NEPA does not require the NRC to consider the environmental impacts from hypothetical terrorist attacks. See Amergen Energy Co., LLC (Oyster Creek Nuclear Generating Station), CLI-07-8, 65 NRC 124 (NRC, 2007). The Commission position rests on Supreme Court NEPA decisions that require a showing of a close causal relationship—analogous to the "proximate cause" requirement in tort law—between agency action and environmental consequences that require NEPA analysis. The Commission has found that there is no such relationship between NRC licensing actions and terrorism. The Federal courts are split on the issue, with the Third Circuit upholding the Commission's view, and the Ninth Circuit disagreeing with it. Hence, for facilities located in the Ninth Circuit, the NRC does perform a NEPA-terrorism review. As stated above, the Commission has ruled that for facilities such as GLE that are not located in the Ninth Circuit, the NRC will not perform a NEPA-terrorism review.

1.4.6 Draft EIS Public Comment Period and Public Participation Activities

The NRC issued the Draft EIS for public review and comment on June 25, 2010, and announced its availability on that date in the *Federal Register* (75 FR 36447) in accordance with 10 CFR 51.73, 51.74, and 51.117. The official public comment period on the Draft EIS began with publication of the Environmental Protection Agency's Notice of Availability in the *Federal*

Register on June 25, 2010 (75 FR 36386). The 45-day public comment period ended on August 9, 2010.

During the public comment period, the NRC held two public comment meetings in Wilmington, North Carolina, on July 22, 2010. The NRC posted meeting notices for these meetings in the NRC's public involvement website. Oral comments on the Draft EIS were presented by eight individuals at the meetings. A court reporter recorded the oral comments and other meeting proceedings and prepared a written transcript for each meeting. In addition to oral comments received at the public meetings, the NRC received written comments on the Draft EIS during the public meetings, and written comments by postal mail and emails during the public comment period. The public meeting transcripts and written comments are part of the public record for the proposed GLE project.

All comments received by the NRC on the Draft EIS were reviewed and considered by the NRC in developing the Final EIS. In Appendix J of this EIS, these comments are presented in groups by topic and summarized, and the NRC's responses to the comments are provided. The NRC made the public comment meeting transcripts part of the public record, contained in the NRC's Agencywide Documents Access and Management System (ADAMS). Members of the public can access ADAMS at http://www.nrc.gov/reading-rm/adams.html. From this website, the transcripts and other comment documents can be accessed. The meeting transcripts, along with all written comments, are presented in Appendix K. The meeting transcripts are also available in the NRC's public website for the proposed GLE project, at http://www.nrc.gov/materials/fuel-cycle-fac/laser.html#3. Other comment documents were added to ADAMS as they were received by the NRC.

In general, the issues identified in the comments were similar to those raised during the EIS scoping process (see Section 1.4.2 and Appendix A). The comments received during the Draft EIS public comment period were on a number of issues and resource areas addressed in the EIS. As discussed in Section 1.4.5, issues that are related to safety, security, and nonproliferation are not within the scope of the EIS. Other safety issues are addressed in the NRC's SER.

1.4.7 Changes from the Draft EIS

The majority of changes to the Draft EIS that the NRC made in preparing the Final EIS were minor corrections and a number of updates and clarifications. Among these changes, based on recent project developments or certain comments on the Draft EIS (see Appendix J), updated or additional information has been included in the EIS in some of the resource area sections and other sections and appendices, to provide more current or complete information and/or analyses. The impacts assessed and the NRC's findings and conclusions remain unchanged for all resource areas.

The most noteworthy of the changes from the Draft EIS are identified below:

<u>Chapter 1 Introduction</u>

- Information regarding the proposed GLE project schedule has been updated in Section 1.2.

- Information relating to purpose and need for the proposed action has been added and updated in Sections 1.3.1 and 1.3.2.

- Information relating to the scope of the proposed action has been updated in Section 1.4.1.

- Additional information explaining why nonproliferation and terrorism are not within the scope of the EIS has been added to Section 1.4.5.

- Information on the Draft EIS public comment period and associated public participation activities, and on comments received on the Draft EIS, has been added (Section 1.4.6).

- Information regarding the Coastal Zone Management Act and the Occupational Safety and Health Act has been added to Section 1.5.1.

- Information regarding the outcome of Endangered Species Act and National Historic Preservation Act consultations has been added to Section 1.5.6.

- Information on applicable State of North Carolina requirements has been added to Table 1-2, and information regarding State construction and operating permit requirements has been updated in Table 1-3.

Chapter 2 Alternatives

- Information regarding the proposed GLE project schedule has been updated in Sections 2.1 and 2.1.5.

- Information regarding the status of conversion facilities for depleted uranium hexafluoride has been updated in Section 2.1.5.1.

- Information on potential impacts of the proposed GLE project has been updated in Tables 2-3 and 2-6.

- Information in Section 2.2 regarding the no-action alternative has been updated.

Chapter 3 Affected Environment

- Information regarding current socioeconomic conditions in Section 3.13 has been updated.

- Information regarding NRC's Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040) was added to Section 3.14.

- Information in Resource Dependencies and Vulnerabilities of Minority and Low-Income Populations was moved from Section 3.14.3 to Section 4.2.14.

Chapter 4 Environmental Impacts and Chapter 5 Mitigation

- Information regarding the proposed GLE project schedule has been updated in Sections 4.1, 4.2.4, 4.2.10, and 4.2.13..

- Section 4.2.2.2 was updated to include the proposed license condition requiring GLE to consider the potential effects on historic and cultural resources from any ground-disturbing activities. Information regarding the outcome of the National Historic Preservation Act Section 106 consultation has been added to the text.

- Results of the air quality impacts analysis have been updated in Section 4.2.4.1, and air quality impacts from road construction and land clearing have been split into two different tables.

- Assumptions about the projected duration of road construction and land clearing have been updated in Sections 4.2.4.1, 4.2.9.1, and 4.2.9.3.

- Information regarding water quality impacts has been added to Section 4.2.7.2.

- Information explaining the NRC's environmental justice impact analysis has been added to Section 4.2.14.

- The summary of impacts discussion in Section 4.2.14 has been updated.

- Information in Resource Dependencies and Vulnerabilities of Minority and Low-Income Populations was moved from Section 3.14.3 to Section 4.2.14.

- Results of the transportation impacts analysis have been updated in Section 4.2.10.1 and Table 4-11.

- Information regarding on-site traffic has been updated in Section 4.2.18.4.

Chapter 7

- Information regarding the proposed GLE project schedule and resulting changes in the cost-benefit analysis has been updated in Section 7.1.

- Information relating to purpose and need for the proposed action has been updated in Section 7.2.

- Section 7.1 of the draft EIS ("The No-Action Alternative") was incorporated into Section 7.2 "Comparative Cost-Benefit Analysis of the Proposed Action Relative to the No-Action Alternative."

- The impact summaries for each resource area were updated in Section 7.1.1.

Chapter 8

- Information regarding the proposed GLE project schedule has been updated.

Appendix B Consultation Letters

- Additional consultation letters have been added to Sections B.1, B.2, and B.3.

Appendix E Air Quality Analysis

- Information regarding the proposed GLE project schedule has been updated in the introduction, Section E.1, and Table E-1.
- Assumptions about the projected duration of road construction and land clearing have been updated in Section E.1.
- Results of the air quality impacts analysis have been updated in Tables E-7 through E-12, and air quality impacts from road construction and land clearing have been split into two different tables.

1.4.8 Related NEPA and Other Relevant Documents

The following NEPA documents were reviewed as part of the development of this EIS.

- *Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio, Final Report, NUREG-1834, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, April, 2006.* This EIS analyzes the potential environmental impacts of the proposed siting, construction, operation, and decommissioning of a gas centrifuge uranium enrichment facility at the existing DOE reservation in Piketon, Ohio. Its description of the purpose of and need for the proposed action, as well as its review of alternatives to the proposed action, are highly relevant to the proposed GLE Facility analysis. The environmental impacts discussed for the proposed ACP are also relevant to the impact analysis for the proposed GLE Facility, especially the analysis of cumulative impacts associated with the management of depleted uranium hexafluoride (UF_6) generated by the ACP, NEF, EREF, and the proposed GLE Facility, as well as the existing DOE inventory of depleted UF_6.
- *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico, Final Report, NUREG-1790, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, June, 2005.* This EIS analyzes the potential environmental impacts of the proposed siting, construction, operation, and decommissioning of a gas centrifuge uranium enrichment facility near Eunice, New Mexico. Its description of the purpose of and need for the proposed action, as well as its review of alternatives to the proposed action, are highly relevant to the proposed GLE Facility analysis. The environmental impacts discussed for the proposed NEF are also relevant to the impact analysis for the proposed GLE Facility, especially the analysis of cumulative impacts associated with the management of depleted UF_6 generated by the ACP, NEF, EREF, and the proposed GLE Facility, as well as the existing DOE inventory of depleted UF_6.
- *Final Environmental Impact Statement for the Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site, DOE/EIS-0360, Oak Ridge Operations, Office of Environmental Management, U.S. Department of Energy, June, 2004.* This site-specific EIS analyzes the impacts associated with the construction, operation, and decommissioning of a depleted UF_6 conversion facility at the Portsmouth, Ohio, site. The EIS also evaluates the impacts of transporting cylinders (depleted UF_6, enriched uranium, and empty) that used to be stored at the East Tennessee Technology

Park near Oak Ridge, Tennessee, to Portsmouth. Transportation of depleted UF_6 conversion products and waste materials to a disposal facility, transportation and sale of the hydrogen fluoride produced as a conversion co-product; and neutralization of hydrogen fluoride to calcium fluoride and its sale or disposal in the event that the hydrogen fluoride product is not sold are also evaluated. The results presented in the EIS are relevant to the management, use, and potential impacts associated with the depleted UF_6 that would be generated at the proposed GLE Facility and the cumulative impacts of depleted UF_6 from the ACP, NEF, EREF, and the proposed GLE Facility, as well as the existing DOE inventory of depleted UF_6.

- *Final Environmental Impact Statement for the Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site, DOE/EIS-0359, Oak Ridge Operations, Office of Environmental Management, U.S Department of Energy, June, 2004.* This site-specific EIS is very similar to the EIS for the Portsmouth, Ohio, site, except that the conversion facility is at the Paducah, Kentucky, site.

- *Environmental Assessment: Disposition of Russian Federation Titled Natural Uranium. DOE/EA-1290, Office of Nuclear Energy, Science and Technology, U.S. Department of Energy, June 1999.* This Environmental Assessment (EA) analyzed the environmental impacts of transporting natural UF_6 from the gaseous diffusion plants to the Russian Federation. Transportation by rail and truck within the United States were considered. The EA addresses both incident-free transportation and transportation accidents. The results presented in this EA are relevant to the transportation of UF_6 for the proposed GLE Facility.

- *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride, DOE/EIS-0269, Office of Nuclear Energy, Science and Technology, U.S. Department of Energy, April 1999.* This EIS analyzes strategies for the long-term management of the depleted UF_6 inventory that was stored at three DOE sites near Paducah, Kentucky; Portsmouth, Ohio; and Oak Ridge, Tennessee at the time the EIS was prepared. This EIS also analyzes the potential environmental consequences of implementing each alternative strategy for the period 1999 through 2039. The results presented in this EIS are relevant to the management, use, and potential impacts associated with the depleted UF_6 that would be generated at the proposed GLE Facility and the cumulative impacts of depleted UF_6 from the ACP, NEF, EREF, and the proposed GLE Facility, as well as the existing DOE inventory of depleted UF_6.

1.5 Applicable Statutory and Regulatory Requirements

This section provides a summary assessment of the major environmental requirements, agreements, Executive Orders, and permits relevant to the construction, operation, and decommissioning of the proposed GLE Facility.

1.5.1 Federal Laws and Regulations

1.5.1.1 *National Environmental Policy Act of 1969*, as amended (42 U.S.C. 4321 et seq.)

The *National Environmental Policy Act* (NEPA) establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment to ensure for all Americans a safe, healthful, productive, and aesthetically and culturally pleasing environment.

The Act provides a process for implementing these specific goals within the Federal agencies responsible for the action. This EIS has been prepared in accordance with NEPA requirements and NRC regulations (10 CFR Part 51) for implementing NEPA.

1.5.1.2 *Atomic Energy Act of 1954*, as amended (42 U.S.C. 2011 et seq.), and the *Energy Reorganization Act of 1974* (42 U.S.C. 5801 et seq.)

The *Atomic Energy Act* (AEA), as amended, and the *Energy Reorganization Act of 1974* (Title 42, Section 5801 et seq. of the *United States Code* [42 U.S.C. 5801 et seq.]) give the NRC the licensing and regulatory authority for nuclear energy uses within the commercial sector. If the license application for the proposed GLE Facility is approved, the NRC would license and regulate the possession, use, storage, and transfer of special nuclear, source, and by-product materials to protect public health and safety as stipulated in 10 CFR Parts 30, 40, and 70.

1.5.1.3 *Clean Air Act of 1970,* as amended (42 U.S.C. 7401 et seq.)

The *Clean Air Act* (CAA) establishes regulations to ensure air quality and authorizes individual States to manage permits. The CAA requires (1) the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards as necessary to protect the public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 U.S.C. 7409 et seq.); (2) the establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants (42 U.S.C. 7411); (3) specific emission increases to be evaluated so as to prevent a significant deterioration in air quality (42 U.S.C. 7470 et seq.); and (4) specific standards for releases of hazardous air pollutants (including radionuclides) (42 U.S.C. 7412). These standards are implemented through plans developed by each State and approved by the EPA. The CAA requires sources to meet standards and obtain permits to satisfy those standards. The North Carolina Department of Environment and Natural Resources (NCDENR) Division of Air Quality implements the CAA in the State. Construction and operating permits are required for the proposed GLE Facility but emissions during operation will not rise to the CAA's major source threshold.

1.5.1.4 *Clean Water Act of 1977 (*amending the *Federal Water Pollution Control Act of 1948)*, as amended (33 U.S.C. 1251 et seq.)

The *Clean Water Act* (CWA) requires the EPA to set national effluent limitations and water quality standards and establishes a regulatory program for enforcement. Specifically, Section 402(a) of the Act establishes water quality standards for contaminants in surface waters. The CWA requires a National Pollutant Discharge Elimination System (NPDES) permit before discharging any point source pollutant into surface waters of the United States. The NPDES permit program contains a program applicable to discharges of stormwater to waters of the United States from construction and industrial operations. Section 404 of the CWA authorizes the U.S. Army Corps of Engineers (USACE) to issue permits for the discharge of dredged or fill material into the waters of the United States. The Section 401 water quality certification and NPDES provisions of the CWA have been delegated to the NCDENR Division of Water Quality. The proposed GLE Facility will require a Section 404 permit. Existing NPDES permits for Wilmington Site operations will require modification to incorporate the proposed GLE Facility; a new NPDES permit for construction of the facility will be required.

1.5.1.5 *Resource Conservation and Recovery Act of 1976* (amending the *Solid Waste Disposal Act of 1965*), as amended (42 U.S.C. 6901 et seq.)

The *Resource Conservation and Recovery Act* (RCRA), as amended, requires the EPA to define and identify hazardous waste; establish standards for its transportation, treatment, storage, and disposal; and require permits for persons engaged in hazardous waste activities. Section 3006 (42 U.S.C. 6926) allows States to establish and administer these permit programs with EPA approval; the NCDENR Division of Waste Management has received that approval. EPA regulations implementing RCRA are found in 40 CFR Parts 260 through 283. Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also affects the extent and complexity of the requirements. A RCRA treatment, storage, or disposal permit will not be required for the proposed GLE Facility due to the amount of hazardous waste generated and the stated plans for the wastes to be shipped to a RCRA-permitted facility within the 90-day accumulation period. A hazardous waste generator number will be required.

1.5.1.6 *Low-Level Radioactive Waste Policy Act of 1980*, as amended (42 U.S.C. 2021 et seq.)

The *Low-Level Radioactive Waste Policy Act of 1980* amended the AEA to specify that the Federal Government is responsible for disposal of low-level radioactive waste generated by its activities and that States are responsible for disposal of other low-level radioactive waste (LLRW). The *Low-Level Radioactive Waste Policy Act of 1980* provides for and encourages interstate compacts to carry out the State responsibilities. The LLRW generated at the proposed GLE Facility is Class-A waste; this class has the lowest concentration of radioactive material and poses the least potential hazard of the LLRW classes. Plans call for shipment of the LLRW to the Energy*Solutions* disposal facility in Clive, Utah.

1.5.1.7 *Emergency Planning and Community Right-to-Know Act of 1986* (42 U.S.C. 11001 et seq.) (also known as Superfund Amendments and Reauthorization Act of 1986 [SARA] Title III)

The *Emergency Planning and Community Right-to-Know Act of 1986*, which is the major amendment to the *Comprehensive Environmental Response, Compensation, and Liability Act* (42 U.S.C. 9601), establishes the requirements for Federal, State, and local governments; Indian tribes; and industry regarding emergency planning and "Community Right-to-Know" reporting on hazardous and toxic chemicals. The "Community Right-to-Know" provisions increase the public's knowledge and access to information about chemicals at individual facilities, their uses, and releases into the environment. States and communities working with facilities can use the information to improve chemical safety and protect public health and the environment. The Act requires emergency planning and notice to communities and government agencies concerning the presence and release of specific chemicals. The EPA implements this Act under regulations found in 40 CFR Parts 355, 370, and 372. The Act requires the proposed GLE Facility to provide the State Emergency Planning Committee and local fire departments with information on the storage and use of chemicals above certain threshold levels and comply with toxic chemical reporting requirements if thresholds for chemical releases are exceeded.

1.5.1.8 *Safe Drinking Water Act of 1974*, as amended (42 U.S.C. 300f et seq.)

The *Safe Drinking Water Act* was enacted to protect the quality of public water supplies and sources of drinking water through establishing minimum national standards for public water supply systems. The Act includes the Sole Source Aquifer Program and provisions for the protection of public drinking water systems. The NCDENR Division of Environmental Health, Public Water Supply Section enforces the *Safe Drinking Water Act*. The proposed GLE Facility would use groundwater for industrial process water and drinking water from wells on the Wilmington Site. North Carolina requires the registration of water withdrawals above certain thresholds; the Wilmington Site registers its withdrawals with the State.

1.5.1.9 *Noise Control Act of 1972*, as amended (42 U.S.C. 4901 et seq.)

The *Noise Control Act* delegates the responsibility of noise control to State and local governments. Commercial facilities are required to comply with Federal, State, interstate, and local requirements regarding noise control. New Hanover County enacted a noise ordinance pursuant to the authority granted it by a North Carolina law. The noise ordinance established decibel levels for areas zoned nonresidential with which the proposed GLE Facility must comply.

1.5.1.10 *National Historic Preservation Act of 1966*, as amended (16 U.S.C. 470 et seq.)

The *National Historic Preservation Act* was enacted to create a national historic preservation program, including the *National Register of Historic Places* (NRHP) and the Advisory Council on Historic Preservation (ACHP). Section 106 requires Federal agencies to take into account the effects of their undertakings on historic properties. The ACHP regulations implementing Section 106 of the Act are found in 36 CFR Part 800. The regulations call for public involvement in the Section 106 consultation process, as well as consultation with American Indian Tribes and State Historic Preservation Officers. The NRC has completed the Section 106 consultation process (see Section 1.5.6.2 and Appendix B).

1.5.1.11 *Endangered Species Act of 1973,* as amended (16 U.S.C. 1531 et seq.)

The *Endangered Species Act* (ESA) was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7 of the Act requires consultation with the U.S. Fish and Wildlife Service (FWS) of the U.S. Department of the Interior or the National Marine Fisheries Service of the U.S. Department of Commerce to determine whether endangered and threatened species or their critical habitats are known to be in the vicinity of the proposed action, and to determine whether the proposed Federal action may affect listed species or critical habitat. The NRC has completed the ESA consultation process (see Section 1.5.6.1 and Appendix B).

1.5.1.12 *Coastal Zone Management Act of 1972*, as amended (16 U.S.C. 1451 et seq.)

The *Coastal Zone Management Act* (CZMA) provides for management of the nation's coastal resources and balances economic development with environmental conservation. It encourages States and tribes to voluntarily preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those

habitats. The Act makes federal financial assistance available to any coastal State, tribe, or territory that is willing to develop and implement a comprehensive coastal management program. The CZMA is implemented by the North Carolina Division of Coastal Management through the state's Coastal Area Management Act. The consistency determination required by the CZMA and the Coastal Area Management Act is conducted prior to obtaining a Federal permit or license.

1.5.1.13 ***Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006*, as amended (16 U.S.C. 1801 et seq.)**

The *Magnuson-Stevens Fishery Conservation and Management Reauthorization Act* provides for a national program for the conservation and management of the fishery resources of the United States. The purposes of the program are to prevent overfishing, rebuild overfished stocks, ensure conservation, facilitate long-term protection of essential fish habitats, and realize the full potential of the nation's fishery resources. The Act establishes regional fishery management councils which can develop fishery management plans; North Carolina is a member of the South Atlantic Council.

1.5.1.14 ***Occupational Safety and Health Act of 1970*, as amended (29 U.S.C. 651 et seq.)**

The *Occupational Safety and Health Act* establishes standards to enhance safe and healthy working conditions in places of employment throughout the United States. The Act is administered and enforced by the Occupational Safety and Health Administration (OSHA), a U.S. Department of Labor agency. The identification, classification, and regulation of potential occupational carcinogens are found in 29 U.S.C. 1910.101, while the standards pertaining to hazardous materials are listed in 29 U.S.C. 1910.120. The Occupational Health and Safety Administration regulates mitigation requirements and mandates proper training and equipment for workers. North Carolina is one of the States that manages its own occupational safety and health program through the North Carolina Department of Labor (NCDOL). The proposed GLE Facility would be required to comply with these regulations. The NCDOL would also regulate laser safety at the proposed GLE Facility.

1.5.1.15 ***Hazardous Materials Transportation Act of 1975* (49 U.S.C. 1801 et seq.)**

The *Hazardous Materials Transportation Act* regulates transportation of hazardous material (including radioactive material) in and between States. According to the Act, States may regulate the transport of hazardous material as long as they are consistent with the Act or the U.S. Department of Transportation regulations provided in 49 CFR Parts 171 through 177. 49 CFR Part 173, Subpart I, contains other regulations regarding packaging for transportation of radionuclides. The transport of radioactive materials to and from the proposed GLE Facility would be required to comply with these regulations.

1.5.1.16 ***United States Enrichment Corporation Privatization Act of 1996* (42 U.S.C. 2011 et seq.)**

The *United States Enrichment Corporation Privatization Act* establishes a disposal option for depleted uranium if it is determined to be low-level radioactive waste; the NRC made that determination in 2005. The Act allows any person licensed by the NRC to operate a uranium enrichment facility to request that the U.S. Department of Energy accept for disposal as low-

level radioactive waste depleted uranium it generated. GLE thus has the option of requesting that its depleted uranium be accepted by the Department of Energy for disposal.

1.5.1.17 *Environmental Standards for the Uranium Fuel Cycle* (40 CFR Part 190, Subpart B)

These regulations establish maximum doses to the body or organs of members of the public as a result of operational normal releases from uranium fuel cycle activities, including uranium enrichment. These regulations were promulgated by the EPA under the authority of the AEA, as amended, and have been incorporated by reference in the NRC regulations in 10 CFR 20.1301(e). The proposed GLE Facility would be required to comply with these regulations for releases from normal operations.

1.5.2 Applicable Executive Orders

- *Executive Order 11988* (Floodplain Management) directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts be avoided to the extent practicable.

- *Executive Order 11990* (Protection of Wetlands) directs Federal agencies to avoid new construction in wetlands unless there is no practicable alternative and unless the proposed action includes all practicable measures to minimize harm to wetlands that might result from such use.

- *Executive Order 12898* (Environmental Justice) calls for Federal agencies to address environmental justice in minority and low-income populations, and directs Federal agencies to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority and low-income populations. In response to this Executive Order, the NRC issued a final policy statement on the "Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions" (69 FR 52040; August 24, 2004) and environmental justice procedures to be followed in NEPA documents prepared by the NRC's Office of Nuclear Material Safety and Safeguards (NRC, 2003).

1.5.3 Applicable State of North Carolina Requirements

Certain environmental requirements, including some discussed earlier, have been delegated to State authorities for implementation, enforcement, or oversight. Table 1-2 lists the State of North Carolina environmental requirements.

1.5.4 Permit and Approval Status

Several construction and operating permits must be prepared and submitted, and regulatory approval and/or permits must be received prior to construction or operation of the proposed GLE Facility. Table 1-3 lists the Federal, State, and local permits that may be required and their present status.

Table 1-2 State of North Carolina Environmental Regulations

Law/Regulation	Citation	Requirements
Air Pollution Control Requirements	*15A North Carolina Administrative Code* (NCAC) 02D, authorized by *North Carolina General Statutes* (NCGS) 143, Article 21B, Air Pollution Control[a]	Establishes a system for classifying air pollution sources which the Environmental Management Commission uses to classify air pollution sources it believes to be of sufficient importance to justify classification or control.
Air Quality Permit Procedures	15A NCAC 02Q, authorized by NCGS 143, Article 21B, Air Pollution Control	Establishes the requirements and procedures for applying for construction and operation air quality permits and exceptions to them; incorporates 40 CFR Parts 61 to 80 by reference.
Archaeology and Historic Preservation Section	07 NCAC 04R, authorized by multiple NCGS	Establishes the role of the State Historic Preservation Officer (SHPO), the procedures for archaeological review, and the process for making nominations to the NRHP.
Coastal Management	15A NCAC 07, authorized by NCGS 113A, Article 7, Coastal Area Management	Requires a permit before undertaking any development in any area of environmental concern. Establishes a cooperative program of coastal area management between local and State governments.
Discharges to Isolated Wetlands and Isolated Waters	15A NCAC 02H.1300, authorized by NCGS 143, Article 21, Water and Air Resources	Defines the terms “discharge” and “isolated wetlands” and requires an Individual Permit or a Certificate of Coverage to operate under a General Permit for any regulated discharges to isolated wetlands.
Endangered and Threatened Species	15A NCAC 10I , authorized by NCGS 113, Article 24, Endangered and Threatened Wildlife and Wildlife Species of Special Concern	Bans open seasons for taking any of the species listed as endangered or threatened; establishes permit protocols for taking or possessing an endangered, threatened, or special concern species.
Hazardous Waste Management	15A NCAC 13A, authorized by NCGS 130A, Article 9, Solid Waste Management	Establishes the general requirements for the State’s hazardous waste management program and permit program; adopts applicable RCRA regulations by reference.

Table 1-2 State of North Carolina Environmental Regulations (Cont.)

Law/Regulation	Citation	Requirements
Hazardous Waste Permit Program	15A NCAC 13A.0113, authorized by NCGS 130A, Article 9, Solid Waste Management	Establishes the procedures and requirements for hazardous waste permits; incorporates 40 CFR 270.1 through 270.6 by reference.
Historic Sites Regulation	07 NCAC 04N authorized by NCGS 121, Article 1, General Provisions	Itemizes activities banned from state historic site properties unless specifically authorized via a written work order or permit; describes the permit process.
Human Skeletal Remains	NCGS 70, Article 3, *Unmarked Human Burial and Human Skeletal Remains Protection Act*	Requires cessation of activities disturbing unmarked human burials or human skeletal remains when they are encountered as a result of construction until authorization to resume the activity is received either from the county medical examiner or the State Archaeologist.
Noise	*New Hanover County Code of Ordinances*, Chapter 23, Article II, authorized by GS 153A-133, Noise Regulation	Establishes the lawful decibel levels and corresponding time periods for non-residentially zoned districts.
Point Source Discharges to the Surface Waters	15A NCAC 02H.0100, authorized by NCGS 143, Article 21, Water and Air Resources	Provides the requirements and procedures for application and issuance of State NPDES permits for discharges from outlets, point sources, or disposal systems discharging to the surface waters of the State.
Solid Waste Management Permits	15A NCAC 13B.0200, authorized by NCGS 130A, Article 9, Solid Waste Management	Requires disposal of solid waste in solid waste management facilities permitted for such activity.
Surface Water and Wetland Standards	15A NCAC 02B, authorized by NCGS 143, Article 21, Water and Air Resources	Establishes the rules for the series of State classifications and water quality standards applicable to surface waters and wetlands.

Table 1-2 State of North Carolina Environmental Regulations (Cont.)

Law/Regulation	Citation	Requirements
Waste Not Discharged to Surface Waters	15A NCAC 02T, authorized by NCGS 143, Article 21, Water and Air Resources, and NCGS 130A, Article 11, Wastewater Systems	Establishes the requirements and procedures for application and issuance of permits for systems such as sewer systems, disposal systems, and treatment works that do not discharge to surface waters of the State.
Water Quality Certification	15A NCAC 02H.0500, authorized by NCGS 143, Article 21, Water and Air Resources	Outlines the application and review procedures for activities requiring water quality certifications because they involve discharges into navigable waters.
Water Use Registration and Allocation	15A NCAC 02E, authorized by NCGS 143, Article 21, Water and Air Resources	Establishes the requirements and procedures for registering water withdrawals above certain thresholds and periodic updates of the registration.
Well Abandonment	15A NCAC 02C.0113, authorized by NCGS 87, Article 7, North Carolina Well Construction Act	Establishes the applicable procedures when monitoring wells are abandoned.

[a] 15A = Title; NCAC = *North Carolina Administrative Code*; 02 = Chapter; D = Subtitle. The number following NCGS is the chapter number.

1.5.5 Cooperating Agencies

No Federal, State, or local agencies are cooperating agencies in the preparation of this EIS.

1.5.6 Consultations

As a Federal agency, the NRC is required to comply with the consultation requirements of the *Endangered Species Act of 1973*, the *National Historic Preservation Act of 1966,* and the *Fish and Wildlife Coordination Act of 1934.*

1.5.6.1 *Endangered Species Act of 1973* Consultation

The *Endangered Species Act* (ESA) was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7 of the Act requires consultation with the FWS of the U.S. Department of the Interior or the NMFS of the U.S. Department of Commerce to determine whether endangered and threatened species or their critical habitats are known to be in the vicinity of the proposed action, and to determine whether the proposed Federal action may affect listed species or critical habitat. On May 1, 2009, the NRC sent a letter to the FWS Raleigh Field Office describing the proposed action and requesting a list of threatened and endangered species and critical habitats that could potentially be affected by the proposed action (NRC, 2009b). A similar letter was sent to the NMFS Southeast Regional Office (NRC, 2009d).

Table 1-3 Potentially Applicable Permit and Approval Requirements for the Construction, Operation, and Decommissioning of the Proposed GLE Facility

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
Federal			
Rules of General Applicability to Domestic Licensing of By-product Material, Domestic Licensing of Source Material, and Domestic Licensing of Special Nuclear Material	NRC	10 CFR Parts 30, 40, and 70, authorized by the AEA	The proposed GLE Facility must obtain a license to possess and use source material, special nuclear material, and by-product material; an application for the required license has been submitted.
Section 404 Permit	USACE	40 CFR Part 230, authorized by the CWA	The discharge of dredged or fill material into the waters of the United States would be associated with the proposed GLE Facility; an application for the permit allowing such discharge will be made.
Endangered Species Act Consultation	FWS	50 CFR Part 402, authorized by the ESA	Consultation is complete (see Appendix B).
National Historic Preservation Act Consultation	ACHP	36 CFR Part 800, authorized by the *National Historic Preservation Act*	Consultation is complete (see Appendix B).
State			
Construction and Operating Permit	NCDENR Division of Air Quality	15A NCAC 02Q.0300, Construction and Operation Permits; authorized by NCGS 143, Article 21B, Air Pollution Control	Air emissions from the construction phase of the proposed GLE Facility would be moderate but temporary in nature; air emissions from facility operations are not expected to meet thresholds that would require a CAA major source permit. Application will be made for a construction and operating permit.

Table 1-3 Potentially Applicable Permit and Approval Requirements for the Construction, Operation, and Decommissioning of the Proposed GLE Facility (Cont.)

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
State			
Section 401 Water Quality Certification	NCDENR Division of Water Quality	15A NCAC 02H.0500, authorized by NCGS 143, Article 21, Water and Air Resources	The NRC has not received a Section 401 Water Quality Certification. The proposed GLE Facility will require a CWA Section 404 permit, which is dependent on issuance of a water quality certification; the certification will be sought.
NPDES Individual Permit for Construction Stormwater Management	NCDENR Division of Water Quality	15A NCAC 2H.0100, authorized by NCGS 143, Article 21, Water and Air Resources	Stormwater discharge would be associated with construction of the proposed GLE Facility; an application will be made for an NPDES permit.
NPDES Individual Permit for Stormwater Management (Operations)	NCDENR Division of Water Quality	15A NCAC 2H.0100, authorized by NCGS 143, Article 21, Water and Air Resources	The existing Wilmington Site permit, NCS000022, will be modified to accommodate anticipated increased stormwater discharge associated with operation of the proposed GLE Facility.
NPDES Individual Permit for Industrial and Sanitary Waste Treatment	NCDENR Division of Water Quality	15A NCAC 02T.0100, authorized by NCGS 143, Article 21, Water and Air Resources	The existing Wilmington Site final process lagoon and sanitary wastewater treatment facilities would be used to process wastewater and sanitary wastewater from the proposed GLE Facility. The existing Wilmington Site permit, NC0001228, will be modified.
Isolated Wetlands Permit	NCDENR Division of Water Quality	15 NAC 02H.1300, authorized by NCGS 143, Article 21, Water and Air Resources	A permit will be requested if impacts on isolated wetlands would result from construction or operations as apparent from the final facility design.

Table 1-3 Potentially Applicable Permit and Approval Requirements for the Construction, Operation, and Decommissioning of the Proposed GLE Facility (Cont.)

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
State			
Hazardous Waste Generator Identification Number	NCDENR Division of Waste Management	15A NCAC 13A.0107(a), authorized by NCGS 130A, Article 9, Solid Waste Management	The proposed GLE Facility will produce hazardous waste at volumes requiring a generator identification number; application for the number will be made unless the proposed GLE Facility is determined to be contiguous with the existing GNF-A facility and can operate under the same number.
Coastal Area Management Act Certification	NCDENR Division of Coastal Management	15A NCAC 7, authorized by NCGS 113A, Article 7, Coastal Area Management	The NRC has not received a CZMA consistency certification.
Driveway and Right-of-Way Permits	North Carolina Department of Transportation	19A NCAC 02B.0602, authorized by NCGS 136, Article 6D, Controlled Access Facilities	An entrance off NC 133 (Castle Hayne road) to the proposed GLE Facility is planned and would require a driveway permit; the permit will be requested.
Local Agencies			
Tree Removal Permit or Letter of Exemption	New Hanover County	Zoning Ordinance, Article VI, Supplementary District Regulations	If the final design for the proposed GLE Facility requires the removal of significant or regulated trees, a tree removal permit or a letter of exemption from the County Zoning Administrator will be required; if required, it will be requested.
Land-Disturbing Permit	New Hanover County	Chapter 23, Article VI, Erosion and Sedimentation	The proposed GLE Facility would disturb more than 0.4 ha (1 ac) of land, thereby triggering the need for an approved erosion and sedimentation control plan and permit; a permit will be requested.

Table 1-3 Potentially Applicable Permit and Approval Requirements for the Construction, Operation, and Decommissioning of the Proposed GLE Facility (Cont.)

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
Local Agencies			
Stormwater Permit	New Hanover County	Chapter 23, Article VII, Stormwater Management	The proposed GLE Facility must comply with the county stormwater ordinance; the permit will be requested.
Floodplain Development Permit	New Hanover County	Chapter 29, Article II, Flood Hazard Reduction	If the final facility design includes development of the proposed GLE Facility within areas of special flood hazard lying within the regulatory jurisdiction of the county, a permit may be required.

By letter dated June 8, 2009, the FWS Raleigh Field Office indicated that nine listed species are present in New Hanover County and that several of the species may occur in the area of the Wilmington Site (FWS, 2009). The FWS indicated that it wanted those species to be considered in the EIS, and this letter was discussed in a teleconference with FWS on August 26, 2009. By letter dated August 10, 2010, the FWS Raleigh Field Office submitted comments on the draft EIS and concluded that "the requirements of section 7(a)(2) of the ESA have been satisfied" (FWS, 2010). By e-mail sent August 3, 2009, the NMFS provided information on the protected species under its purview that may occur in the area of the Wilmington Site (NOAA, 2009).

The NRC determined that there would be no effect on protected species under the purview of NMFS (NRC, 2010b). By e-mail sent April 20, 2011, the NMFS indicated that no-effect determinations made by Federal agencies do not require ESA consultation with (or concurrence by) NMFS (NOAA, 2011).

1.5.6.2 *National Historic Preservation Act of 1966* Section 106 Consultation

The *National Historic Preservation Act* (NHPA) was enacted to create a national historic preservation program, including the *National Register of Historic Places* (NRHP) and the Advisory Council on Historic Preservation (ACHP). Section 106 requires Federal agencies to take into account the effects of their undertakings on historic properties. The ACHP regulations implementing Section 106 of the Act are found in 36 CFR Part 800. The regulations call for public involvement in the Section 106 consultation process, including American Indian tribes and other interested members of the public, as applicable. In response to an April 29, 2009, letter from the NRC (NRC, 2009a), the North Carolina Department of Cultural Resources confirmed via a letter dated June 2, 2009, that an archeological site was eligible for listing on the NRHP (NCDCR, 2009). On September 2, 2009, the NRC sent letters to 16 American Indian tribes inquiring if the tribes believed the site under consideration had any traditional cultural or religious significance (see Section 9.2 for a list of the tribes that were contacted, and

Appendix B for copies of the communications). None of the tribes indicated that they had any concerns. On March 28, 2011, the NRC informed the North Carolina SHPO that a license condition addressing the consideration of significant historic and cultural resources on the GLE property would be part of the license issued to GLE, if it were issued (NRC, 2011a). The SHPO responded on April 5, 2011, stating that with inclusion of the license condition, a determination of no adverse effect is appropriate for the proposed project (NCDCR, 2011).

1.5.6.3 *Fish and Wildlife Coordination Act of 1934*

The consultation component of the *Fish and Wildlife Coordination Act* requires that "whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license, such department or agency first shall consult with the U.S. Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular State wherein the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources as well as providing for the development and improvement thereof in connection with such water-resource development." Because the proposed action does not involve such modifications to a stream or other body of water, the NRC is not implementing consultations under the *Fish and Wildlife Coordination Act.* The NRC has completed consultation with the FWS and the State agency that exercises administrative control over the wildlife resources under the ESA, as noted in Section 1.5.6.1.

1.6 Organizations Involved in the Proposed Action

Two organizations have specific roles in the implementation of the proposed action:

- GE-Hitachi Global Laser Enrichment LLC (abbreviated as GLE for the purposes of this EIS) is the NRC license applicant. If the license is granted, GLE would be the holder of an NRC license for the possession and use of special nuclear, source, and by-product material at the proposed GLE Facility. GLE would be responsible for constructing, operating, and decommissioning the proposed facility in compliance with that license and applicable NRC regulations.

- GLE is a Delaware limited liability company. It currently is the only subsidiary of majority owner GE-Hitachi (GEH) Nuclear Energy Americas, LLC, a global supplier of nuclear energy-related equipment and services. GEH, also a Delaware limited liability company, is a wholly owned subsidiary of GE-Hitachi Nuclear Energy Holdings LLC (Holdings). Holdings is a subsidiary of majority owner GENE Holding LLC (GENE), a Delaware limited liability company wholly owned by GE, a U.S. corporation, and of minority owner Hitachi America, Ltd., which is a wholly owned subsidiary of Hitachi Ltd., a Japanese corporation. Cameco Enrichment Holdings, LLC ("Cameco Enrichment"), has a 24 percent ownership interest in GLE, and GENE owns 13.5 percent of GLE. Cameco Enrichment is a Delaware limited liability company wholly owned by Cameco U.S. Holdings, Inc., a Nevada corporation, which is in turn wholly owned by Cameco Corporation, a Canadian corporation (GLE, 2009a). The foreign ownership, control, and influence issue is beyond the scope of this EIS but will be addressed by the NRC.

The NRC is the licensing agency. The NRC has the responsibility to evaluate the license application for compliance with the NRC regulations associated with uranium enrichment facilities. These include standards for protection against radiation in 10 CFR Part 20 and requirements in 10 CFR Parts 70, 40, and 30 that would authorize GLE to possess and use special nuclear material, source material, and by-product material, respectively, at the proposed GLE Facility. The NRC is responsible for regulating activities performed within the proposed GLE Facility through its licensing review process and subsequent inspection program. To fulfill the NRC responsibilities under NEPA, the environmental impacts of the proposed action are evaluated in accordance with the requirements of 10 CFR Part 51 and documented in this EIS.

1.7 References

(AES, 2008) AREVA Enrichment Services, LLC. "Eagle Rock Enrichment Facility, Application for a Uranium Enrichment Facility License under 10 CFR 70, 'Domestic Licensing of Special Nuclear Material.' " December. ADAMS Accession No. ML090300656.

(Bellemare, 2003) Bellemare, B. "What Is a Megawatt?" UtiliPoint International Inc. June 24. <http://www.utilipoint.com/2003/06/what-is-a-megawatt/> (Accessed January 23, 2012).

(DOE, 2002) U.S. Department of Energy. Letter from W.J. Magwood, IV (U.S. Department of Energy) to M.J. Virgilio (U.S. Nuclear Regulatory Commission), dated July 25. "Subject: DOE Comments on General Policy Issues Raised by Louisiana Energy Services (LES) in Preparation for Enrichment Plant License Application." ADAMS Accession No. ML022350130.

(DOE, 2007) U.S. Department of Energy. "Uranium Enrichment Decontamination & Decommissioning Fund 2007 Report to Congress." ADAMS Accession No. ML103490664.

(DOE, 2010a) U.S. Department of Energy, Portsmouth/Paducah Project Office. "Portsmouth Plant History." January. <http://www.pppo.energy.gov/port_history.html> (Accessed January 28, 2010).

(DOE, 2010b) U.S. Department of Energy, National Nuclear Security Administration. "Highly Enriched Uranium Disposition." <http://nnsa.energy.gov/aboutus/ourprograms/nonproliferation/materialremovaldisposition/highlyenricheduraniumdisposition> (Accessed January 28, 2010).

(DOE 2010c) U.S. Department of Energy. Loan Programs Office. Press Release: "DOE Offers Conditional Loan Guarantee for Front End Nuclear Facility in Idaho." May 20. <https://lpo.energy.gov/wp-content/uploads/2010/09/052010.pdf> (Accessed February 6, 2012).

(EIA, 2003) Energy Information Administration, U.S. Department of Energy. "U.S. Nuclear Fuel Cycle Projections 2000-2025." January. ADAMS Accession No. ML101790059.

(EIA, 2010) Energy Information Administration, U.S. Department of Energy. "Annual Energy Outlook 2010 with Projections to 2035." DOE/EIA-0383(2010). April. ADAMS Accession No. ML103480627.

(EIA, 2011) Energy Information Administration, U.S. Department of Energy. "Uranium Marketing Annual Report." May. <http://www.eia.gov/FTPROOT/nuclear/umar2010.pdf> (Accessed February 6, 2012).

(FWS, 2009) U.S. Fish and Wildlife Service. Letter from H. Hall (U.S. Fish and Wildlife Service) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 8. "Subject: Docket No. 70-7016; General Electric-Hitachi Global Laser Enrichment Facility, New Hanover County, North Carolina." ADAMS Accession No. ML091700024.

(FWS, 2010) U.S. Fish and Wildlife Service. Letter from H. Hall (U.S. Fish and Wildlife Service) to K. Hsueh (U.S. Nuclear Regulatory Commission) dated August 10. "Subject: Comments on the Draft Environmental Impact Statement (DEIS) for the Proposed GE-Hitachi Global Laser Enrichment (GLE) LLC Facility in Wilmington, North Carolina." ADAMS Accession No. ML102420377.

(GLE, 2008a) GE-Hitachi Global Laser Enrichment LLC. "Environmental Report for the GLE Commercial Facility, Revision 0." December. ADAMS Accession No. ML090910573.

(GLE, 2008b) GE-Hitachi Global Laser Enrichment LLC. Letter from T.G. Orr (GE-Hitachi Global Laser Enrichment LLC) to M. Weber (U.S. Nuclear Regulatory Commission) dated December 8. "Subject: Request for Exemption from 10 CFR §§70.4 and 70.23(a)(7) Requirements Governing 'Commencement of Construction'." ADAMS Accession No. ML090350201.

(GLE, 2009a) GE-Hitachi Global Laser Enrichment LLC. Letter from T.G. Orr (GE-Hitachi Global Laser Enrichment LLC) to M. Weber (U.S. Nuclear Regulatory Commission) dated June 26. "Subject: GE-Hitachi Global Laser Enrichment LLC License Application Submittal." ADAMS Accession No. ML091870998.

(GLE, 2009b) GE-Hitachi Global Laser Enrichment LLC. "Global Laser Enrichment Environmental Report Supplement 1 – Early Construction." July. ADAMS Accession No. ML092100528.

(GLE, 2009c) GE-Hitachi Global Laser Enrichment LLC. "Global Laser Enrichment Environmental Report Supplement 2." November. ADAMS Accession No. ML093240935.

(GLE, 2009d) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 5. "Subject: GE-Hitachi Global Laser Enrichment Response to Request for Additional Information Related to NRC Review of GLE Environmental Report." ADAMS Accession No. ML093170517.

(GLE, 2009e) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 5. "Subject: GE-Hitachi Global Laser Enrichment Response to Request for Additional Information (Security-Related Information) Related to NRC Review of GLE Environmental Report." ADAMS Accession No. ML093200138.

(GLE, 2009f) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 11. "Subject: GE-Hitachi Global Laser Enrichment Response (#2) to Request for Additional Information Related to NRC Review of GLE Environmental Report." ADAMS Accession No. ML093220060.

(GLE, 2009g) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 11. “Subject: GE-Hitachi Global Laser Enrichment Response (#2 Proprietary Information) to Request for Additional Information Related to NRC Review of GLE Environmental Report.” ADAMS Accession No. ML093220067.

(GLE, 2009h) GE-Hitachi Global Laser Enrichment LLC. Letter from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to J. Davis (U.S. Nuclear Regulatory Commission) dated November 23. “Subject: Submittal of Corrected Response to RAI 4-1-A.” ADAMS Accession No. ML093270378.

(GLE, 2009i) GE-Hitachi Global Laser Enrichment LLC. Letter from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 24. “Subject: Submittal of Air Quality Responses from October 7, 2009 Request for Additional Information.” ADAMS Accession Nos. ML093280887 and ML093280889.

(GLE, 2009j) GE-Hitachi Global Laser Enrichment LLC. Letter from A.E. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to B. Smith (U.S. Nuclear Regulatory Commission) dated December 28. “Subject: Response to Request for Additional Information Dated November 19, 2009 for Global Laser Enrichment License Application – Public Responses.” ADAMS Accession Nos. ML093620823 and ML093620841.

(GLE, 2011) GE-Hitachi Global Laser Enrichment LLC. Letter from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to J. Davis (U.S. Nuclear Regulatory Commission) dated January 17. “Subject: Response to Questions from Telecon Held on January 5, 2011, Regarding the Global Laser Enrichment Environmental Report.” ADAMS Accession No. ML110460567.

(GLE, 2012) GE-Hitachi Global Laser Enrichment LLC. Personal communication from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to J. Davis (U.S. Nuclear Regulatory Commission) dated February 6. "Subject: Transportation Table 4.2.1." ADAMS Accession No. ML120440072.

(NCDCR, 2009) North Carolina Department of Cultural Resources, State Historic Preservation Office. Letter from P. Sandbeck (State Historic Preservation Office) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 2. “Subject: Initiation of the National Historic Preservation Act Section 106 Process for General Electric-Hitachi Global Laser Enrichment Proposed Uranium Enrichment Facility, New Hanover County, ER 07-2157.” ADAMS Accession No. ML091630258.

(NCDCR, 2011) North Carolina Department of Cultural Resources, State Historic Preservation Office. Letter from R. Gledhill-Earley (State Historic Preservation Office) to K. Hsueh (U.S. Nuclear Regulatory Commission) dated April 5. “Re: General Electric-Hitachi Laser-Based Uranium Enrichment Facility near Wilmington, Docket 70-7016, New Hanover County, ER 07-2157.” ADAMS Accession No. ML110950680.

(NOAA, 2009) National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Personal communication from A. Herndon (NOAA Fisheries) to A. Kock (U.S. Nuclear Regulatory Commission) dated August 3. “NOAA Fisheries Protected Species Information.” ADAMS Accession No. ML092170775.

(NOAA, 2011) National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Personal communication from A. Herndon (NOAA Fisheries) to J. Cushing (U.S. Nuclear Regulatory Commission) dated April 20. "NRC's Determination Re: the General Electric-Hitachi Laser-Based Uranium Enrichment." ADAMS Accession No. ML111110808.

(NRC, 2003) U.S. Nuclear Regulatory Commission. "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs." NUREG-1748. August. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1748/sr1748.pdf> (Accessed January 29, 2010).

(NRC, 2005a) U.S. Nuclear Regulatory Commission. "Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico." NUREG-1790. June. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/> (Accessed March 26, 2009).

(NRC, 2005b) "Louisiana Energy Services, L.P." CLI-05-28. November. ADAMS Accession No. ML053250203.

(NRC, 2006a) U.S. Nuclear Regulatory Commission. "Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio, Final Report." NUREG-1834. April. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/> (Accessed March 26, 2009).

(NRC, 2006b) "USEC Inc." CLI-06-10. April. ADAMS Accession No. ML060930763.

(NRC, 2007) U.S. Nuclear Regulatory Commission. "Amergen Energy Company LLC" CLI-07-08. February. ADAMS Accession No. ML070570511.

(NRC, 2008) U.S. Nuclear Regulatory Commission. "Stages of the Nuclear Fuel Cycle." November 21. <http://www.nrc.gov/materials/fuel-cycle-fac/stages-fuel-cycle.html> (Accessed August 18, 2009).

(NRC, 2009a) U.S. Nuclear Regulatory Commission. Letter from A. Kock (U.S. Nuclear Regulatory Commission) to P. Sandbeck (North Carolina State Historic Preservation Office) dated April 29. "Subject: Initiation of the National Historic Preservation Act Section 106 Process for General Electric-Hitachi Global Laser Enrichment Uranium Enrichment Facility (State Historic Preservation Office Tracking Number ER 07-2157)." ADAMS Accession No. ML91100104.

(NRC, 2009b) U.S. Nuclear Regulatory Commission. Letter from A. Kock (U.S. Nuclear Regulatory Commission) to P. Benjamin (U.S. Fish and Wildlife Service) dated May 1. "Subject: Request for Information Regarding Endangered Species and Critical Habitats for General Electric-Hitachi Global Laser Enrichment Proposed Uranium Enrichment Facility in New Hanover County, North Carolina." ADAMS Accession No. ML091100107.

(NRC, 2009c) U.S. Nuclear Regulatory Commission. Letter from D.H. Dorman (U.S. Nuclear Regulatory Commission) to A.E. Kennedy (GE-Hitachi Global Laser Enrichment LLC) dated May 8. "Subject: Approval of GE-Hitachi Exemption Request Related to Commencement of Construction." ADAMS Accession No. ML083510647.

(NRC, 2009d) U.S. Nuclear Regulatory Commission. Letter from A. Kock (U.S. Nuclear Regulatory Commission) to D. Bernhart (NOAA Fisheries) dated June 18. “Subject: Request for Information Regarding Endangered or Threatened Species and Critical Habitat Relevant to the Proposed General Electric-Hitachi Global Laser Enrichment (GLE) Commercial Facility.” ADAMS Accession No. ML091660481.

(NRC, 2010a) U.S. Nuclear Regulatory Commission. Letter from M. Bailey (U.S. Nuclear Regulatory Commission) to S.A. Toelle (United States Enrichment Corporation) dated September 9. “Subject: Approval of Certificate Amendment Request Regarding Deletion of Technical Safety Requirements for Facilities at Portsmouth Gaseous Diffusion Plant (TAC No. L32746).” ADAMS Accession No. ML102250346.

(NRC, 2010b) U.S. Nuclear Regulatory Commission. Letter from K. Hsueh (U.S. Nuclear Regulatory Commission) to D. Bernhart (NOAA Fisheries) dated June 17. “Subject: Notification of the Issuance of and Request for Comments on the Draft Environmental Impact Statement for the Proposed General Electric-Hitachi Laser-Based Uranium Enrichment Facility Near Wilmington, North Carolina.” ADAMS Accession No. ML101260503.

(NRC, 2011a) U. S. Nuclear Regulatory Commission. Letter from K. Hsueh (U.S. Nuclear Regulatory Commission) to R. Gledhill-Earley (North Carolina State Historic Preservation Office) dated March 28. “Subject: General Electric-Hitachi Laser-Based Uranium Enrichment Facility Near Wilmington, North Carolina (State Historic Preservation Office Tracking Number ER 07-2157).” ADAMS Accession No. ML 110840685.

(NRC, 2011b) U.S. Nuclear Regulatory Commission. Letter from A. Hsia (U.S. Nuclear Regulatory Commission) to S. Shakir (AREVA Enrichment Services LLC) dated October 12, “Subject: License for the AREVA Enrichment Services Eagle Rock Enrichment Facility.” ADAMS Accession No. ML111650384.

(NRC, 2011c) U.S. Nuclear Regulatory Commission. Letter from J. Kinneman (U.S. Nuclear Regulatory Commission) to R. Van Namen (United States Enrichment Corporation) dated October 12. “Subject: Part 76 Certificate of Compliance Termination for the United States Enrichment Corporation, Portsmouth Gaseous Diffusion Plant (TAC No. L32771).” ADAMS Accession No. ML11257A078.

(Urenco, 2008) URENCO. Press Release: “National Enrichment Facility Expansion.” December 12. <http://www.urenco.com/content/169/National-Enrichment-Facility-expansion.aspx> (Accessed February 1, 2010).

(U.S. Congress, 2010) U.S. Congress. Hearing Transcripts from Hearing before the Subcommittee on Energy of the Committee on Energy and Natural Resources, United States Senate, One Hundred Eleventh Congress, Second Session on S. 679, S. 3251, S.2900, S. 3396, S. 3233, S. 3460. June 15, 2010.

(USEC, 2007) USEC, Inc. News Release: “USEC Updates Cost Estimate and Schedule for American Centrifuge Plant.” February 12. <http://www.usec.com/news/usec-updates-cost-estimate-and-schedule-american-centrifuge-plant> (Accessed February 6, 2012).

(USEC, 2009) USEC, Inc. “What’s a SWU?” <http://www.usec.com/whatisaswu.htm> Document no longer available online.

(USEC, 2010) USEC, Inc. “Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange act of 1934 for the Fiscal Year Ended December 31, 2009.” March 1. <http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9MzcxMTE0fENoaWxkSUQ9MzY4MDY0fFR5cGU9MQ==&t=1> (Accessed June 4, 2010).

(USEC, 2011a) USEC, Inc. News Release: “USEC’s Supply Agreement with TENEX Takes Effect.” December 21. <http://www.usec.com/news/usec%E2%80%99s-supply-agreement-tenex-takes-effect> (Accessed January 31, 2012).

(USEC, 2011b) USEC, Inc. News Release: “Megatons to Megawatts Eliminates Material for 17,000 Nuclear Warheads.” August 24. <http://www.usec.com/news/megatons-megawatts-eliminates-material-17000-nuclear-warheads> (Accessed January 31, 2012).

2 ALTERNATIVES

This chapter describes and compares the proposed action and alternatives. As discussed in Chapter 1, the proposed action is for General Electric (GE)-Hitachi Global Laser Enrichment, LLC (GLE) to construct, operate, and decommission a laser-based uranium enrichment facility near Wilmington, North Carolina. To allow the proposed action, the U.S. Nuclear Regulatory Commission (NRC) would need to grant GLE a license to possess and use special nuclear material, source material, and byproduct material at the proposed Global Laser Enrichment Facility. The NRC also evaluated the no-action alternative in this EIS. Under the no-action alternative, GLE would not construct, operate, or decommission the proposed GLE Facility. Therefore, the no-action alternative provides a basis for evaluating and comparing the potential impacts of the proposed action. In addition to the proposed action and alternatives to the proposed action, alternatives for the disposition of depleted uranium hexafluoride (UF_6) resulting from enrichment operations over the lifetime of the proposed GLE Facility are also analyzed.

Section 2.1 presents technical details of the proposed action and connected actions, including descriptions of the proposed site, laser enrichment technology, facilities to be constructed, and the activities at the proposed GLE Facility. The activities are grouped under preconstruction and construction, operation, and decontamination and decommissioning. Section 2.2 describes the no-action alternative and provides a comparison of predicted environmental impacts for the proposed action and no-action alternatives. Section 2.3 discusses alternatives to the proposed action that were considered but not analyzed in detail, including alternative sites, enrichment technologies other than the proposed laser technology, and use of alternate sources of enriched uranium. Gas centrifuge technology is discussed in Section 2.3.4, along with a comparison of the potential impacts of the laser-based and gas centrifuge technologies. The chapter concludes with a recommendation from the NRC regarding the proposed action (Section 2.4).

2.1 Proposed Action

The proposed action is for GLE to construct, operate, and decommission a laser-based uranium enrichment facility near Wilmington, North Carolina. To allow the proposed action, NRC would need to grant GLE a license to possess and use special nuclear material, source material, and byproduct material. The initial NRC license, if granted, would be for a period of 40 years, after which GLE would request renewal of the license or begin decommissioning of the facility. GLE could begin preconstruction activities prior to the licensing decision in 2012, under an exemption granted by NRC (see Section 1.4.1). If granted, GLE would begin construction of the proposed GLE Facility (anticipated in 2012), commence commercial enrichment operations in 2014, and increase to the initial maximum target production capacity of 6 million separative work units (SWU) by 2020, at an enrichment of up to 8 percent uranium-235 by weight. Although there is currently no demand for enrichment greater than 5 percent, GLE believes that there is potential for future demand to change (GLE, 2009c).

Section 2.1.1 describes the location of the proposed site. The proposed facility and GLE's laser-based enrichment process are described in Section 2.1.2 and the management options for management of the depleted UF_6 tails generated at the proposed facility are reviewed in Section 2.1.3. Section 2.1.4 describes the anticipated decontamination and decommissioning activities at the proposed facility and Section 2.1.5 provides the projected timelines for the three phases of the proposed action.

2.1.1 Location and Description of Proposed Site

The GE property, on which the proposed GLE Facility would be sited, is located in an unincorporated area of New Hanover County, North Carolina, the most populated of three counties that comprise the Wilmington Metropolitan Statistical Area. The site is located approximately 10 kilometers (6 miles) north of Wilmington, North Carolina, and is hereafter referred to as the Wilmington Site. Figures 1-1 and 1-2 show the location of the Wilmington Site in relation to the surrounding counties and municipalities.

The Wilmington Site consists of approximately 656 hectares (1621 acres), and GE owns an additional 10 hectares (24 acres) to the east of the site. Figure 2-1 shows the Wilmington Site and the location of GE's existing principal manufacturing facilities (namely, the Global Nuclear Fuel-Americas [GNF-A] Fuel Manufacturing Operation [FMO] facility and the GE Aircraft Engines/Services Components Operation [AE/SCO] facility). The land to the west of the Wilmington Site (across the Northeast Cape Fear River) is dominated by industrial use, and the area to the north and northwest is privately owned and used for timber management and private hunting. The areas to east and south of the site are dominated by residential development. The southeast corner of the site borders Interstate 140 (I-140) (GLE, 2008).

The proposed GLE Facility would occupy approximately 40 hectares (100 acres) of the North-Central Site Sector. A North access road would be built along the northeast portion of the Eastern Site Sector to connect the proposed GLE Facility to NC Route 133, using existing site road service where practical (Figure 2-2).

The nearest major population center is Skippers Corner, approximately 1 kilometer (0.6 mile) northeast of the site boundary on NC Route 133 (Castle Hayne Road). The distance from the proposed GLE Facility to the nearest member of the public (i.e., actual permanent residence) is about 1352 meters (0.84 mile). The environmental characteristics of the proposed site and surrounding areas are described in detail in Chapter 3 of this EIS.

The Wilmington Site is served by two of southeastern North Carolina's major highway systems: Interstate 40 (I-40) ("Outer Loop Freeway") and U.S. Route 17 (see Figure 1-2). The site can be accessed by two access roads (south access road and north access road) from Castle Hayne Road (NC Route 133) just north of the junction of I-140 and Castle Hayne Road (GLE, 2008).

The Wilmington Site does not have rail access (and GLE does not anticipate the use of freight rail for shipping needs), but freight service to the region is provided by CSX Transportation, Inc.; the primary rail service foci are the Port of Wilmington and Military Ocean Terminal Sunny Point (MOTSU).

2.1.2 Description of the Proposed GLE Facility

Figure 2-2 shows the location of the GLE study area, which includes the proposed GLE Facility site and the areas that would be disturbed by preconstruction and construction activities. The proposed facility would comprise various buildings and areas that house systems and equipment necessary to support the uranium enrichment process. These buildings and areas would include the operations building and UF_6 storage areas. UF_6 would be stored temporarily onsite as normal feed material to the enrichment process and as depleted UF_6 and enriched

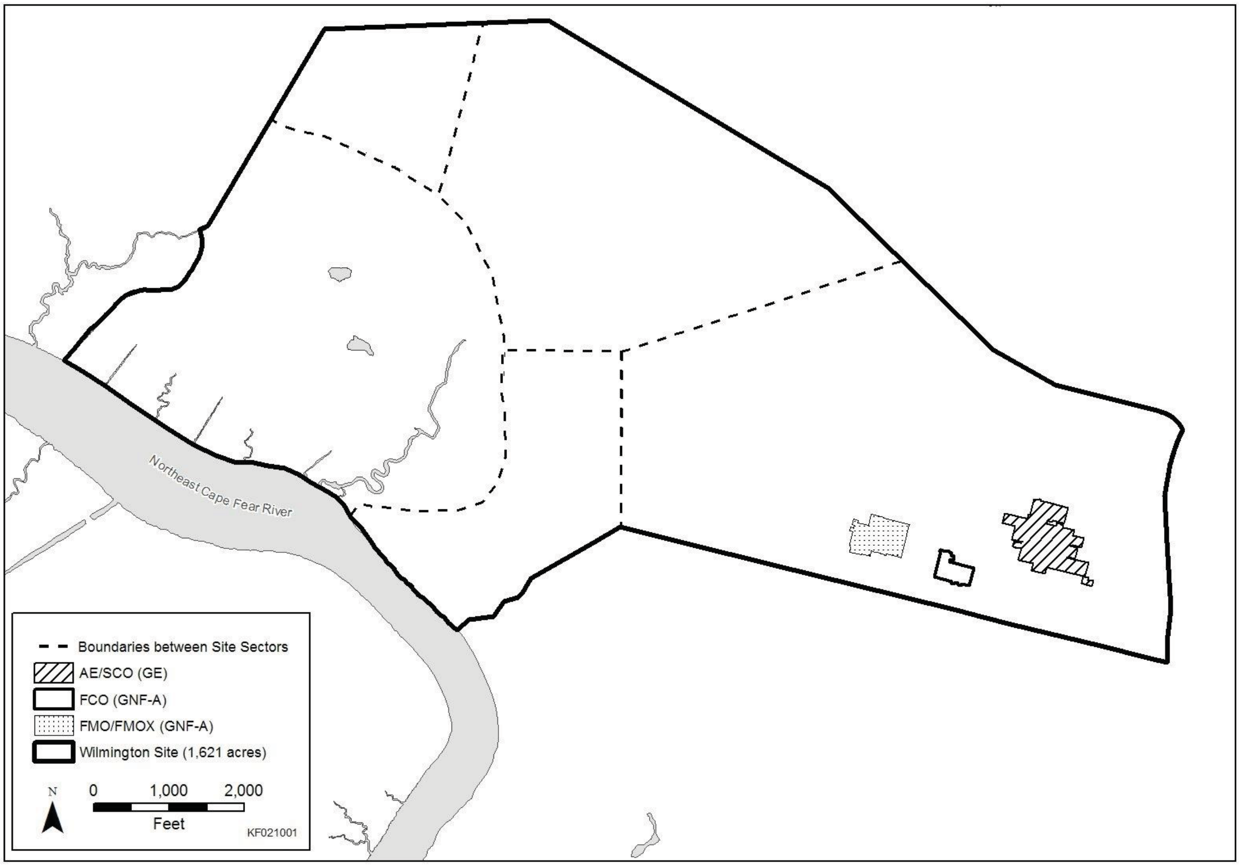


Figure 2-1 Schematic of the Existing Wilmington Site (GLE, 2008)

product UF_6 after the enrichment process. There would be other ancillary and support buildings and areas onsite.

Primary facilities are those critical to the enrichment process, while secondary facilities provide indirect support to the process. These facilities are described in Sections 2.1.2.1 and 2.1.2.2, respectively. These sections are followed by summary descriptions of the laser-based enrichment process proposed by GLE (Section 2.1.2.3), Waste Management Systems (Section 2.1.2.4), and Liquid and Air Effluents (Section 2.1.2.5).

2.1.2.1 Primary Facilities

The primary facilities include an operations building and six cylinder storage pads where licensed material would be used or stored; these are considered to be key facilities in support of the uranium enrichment process. The primary facilities are located or would be constructed adjacent to each other in the North-Central Site Sector. Technical details regarding primary facilities are presented in Appendix H. This information is considered proprietary and contains security-related information and will not be disclosed in this EIS.

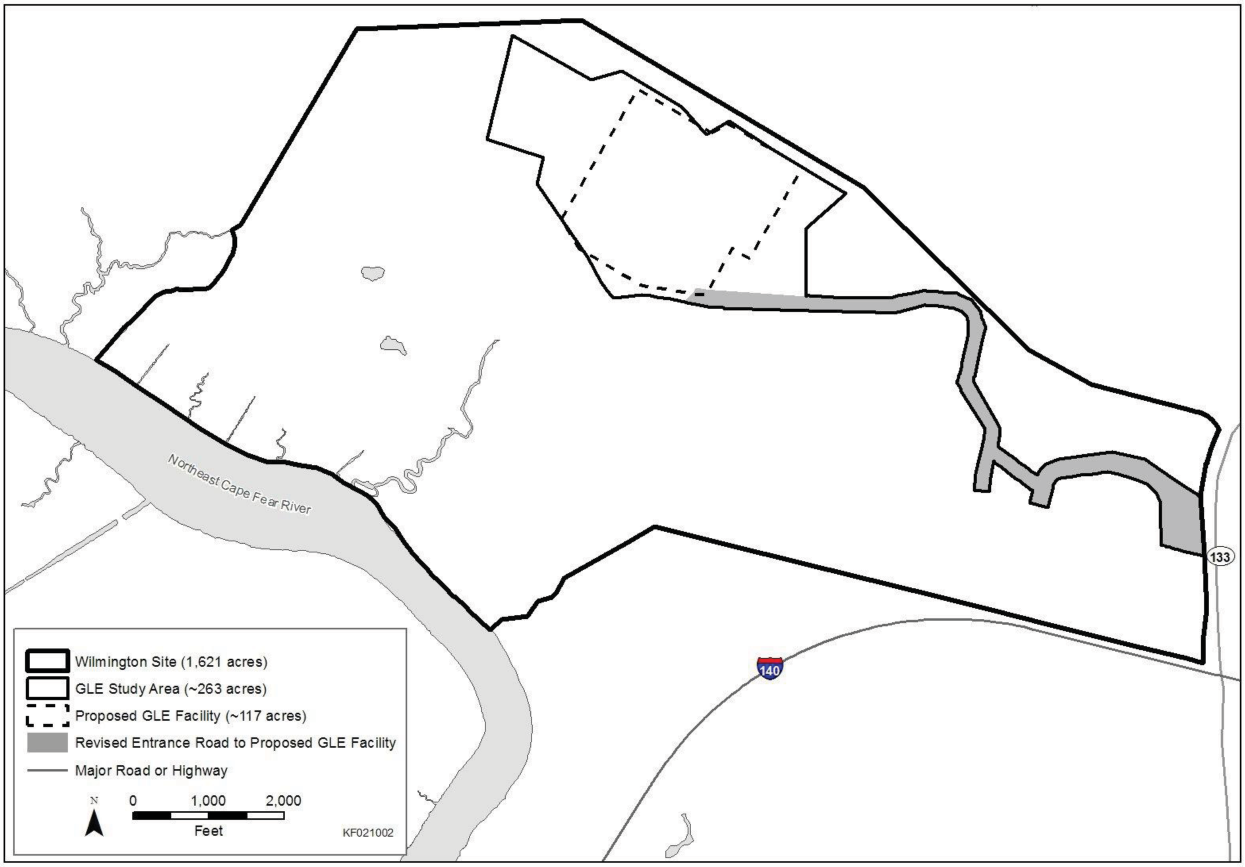


Figure 2-2 Location of Proposed GLE Facility at the Wilmington Site (GLE, 2009b)

Operations Building

The primary purpose of the operations building would be to house the laser equipment and support systems necessary to perform the actual enrichment process. The Operations Building would include the following process and support areas:

- Cylinder Shipping and Receiving Area
- UF_6 Feed and Vaporization Area
- Product Withdrawal Area
- Tails Withdrawal Area
- Cascade/Gas Handling Area
- Blending Area
- Sampling Area
- Radioactive Waste Area

- Heating, Ventilation, and Air Conditioning (HVAC) Equipment Area
- Decontamination/Maintenance Area
- Laboratory Area
- Laser Area

The functional descriptions of these areas are summarized below, based on the information provided in Chapter 1 of the License Application (GLE, 2009a).

Cylinder Shipping and Receiving Area

The operations performed in this area would include:

- receipt of feed UF_6 cylinders from offsite
- weighing the feed cylinders and performing other material control functions
- providing interim storage of feed, product, and depleted UF_6 cylinders
- preparing the product and full depleted UF_6, and empty cylinders for transfer to other locations onsite such as the UF_6 Cylinder Pads or offsite

Feed and Vaporization Area

The UF_6 Feed and Vaporization Area would contain the necessary equipment to perform the following operations:

- receive UF_6 feed cylinders from the Cylinder Shipping and Receiving Area
- vaporize the UF_6 contained within the feed cylinders
- feed the vaporized UF_6 to the feed header between the Vaporization Area and the Cascade/Gas Handling Area within the Operations Building

The UF_6 feed rates to the feed header would be maintained within the design basis temperature and pressure range. The residual UF_6 from the emptied feed cylinders (known as heels) would be sufficiently recovered to meet U.S. Department of Transportation (DOT) offsite cylinder shipping requirements for empty cylinders.

Product Withdrawal Area

In the Product Withdrawal Area, the empty to-be-filled cylinders would be received from interim storage within the Cylinder Shipping and Receipt Area and would be filled with the enriched UF_6 product.

Tails Withdrawal Area

This area would be used to receive empty cylinders from interim storage within the Cylinder Shipping and Storage Area, and fill them with the tails (depleted UF_6) for interim storage and later disposition.

Cascade/Gas Handling Area

The Cascade/Gas Handling Area is where the enrichment process would occur. The UF_6 gas would be exposed to laser-emitted light and two process streams are generated; one enriched in uranium-235 and one depleted in uranium-235. The enriched stream would go to the Product Withdrawal Area and the depleted stream would be sent to the Tails Withdrawal Area.

Blending Area

The Blending Area is where the product cylinders that meet the customer specifications would be filled. This would be accomplished by mixing the right quantities of enriched product at different enrichment levels to produce the exact enrichment level required by customers. The 76- or 122-centimeter (30- or 48-inch) cylinders that would contain the original product (called donor cylinders) would be received from interim storage within the Cylinder Shipping and Receiving Area. The UF_6 within the donor cylinders would be vaporized and fed into the receiver cylinders that would be sent to customers.

Sampling Area

In the Sampling Area, the receiver cylinders would be sampled to assure that the enrichment level of UF_6 in the filled cylinders meets the customer specifications. The cylinders would be heated and the UF_6 would be liquefied before samples were taken. This would be the only place in the proposed GLE Facility where conversion of solid UF_6 to liquid UF_6 would take place.

Liquid and Solid Radioactive Waste Areas

The various processes and operations that would take place in the proposed GLE Facility would likely generate quantities of radiologically contaminated, potentially contaminated, and non-contaminated liquid and solid waste streams. The equipment and processes used to temporarily store, treat as appropriate, and prepare for offsite shipment of liquid and solid wastes are described in Section 2.1.2.4. Section 2.1.2.5 discusses the systems used to control liquid emissions from the proposed GLE Facility.

HVAC Equipment Areas

Various heating and ventilation systems throughout the operations building would be used to control the environmental conditions such as the pressure, temperature, humidity, and airflow in different parts of the building to meet requirements for personnel, process equipment, and supporting systems and utilities. The systems used to control atmospheric air emissions are discussed in Section 2.1.2.5.

Decontamination/Maintenance Area

The Decontamination/Maintenance Area would provide a place for personnel to remove contamination from, and make repairs to, equipment and process components used in various parts of the GLE Facility.

Laboratory Area

The Laboratory Area would contain the various onsite laboratories used to analyze the samples taken at the proposed GLE Facility. The analyses performed would include wet chemistry and safety and regulatory testing and analysis.

Laser Area

All necessary equipment needed to operate the laser systems that are part of the GLE laser-based enrichment technology would be located in this area.

UF_6 Cylinder Pads

There would be three UF_6 Cylinder Pads at the proposed GLE Facility:

- The Product Pad, which would occupy approximately 4462 square meters (48,000 square feet) and be used to store enriched product in 76-centimeter (30-inch) cylinders.

- The In-Process Pad, which would occupy approximately 12,084 square meters (130,000 square feet) and be used to store feed material and cylinders emptied on site (with or without heels).

- The Tails Pad, which would occupy approximately 43,224 square meters (465,000 square feet) and be designed to store 122-centimeter (48-inch) cylinders containing tails (depleted UF_6). This pad would be sized to accommodate the tails cylinders resulting from 10 years of facility operation (9000 cylinders).

All of the pads would be constructed to provide for rainwater drainage to the edges of the pads. Saddles would be used to store the cylinders and, except for the tails cylinders, the cylinders would not typically be stacked. Stormwater collected from the cylinder pads would be directed to a new holding pond specifically constructed for the cylinder pads and then to a new onsite wet detention basin.

2.1.2.2 Other Facility Buildings and Supporting Infrastructure

New facility buildings and supporting infrastructure would include three administrative buildings, waste storage buildings, an electrical substation, backup diesel generators, potable and process water systems, a holding pond for cylinder storage pad stormwater, a stormwater wet detention basin, parking areas, and roads.

The new potable and process water supply lines to the GLE Facility would be connected to the existing Wilmington Site water supply infrastructure. Sanitary waste, process wastewater, and treated liquid radiological wastewater that would be generated at the proposed GLE Commercial

Facility would be routed to the existing facilities at the Wilmington Site via underground lines for final processing and disposition. In particular, the sanitary wastewaters would be routed to the existing Site Sanitary Waste Water Treatment Facility, and the process and treated wastewaters would be sent to the existing Final Process Lagoon Treatment Facility.

Two detention basins (one new and one existing) would receive stormwater runoff from the GLE Facility. An existing collection basin on the Wilmington Site would receive the majority of the runoff from the GLE Facility, including the Operations Building. The remaining runoff, including runoff from the UF_6 Cylinder Pads, would drain to a new GLE site wet detention basin.

In addition, there would be a new water tower and a firewater retention basin located on the proposed GLE Facility site. The water in the tower would be used for process water at the proposed GLE Facility, but it would be designed to always maintain a reserved level for firefighting. The firewater retention basin and associated diesel-powered firewater pumps would be designed as a backup source for fire protection systems.

The proposed GLE Facility would be served by two main roads on the Wilmington Site. The first road would connect the proposed GLE Facility to Castle Hayne Road and would serve as the main entrance to the facility. The other road would lead to the GNF-A Fuel Manufacturing Operation (FMO) Facility and would be used mainly for transport of enriched product to the FMO facility for fuel manufacturing.

2.1.2.3 Process Description

The proposed GLE Facility would employ the Separation of Isotopes by Laser Excitation (SILEX) process, a third-generation laser-based technology for enriching natural uranium that was developed by Silex Systems Ltd, in partnership with GLE (and formerly, the U.S. Enrichment Corporation [USEC]). Isotopes of the same element, though chemically identical, have different electronic energies and absorb different colors of laser light. The isotopes of most elements can be separated by a laser-based process if they can be vaporized efficiently into individual atoms. In laser excitation enrichment, UF_6 vapor is illuminated with a tuned laser of a specific wavelength that is absorbed only by uranium-235 atoms while leaving other isotopes unaffected.

Given below is an overview of the GLE laser-based enrichment process. A more detailed description of the process is provided in the license application (GLE, 2009a). However, the technical details of the GLE laser-based enrichment process are proprietary, subject to export control, and in many cases, may also fall into the categories of security-related, safeguards, or classified information, to which access is limited by U.S. laws and regulations. As such, the details of this process are not contained in this EIS.

The proposed GLE Facility is designed to separate a feed stream of UF_6 containing the naturally occurring proportions of uranium isotopes (approximately 0.7 percent uranium-235, 99.3 percent uranium-238, and 0.0055 percent uranium-234) into a product stream (enriched in the uranium-235 isotope) and a tails stream (depleted in the uranium-235 isotope). Except for the actual step in the enrichment process that involves the use of lasers, the processes that would be used for receipt and handling of the feedstock and the enriched and depleted UF_6 streams are very similar to those used at other enrichment facilities. The cylinders that would be used for transportation and storage of UF_6 are industry-standard containers. The proposed GLE

Facility is designed to produce an enriched UF_6 stream that is up to 8 percent uranium-235 with a nominal capacity of 6 million SWU per year.

The four major processing steps involved in enriching the natural UF_6 at the proposed GLE Facility would be (1) UF_6 Feed and Vaporization, (2) Cascade/Gas Handling, (3) Product Withdrawal, and (4) Tails Withdrawal.

The UF_6 Feed Vaporization System would provide a continuous supply of gaseous UF_6 from the feed cylinders to the Cascade/Gas Handling Area (where the enrichment takes place). Approximately nine hundred 122-centimeter (48-inch) cylinders would be processed annually. Feed cylinders would be loaded into solid feed stations; vented for removal of light gases (primarily air and hydrogen fluoride); and heated to sublime the UF_6 (converting it directly from solid to gas phase without going through the liquid phase). The light gases and UF_6 gas generated during feed purification would be routed to the Feed Purification Subsystem, where the UF_6 would be desublimed (converted directly from gas to solid phase without passing though the liquid phase). The Feed Purification Subsystem would remove any light gases such as air and hydrogen fluoride from UF_6 prior to introduction into the Cascade/Gas Handling Area.

After purification, UF_6 from the solid feed stations would be routed to the Cascade/Gas Handling Area. The UF_6 in gaseous form would be exposed to laser-emitted light and separated into two streams (one enriched in uranium-235 and one depleted in uranium-235). Enriched UF_6 from the Cascade/Gas Handling Area would be transported to the Product Withdrawal Area, where it would be placed in the product cylinders and desublimed. The heat from desublimation of the UF_6 would be removed by air. Filling of product cylinders would be monitored, and filled cylinders would be transferred to the Sampling Area for sampling and sent to the Blending Area or put into interim storage on the Product Pad.

The enriched UF_6 in product cylinders forwarded to the Blending Area would be vaporized and pumped into receiver cylinders. During this process, the enrichment level of UF_6 put into the receiver cylinders would be carefully controlled to meet the customer specifications as well as transportation standards.

As a final step, the receiver cylinders would be sent back to the Sampling Area, where the UF_6 would be liquefied to create a homogenous mixture of UF_6 and would be sampled to make sure that it meets the applicable requirements. A cylinder to be sampled would be moved into an autoclave with heating and cooling capability, where the UF_6 in the cylinder would be liquefied by electrically heated air, to homogenize the liquefied UF_6, and a representative sample of the contents would be taken. The UF_6 in the cylinder would then be solidified in the autoclave using cold air before removing the cylinder from the autoclave. The autoclaves would be designed to contain a UF_6 release in the autoclave.

Depleted UF_6 from the Cascade/Gas Handling Area would be transported to the Tails Withdrawal Area, where it would be placed in the tails cylinders and desublimed. The heat of desublimation of the UF_6 would be removed by air. Filling of tails cylinders would be monitored, and filled cylinders would be transferred to the Tails Pad.

2.1.2.4 Waste Management Systems

This section describes the systems used to treat and disposition the liquid and solid wastes generated at the proposed GLE Facility. The quantities of waste generated and the waste management impacts are discussed in Section 4.2.12.

Liquid Wastes

GLE provided a summary of the systems and operations that would be used to manage the wastewater generated at the proposed GLE Facility, as shown in Table 2-1 (GLE, 2009a). Liquid radioactive wastes generated in the Operations Building would be collected in closed-drain systems that discharge to an accumulator tank. Subsequently, the liquid would be treated in the Radiological Liquid Waste Treatment System (RLETS) at the proposed GLE Facility to remove uranium through precipitation and fluoride through evaporation. The resulting solids would be dried and disposed of as low-level radioactive waste (LLRW).

The treated wastewaters from the RLETS would meet discharge requirements in 10 CFR Part 20, Appendix B (GLE, 2009c), before discharge to the Final Process Lagoon

Table 2-1 Management of Wastewater Generated by Proposed GLE Facility Operations

Wastewater Type	Onsite Waste Management	Offsite Waste Treatment/Disposal
Process liquid radiological waste	Wastewaters collected in closed drain system connected to Radiological Liquid Waste Treatment System (RLETS). Treated radiological waste effluent is discharged to existing Wilmington Site process wastewater aeration basin and Final Process Lagoon Treatment Facility (FPLTF).	Treated effluent from the Wilmington Site FPLTF is discharged at National Pollution Discharge Elimination System (NPDES)-permitted Outfall 001 to the onsite effluent channel.
Cooling tower blowdown	Blowdown is pumped from cooling tower to existing Wilmington Site FPLTF.	Treated effluent from the Wilmington Site FPLTF is discharged at NPDES-permitted Outfall 001 to the onsite effluent channel.
Sanitary waste	Sanitary waste is collected in sewer system connected to existing Wilmington Site Sanitary Wastewater Treatment Plant. Waste stream is treated by activated sludge aeration process.	Treated effluent from the Wilmington Site Sanitary Wastewater Treatment Plant is discharged at NPDES-permitted Outfall 002 to the onsite effluent channel.
Stormwater	Stormwater runoff is collected in drainage conduits and channels flowing to onsite retention basins.	Stormwater from onsite retention basins is discharged per requirements of NPDES storm water permit.

Source: GLE, 2009a

Treatment Facility (FPLTF). The FPLTF is an existing facility at the Wilmington Site that is currently used to treat liquid effluents from existing industrial operations. It would also be used to treat the effluents from the proposed GLE Facility. The treated effluent from the FPLTF is currently discharged via National Pollutant Discharge Elimination System (NPDES)-permitted Outfall 001 to the Wilmington Site effluent channel, where it is combined with stormwater, discharging groundwater, and treated sanitary wastewater effluent. The effluent channel flows to the Unnamed Tributary #1, which drains to the Northeast Cape Fear River. GLE has stated that these operations would continue in the same mode when the proposed GLE Facility becomes operational.

A new cooling tower would be constructed for the proposed GLE Facility. The cooling tower would use a closed-loop system that does not contact any uranium materials or uranium-contaminated wastewater streams. To minimize the amount of dissolved solids and other impurities in the circulating water, a portion of the circulating water from the cooling tower loop (called blowdown) would be regularly removed from the cooling tower loop and discharged to the existing Wilmington Site FPLTF. Fresh water or treated sanitary wastewater effluent would be added to the cooling tower loop to make up for the water loss.

The sanitary wastes generated at the proposed GLE Facility would be collected in a sewer system connected to the existing Wilmington Site Sanitary Wastewater Treatment Facility (WWTF), which employs an Activated Sludge Aeration Process. The treated effluent from the WWTF could be reused as makeup water in cooling towers at the Wilmington Site or discharged at NPDES-permitted Outfall 002 to the onsite effluent channel.

Stormwater runoff from outdoor impervious surfaces within the GLE Facility site would be collected in drainage conduits and channels flowing into detention basins used for collection of runoff. The detention basins would be routed to one of the unnamed tributaries on the Wilmington Site that flow into the Northeast Cape Fear River. Stormwater collected from the cylinder storage pads would be directed to a new holding pond and from there to a new wet detention basin on the proposed GLE Facility site.

Solid Wastes

Solid wastes that would be generated by the proposed GLE Facility include municipal solid waste, nonhazardous industrial wastes, wastes designated as *Resource Conservation and Recovery Act* (RCRA) hazardous wastes, and LLRW. No high-level radioactive wastes would be generated by the proposed GLE Facility operations. GLE provided a summary of the methods used to manage these wastes onsite and for offsite treatment and disposal, as shown in Table 2-2 (GLE, 2009a).

The municipal solid waste would be collected and placed in rolloff-type containers. A commercial refuse collection service would regularly collect the filled containers and transport the waste to a RCRA-permitted Subtitle D landfill for disposal. The nonhazardous industrial waste, such as spent coolant and used filter media, would be collected and temporarily stored in containers appropriate for the waste type. Depending on their composition, these wastes would either be shipped directly to a permitted RCRA Subpart D landfill for treatment and burial, or routed to other approved facilities for reuse, reclamation, or treatment. The RCRA hazardous waste would be collected, packaged in DOT-approved shipping containers, and temporarily stored onsite for shipment to a RCRA-permitted Subtitle C treatment, storage, and disposal

Table 2-2 Management of Solid Waste Generated at Proposed GLE Facility During Operations

Solid Waste Source	Onsite Waste Management	Offsite Waste Treatment/Disposal
Municipal solid waste (MSW)	Collected and temporarily stored in rolloff containers	Filled rolloff containers are transported by commercial refuse collection service to an approved disposal site
Non-hazardous wastes from operations equipment cleaning and maintenance activities that are recyclable or not accepted by MSW landfill	Collected and temporarily stored in containers	Filled containers are transported by truck to an approved disposal site[a]
Wastes designated RCRA hazardous wastes	Collected and temporarily stored in containers	Filled containers are transported by truck to an approved disposal site[b]
Laboratory waste from UF_6 feed sampling and analysis	Collected and temporarily stored in containers	Either transported by truck to an approved disposal site or transported to an approved uranium recovery vendor
Combustible used or spent uranium-contaminated materials	Collected and temporarily stored in containers	Either transported by truck to an approved disposal site or transported to an approved uranium recovery vendor
Non-combustible used or spent uranium-contaminated materials	Collected and temporarily stored in boxes	Filled boxes are transported by truck to an approved disposal site[c]
Liquid Radiological Waste Treatment System filtrate/sludge	Collected and temporarily stored in metal cans	Filled cans are transported by truck to an approved disposal site

[a] Licensed RCRA Subpart D landfill.
[b] Licensed RCRA Subpart C Treatment, Storage, and Disposal Facility (TSDF).
[c] Licensed Low-Level Radioactive Waste Disposal Facility.
Source: GLE, 2009a

facility. LLRW would be collected in containers and shipped by truck to an approved disposal facility.

2.1.2.5 Liquid and Air Effluents

This section discusses the potential liquid and air effluents from the proposed GLE Facility. The impacts associated with these effluents are discussed in Section 4.2.11.

Liquid Effluents

Uranium enrichment operations performed at the proposed GLE Facility would generate process wastewater that would contain small concentrations of uranium and fluoride. This

wastewater would be generated from decontamination operations, cleaning wash water, and laboratory wastes, and is collectively referred to as liquid radioactive waste.

The process wastewater would be treated to remove the uranium and the fluoride. The treated wastewater would meet the discharge requirements in 10 CFR Part 20, Appendix B, before discharge to the existing Wilmington Site FPLTF (GLE, 2009c). This facility currently receives Wilmington Site process wastewater, including the treated effluent from the GNF-A FMO Facility Radiological Waste Treatment System. The treated effluent from the FPLTF is discharged via NPDES-permitted Outfall 001 to the Wilmington Site effluent channel, where it is combined with stormwater, discharging groundwater, and treated sanitary wastewater effluent. The effluent channel flows to the Unnamed Tributary #1, which flows into the Northeast Cape Fear River.

As discussed in Section 2.1.2.4 and in Table 2-1, there would be three other liquid effluents from the proposed GLE Facility. These effluents would not contain radioactive constituents. The cooling tower blowdown effluent would be discharged to the effluent channel at Outfall 001 along with the process wastewater from the FPLTF. Treated sanitary wastewater would either be reused as makeup water for cooling towers or released to the effluent channel at Outfall 002. The stormwater overflow from the onsite wet detention basins would be discharged to one of the unnamed tributaries to the Cape Fear River.

Air Effluents

Because the laser-based enrichment process proposed by GLE is a closed process, no routine venting of process gases would occur during operations. However, some short-term gaseous releases could occur inside the Operations Building during certain operations, such as the connection/disconnection of UF_6 cylinders to process equipment and process equipment maintenance. These gaseous releases would be routed through the building's ventilation system.

The ventilation system air stream would pass through a series of emissions-control devices, consisting of high-efficiency particulate air (HEPA) filters and high-efficiency gas absorption (HEGA) filters. The exhaust air stream from these emission controls would be vented to the atmosphere and would meet the discharge requirements in 10 CFR Part 20, Appendix B (GLE, 2009c).

2.1.3 Depleted Uranium Management

The term "depleted uranium" refers to any chemical form of uranium (e.g., UF_6 and U_3O_8) that contains uranium-235 in concentrations less than the 0.7 percent found in natural uranium. As discussed in Section 2.1.2.3, the uranium enrichment process would generate a depleted UF_6 stream (also called tails). In contrast to the uranium in the enriched UF_6 produced by the enrichment facility, the uranium in the depleted UF_6 stream would be depleted in uranium-235 isotope of uranium. At full production, the proposed GLE Facility would generate 900 full 122-centimeter (48-inch) cylinders of depleted UF_6 per year. Initially, the depleted UF_6 would be stored on the Tails Storage Pad (GLE, 2009a). Each 122-centimeter (48-inch) cylinder would hold approximately 12.5 metric tons (13.8 tons), which means that at full production, the site would generate approximately 11,250 metric tons (12,375 tons) of depleted UF_6 every year. During the operation of the facility, it could store up to 9000 cylinders (10 years' worth of generation) of depleted UF_6 (GLE, 2009a). GLE would own the depleted UF_6 and maintain the

cylinders while they are in storage. Maintenance activities would include periodic inspections for corrosion, valve leakage, or distortion of the cylinder shape, and touch-up painting as required. Problem cylinders would be removed from storage and the material transferred to another storage cylinder. The proposed storage area would be kept neat and free of debris, and all stormwater or other runoff would be routed to the onsite holding pond for monitoring and evaporation.

> ***Waste Classification of Depleted Uranium***
>
> *Depleted uranium is different from most low-level radioactive waste in that it consists mostly of long-lived isotopes of uranium, with small quantities of thorium-234 and protactinium-234. Depleted uranium is source material as defined in 10 CFR Part 40, and, if treated as a waste, it falls under the definition of low-level radioactive waste per 10 CFR 61.2. The Commission affirmed that depleted uranium is properly considered a form of low-level radioactive waste in Louisiana Energy Services, L.P. (National Enrichment Facility), CLI-05-5, 61 NRC 22 (January 18, 2005). This means that depleted uranium could be disposed of in a licensed low-level radioactive waste facility if the licensing requirements for land disposal of radioactive waste as indicated in 10 CFR Part 61 are met.*
>
> *Sources: NRC, 1991; NRC, 2005b.*

The Defense Nuclear Facilities Safety Board (DNFSB) has reported that long-term storage of depleted UF_6 in the UF_6 form represents a potential chemical hazard if not properly managed (DNFSB, 1995). For this reason, the strategic management of depleted uranium includes the conversion of depleted UF_6 stock to a more stable uranium oxide (e.g., triuranium octaoxide [U_3O_8]) form for long-term management (OECD, 2001). The U.S. Department of Energy (DOE) also evaluated multiple disposition options for depleted UF_6 and agreed that conversion to U_3O_8 was preferable for long-term storage and disposal of the depleted uranium in its oxide form, due to the chemical stability of U_3O_8 (DOE, 2000). Therefore, the disposal option considered in the EIS is the conversion of the depleted UF_6 to U_3O_8 at either a DOE-owned or commercial conversion facility followed by disposal as U_3O_8. Direct disposal of depleted UF_6 was ruled out because of its chemical reactivity (DOE, 1999).

2.1.3.1 Conversion of Depleted UF_6

Section 3113 of the 1996 *USEC Privatization Act* (42 U.S.C. 2297h-11), states that DOE “shall accept for disposal low-level radioactive waste, including depleted uranium if it were ultimately determined to be low-level radioactive waste, generated by ... any person licensed by the Nuclear Regulatory Commission to operate a uranium enrichment facility under [Sections 53, 63, and 193 of the *Atomic Energy Act of 1954* (42 U.S.C. 2073, 2093, and 2243)].” As a result, unless GLE finds a beneficial use for its inventory of depleted UF_6 generated at the proposed GLE Facility or makes alternate arrangements for conversion to another chemical form elsewhere, GLE would send it to DOE for conversion to the oxide form for disposal. On January 18, 2005, the Commission issued its ruling that depleted uranium is considered a form of low-level radioactive waste (NRC, 2005a). The Commission also stated that, pursuant to Section 3113 of the USEC Privatization Act, disposal by DOE at an approved facility represents a ‘plausible strategy’ for the disposition of depleted uranium tails (NRC, 2005a).

DOE has constructed two conversion plants to convert the depleted UF_6 now in storage at Portsmouth, Ohio, and Paducah, Kentucky, to depleted uranium oxide (primarily U_3O_8) and

hydrofluoric acid. Both plants completed operational testing and were fully operational in September 2011 (Sparks, 2011; BWCS, 2011). GLE would transport the depleted UF_6 generated by the proposed GLE Facility to either of these new facilities and pay DOE to convert and dispose of the material. The proposed GLE Facility would generate approximately 450,000 metric tons (495,000 tons) in total over its 40-year operating lifetime. The depleted UF_6 would be processed in a DOE-operated conversion facility and then shipped offsite for disposal.

In addition to the DOE disposition option for depleted UF_6, one or more NRC-licensed commercial depleted UF_6 conversion facilities may become available during the proposed GLE Facility's operational lifetime. At least one private entity (International Isotopes, Inc.) has announced plans to construct and operate a new depleted UF_6 conversion facility in Hobbs, New Mexico (GLE, 2008). International Isotopes submitted a license application on December 31, 2009, and the NRC is currently reviewing this application (NRC, 2010a). If a commercial facility performs the conversion to U_3O_8, DOE is still obligated to accept the U_3O_8 for disposal if requested by GLE, per Section 3113 of the *USEC Privatization Act*.

2.1.3.2 Disposal of Depleted Uranium

The Commission stated that transfer of depleted uranium tails to DOE for disposal represents a plausible alternative for disposition, and that depleted uranium is considered a form of low-level waste (NRC, 2005a). Disposal of U_3O_8 at a commercial low-level waste disposal facility would also be a viable option, if the commercial waste disposal facility could satisfy the requirements of 10 CFR Part 61.

2.1.4 Decontamination and Decommissioning

At the end of useful plant life, the proposed GLE Facility would be decontaminated and decommissioned in accordance with applicable NRC license termination requirements. Decontamination and decommissioning of the proposed GLE Facility would be funded in accordance with the Decommissioning Funding Plan (DFP) for the proposed GLE Facility (GLE, 2008). The DFP, prepared by GLE in accordance with 10 CFR 70.25(a), provides information required by 10 CFR 70.25(e) regarding GLE's plans for funding the decommissioning of the proposed GLE Facility and the disposal of depleted uranium tails generated as a result of plant operations. Funding would be provided by GLE in accordance with NRC regulations in 10 CFR Part 70 and guidance in NUREG-1757 (NRC, 2003).

The intent of decommissioning is to return the proposed GLE Facility site to a state that meets NRC requirements for release for unrestricted use after decontamination and decommissioning is completed (GLE, 2008). It is anticipated that at the end of the useful life of the plant, some of the support buildings and outdoor areas would already meet NRC requirements for unrestricted use in accordance with 10 CFR 20.1402. Any buildings, outdoor areas, or equipment that do not already meet the NRC requirements at the time the GLE Facility ceases operations would be decontaminated and decommissioned in accordance with NRC regulations at 10 CFR 70.38.

Decontamination and decommissioning activities for the proposed GLE Facility are anticipated to occur approximately 40 years in the future, and therefore, only a general description of the activities that would be conducted for the proposed GLE Facility can be developed for this EIS. The proposed facility would follow NRC decommissioning requirements in 10 CFR 70.38.

Depleted UF_6 Conversion Process

Depleted UF_6 conversion is a continuous process in which depleted UF_6 is vaporized and converted to U_3O_8 by reaction with steam and hydrogen in a fluidized-bed conversion unit. The hydrogen is generated using anhydrous ammonia, although an option of using natural gas is being investigated. Nitrogen is also used as an inert purging gas and is released to the atmosphere through the building stack as part of the clean off-gas stream. The depleted U_3O_8 powder is collected and packaged for disposition. The process equipment would be arranged in parallel lines. Each line would consist of two autoclaves, two conversion units, a hydrofluoric acid recovery system, and process off-gas scrubbers. The Paducah facility would have four parallel conversion lines. Equipment would also be installed to collect the hydrofluoric acid co-product and process it into any combination of several marketable products. A backup hydrofluoric acid neutralization system would be provided to convert up to 100 percent of the hydrofluoric acid to calcium fluoride for storage and/or sale in the future, if necessary.

Sources: DOE, 2004a; DOE, 2004b.

The NRC anticipates that decontamination and decommissioning will involve the following activities:

- installation of decontamination facilities
- purging of process systems and equipment
- dismantling and removal of facilities and equipment
- decontamination and destruction of confidential materials
- decontamination of equipment, facilities, and structures
- survey and spot decontamination of outdoor areas
- removal and sale of any salvaged materials
- removal and disposal of wastes
- management and disposal of depleted uranium
- final radiation survey to confirm that the release criteria have been met

2.1.5 Description and Anticipated Schedule for the Phases of the Proposed Action

As discussed previously, the proposed action would be conducted in three phases starting with (1) preconstruction and construction, (2) facility operation, and (3) decontamination and decommissioning. Each of these phases is described briefly and the anticipated schedule of activities under each phase is provided below.

As discussed in Section 1.4.1, NRC has approved an exemption request from GLE for GLE to conduct certain preconstruction activities prior to NRC issuing a license to GLE for the construction and operation of the proposed GLE Facility (NRC, 2009a). Pre-construction activities covered by the exemption include the following activities and facilities:

- clearing of approximately 40 hectares (100 acres) for the proposed GLE Facility (e.g., removal of trees and vegetation)
- site grading and erosion control (e.g., leveling, installation of physical barriers, and construction of drainages and culverts)
- installing stormwater retention system (e.g., including a holding pond for the cylinder storage pads, wet detention basin, and associated drainage ditches)
- constructing main access roadways and guardhouse(s) (e.g., North access road)
- installing utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, and natural gas) (e.g., aboveground electrical lines, electrical substation, wastewater lift stations, and new water tower)
- constructing parking lots and minor roadways (e.g., employee and visitor parking lot and connections to site access roads)
- constructing administrative building(s) (e.g., office space and personnel Entry Control Facility)

GLE anticipates that it could begin preconstruction activities in 2012 (Figure 2-3), and NRC's licensing decision is anticipated to take place by June 2012. If the license is granted, GLE could begin the actual construction activities at that time. As discussed in Section 1.4.1, GLE has indicated that the schedule for preconstruction activities is uncertain at this time (NRC, 2010c). Therefore, some of the preconstruction activities could still be ongoing after the construction

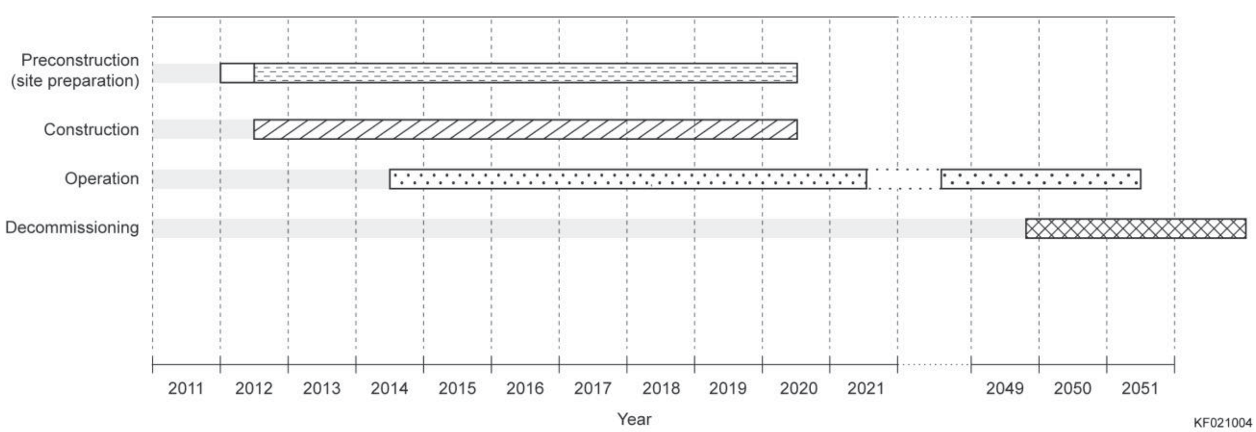


Figure 2-3 Anticipated Timeline for the Proposed GLE Facility[1]

[1] Start and end dates of project phases, as shown, are approximate.

starts. However, for the purposes of the analyses in this EIS (and as indicated in Figure 2-3), it has been assumed that the preconstruction phase of the project would be completed before the construction phase begins (anticipated to be in 2012).

GLE anticipates that the construction would take place over an approximately 7- to 8-year period starting in 2012 and would be completed by 2020. This would include construction of the Operations Building, cylinder storage pads, holding pond for cylinder storage pad stormwater runoff, wet detention basin, and security buffer area. Construction would be phased in such a way that the operations would begin in 2014, while the rest of the facility is being constructed. When the construction is fully completed (in 2020), the facility would begin operating at its rated capacity of 6 million SWU per year.

GLE is seeking a license for the proposed facility for a period of 40 years. Assuming it is granted in 2012, the license would expire in 2052. Prior to 2052, GLE would decide to either seek a new license to continue to operate the facility or plan for the decontamination and decommissioning of the facility per the applicable licensing conditions and NRC rules and regulations. As discussed in Section 2.1.4, decontamination and decommissioning activities would entail installation of decontamination facilities; purging of process systems and equipment; dismantling and removal of facilities and equipment; decontamination and destruction of confidential materials; decontamination of equipment, facilities, and structures; survey and spot decontamination of outdoor areas; removal and sale of any salvaged materials; removal and disposal of wastes; management and disposal of depleted uranium; and final radiation survey to confirm that the release criteria have been met.

During operations, GLE intends to use natural uranium in the form of UF_6 for the proposed GLE Facility. The UF_6 would be transported to the plant in 122-centimeter (48-inch) cylinders that are designed, fabricated, packaged and shipped in accordance with American National Standards Institute (ANSI) N14.1, "Uranium Hexafluoride-Packaging for Transport" (ANSI, 1990). Feed cylinders are expected to be transported to the site by truck. It is anticipated that approximately 900 shipments of feed cylinders per year would arrive at the proposed GLE Facility. Expected feed suppliers include the Cameco Corporation (Port Hope, Ontario, Canada), Honeywell Specialty Chemical Plant (Metropolis, Illinois), and possibly foreign sources (through ports at Baltimore, Maryland, and Portsmouth, Virginia).

The uranium enrichment process as described in Section 2.1.2.3 would occur within the Operations Building. Enrichment would normally be 3–5 percent by weight of uranium-235, although GLE's license application indicates GLE seeks authorization to produce enriched uranium up to 8 percent by weight of uranium-235 (GLE, 2008).

Filled customer product cylinders (Type 30B) would be transported to customers (nuclear fuel fabrication facilities), while empty feed cylinders would be returned to the customers for refilling. All cylinders would be prepared for shipment and shipped in accordance with the applicable NRC and DOT regulations.

All product cylinders shipped from the proposed GLE Facility would be transported by truck. These cylinders would be designed, fabricated, and shipped in accordance with the ANSI standard for packaging and transporting UF_6 cylinders, ANSI N14.1. An average product shipment frequency of 6 cylinders per day is anticipated at full production capacity, with an

annual total of approximately 2100 shipments. Some of these cylinders would be transported to the FMO on the Wilmington Site for fabrication into nuclear fuel.

All wastes generated by the GLE facility would be treated onsite or shipped offsite for treatment and/or disposal. The non-hazardous solid wastes would be disposed of in a local landfill or shipped to an offsite treatment and disposal or reuse facility. The low-level radioactive waste would be collected in appropriate containers and shipped by truck to a licensed disposal facility (Energy*Solutions*) in Clive, Utah. RCRA waste would be appropriately packaged and temporarily stored onsite for quarterly shipment (with RCRA waste generated by existing site facilities) to a RCRA-permitted treatment, storage, and disposal facility (Heritage Environmental Services) in Indianapolis, Indiana.

Approximately 900 Type 48Y or 48G cylinders of depleted UF_6 tails are expected to be generated by the GLE Facility per year during full operation. There are no plans for onsite processing or disposal of depleted UF_6, so the cylinders would be stored on the Tails Storage Pad and monitored until they are ready to be shipped offsite. The planned storage pad will have sufficient capacity to store 9000 double-stacked cylinders, with approximately 24 hectares (60 acres) available for expansion of storage capacity. However, GLE anticipates the availability of at least one offsite UF_6 disposition option, enabling the offsite shipment of depleted UF_6 cylinders prior to reaching the 9000-cylinder capacity. Should the 9000-cylinder capacity be reached during facility operation, GLE would evaluate available options, including expansion of onsite storage capacity.

2.2 No-Action Alternative

Under this alternative, GLE would not construct the proposed GLE Facility at the Wilmington Site. It is assumed that preconstruction activities would take place regardless of the decision to issue a license for the proposed GLE Facility under both the proposed action and the no-action alternative.

Enrichment services would continue to be performed by existing domestic and foreign uranium enrichment suppliers. The Paducah Gaseous Diffusion Plant (GDP) and the National Enrichment Facility (NEF) in Lea County, New Mexico, would continue to supply enrichment services. Both the American Centrifuge Plant (ACP) in Piketon, Ohio; and Eagle Rock Enrichment Facility (EREF) in Bonneville County, Idaho, may also provide enrichment services in the future. Impacts from these other domestic enrichment facilities have been evaluated in other NRC environmental reviews.

Table 2-3 summarizes and compares the environmental impacts for the proposed action and the no-action alternative.

The comparison is intended primarily to highlight the differences between the two alternatives after preconstruction activities have occurred.

2.3 Alternatives Considered but Not Analyzed in Detail

As required by NEPA and NRC regulations, the NRC has considered other alternatives to the construction, operation, and decommissioning of the proposed GLE Facility, and the disposition

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Land Use	SMALL. The project area is owned by GE and zoned for heavy industrial use. The project area consists of mostly mixed pine forest and is bordered by existing GE facilities, the Northeast Cape Fear River, and residential development. Preconstruction activities would occur under the proposed action, removing the undeveloped forest. Construction of the proposed GLE Facility would not alter current land use at the Wilmington Site or affect surrounding land use. Operation of a uranium enrichment facility would affect land use and could affect nearby residential developments. However, operation of the proposed GLE Facility is consistent with other industrial use of the Wilmington Site. These industrial activities have had no effect on residential development. Decommissioning would not alter current land use at the Wilmington Site or affect surrounding land use.	SMALL. Preconstruction activities would occur even if the proposed GLE Facility is not constructed. Preconstruction would alter the undeveloped forest within the Wilmington Site but would not affect surrounding land use.
Historic and Cultural Resources	SMALL to MODERATE. The location for the proposed GLE Facility (study area) comprises 106 hectares (263 acres). Preconstruction activities would have an impact on historic and cultural resources. NRC-authorized construction would take place on ground previously disturbed by preconstruction. No construction activities are expected to occur in the portion of the Wilmington Site where historic and cultural resources are known to exist. GLE Facility operations have the potential to affect historic and cultural resources. While GLE has no plans to alter the site during operations, there is a high potential for additional historic and cultural resources to be discovered during routine maintenance activities. The Wilmington Site is located within a region containing high concentrations of historic and cultural resources. Operational impacts would depend largely on procedures employed to protect historic and cultural resources. The Middle Woodland archaeological site 31NH801 would not be affected by	SMALL. Ground disturbance caused by preconstruction activities could affect historic and cultural resources at the Wilmington Site. Since the proposed GLE Facility would not be constructed, there would be no further effects on historic and cultural resources.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Historic and Cultural Resources (Cont.)	facility operations. The North Carolina State Historic Preservation Office (SHPO) requested that GLE develop procedures to protect site 31NH801. In response, the NRC proposed a license condition requiring GLE to consider the potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed areas of the GLE Facility site. GLE also developed Common Procedure CP-24-201 to address the unanticipated discovery of human remains or artifacts. The SHPO concurred that a determination of “no adverse effect” is appropriate with the inclusion of the proposed license condition. Based on this information, the NRC determined that the impact level would be SMALL to MODERATE given the close proximity of significant historic and cultural resources and high potential for additional historic and cultural resource materials to be discovered during routine operations. The NRC's determination is based on the license containing the proposed license condition. Decommissioning impacts on historic and cultural resources are expected to occur primarily during ground-disturbing activities; the need to clear previously undisturbed land is not expected as a part of decommissioning activities.	
Visual and Scenic Resources	SMALL. The project area has low scenic quality and the environment in the project area is not unique for the area. Preconstruction activities would include clearing vegetation. The proposed GLE Facility would be located adjacent to existing industrial facilities and would be consistent with the existing industrial character of the Wilmington Site. Likewise, the project area is not in a location that is sensitive to visual intrusions. Construction activities would be limited to the Wilmington Site. The greatest visual impacts would result from increased truck and worker traffic, but these impacts would be temporary. The main project area is surrounded by a vegetation barrier, so construction activities would be largely screened. Construction cranes would be visible from greater distances, but this impact would be temporary.	SMALL. Preconstruction activities would include clearing vegetation. Since the proposed GLE Facility would not be constructed, the visual appearance of the Wilmington Site would not change because the vegetation screen along the northern part of the site would remain.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Visual and Scenic Resources (Cont.)	The two most visible (i.e., tallest) structures would be the water tower and a portion of the operations building referred to as the operations building tower. The operations building tower will have front and side profiles of 37 m (120 ft) by 200 m (660 ft), and could reach up to 49 m (160 ft) above grade. The proposed water tower is the same height as the existing Wilmington Site water tower, the top of which is visible from south of Interstate 140 (I-140). Although the operations building tower could be 10 m (30 ft) taller than the existing water tower, it would be visible primarily from Castle Hayne Road and the residential subdivision to the northeast, because it would be farther from I-140 than the existing water tower. The water tower, facility, and operations building tower would not represent a major alteration of the existing visual environment. Portions of the proposed facility may be visible from I-140, and the planting of additional vegetation may minimize visual impacts. Decommissioning impacts on visual and scenic resources would be minimal and of short duration. Temporary visual impacts could result from the use of heavy equipment and the increase in worker traffic. Once decommissioning is complete, most of the visual impacts would cease. The vegetation screen surrounding the Wilmington Site would make changes imperceptable to all but the closest residences.	
Air Quality	SMALL to MODERATE. Preconstruction activities would have an impact on ambient air quality conditions at the Wilmington Site. Air quality impacts would be the highest during preconstruction activities (not a part of the proposed action) and the initial 2 years of GLE Facility construction. Criteria pollutants, volatile organic compounds (VOCs), greenhouse gases, hazardous air pollutants (HAPs), fugitive dust emissions, and engine exhaust emissions would be released during these activities. Emissions of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) would have a SMALL impact on ambient air quality (well below	SMALL. Preconstruction activities would have an impact on ambient air quality conditions at the Wilmington Site. Since the proposed GLE Facility would not be constructed, there would be no further impacts on air quality.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Air Quality (Cont.)	applicable standards). Lead emissions are expected to be negligible and potential carbon dioxide (CO_2) emissions would also be SMALL. Total 24-hour concentrations of particulate matter equal to or smaller than 10 µm (PM_{10}) and particulate matter equal to or smaller than 2.5 µm ($PM_{2.5}$), mostly resulting from fugitive dust emissions, are predicted to exceed air quality standards during preconstruction and construction phases. Since preconstruction and construction activities would last about 9 months and 2 years, respectively, the potential air quality impacts during the preconstruction phase are expected to be MODERATE. Aggressive dust control measures would be implemented during the preconstruction and construction phases to reduce the impact. Because the proposed GLE Facility will not employ any continuous combustion activities during operation, criteria pollutant and HAPs emission rates would be SMALL. Uranium-related and/or hydrogen fluoride (HF) stack emissions would be minimal, and emissions from diesel fuel handling would be very low. Fugitive dust emissions would be minimal, as most working areas and roads would be paved. Potential impacts from GLE Facility operations on regional ozone would also be SMALL. Decontamination activities would mostly occur inside GLE Facility buildings, where emission controls would minimize atmospheric releases. Standard dust suppression techniques could be employed during the demolition of structures and other hard surface areas to control dust emissions. Work areas would be monitored for airborne dust, and a small, temporary shelter or tent with portable HEPA filtration may be used to minimize the release of contaminated dust. The number of workers would be fewer than those required during construction or operations, but truck traffic on the North access road would be comparable to that	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Air Quality (Cont.)	experienced during construction. Air emission rates and associated air quality impacts of decontamination and decommissioning activities at the proposed GLE Facility would be comparable to or less than those during construction.	
Geology and Soil Resources	SMALL. Preconstruction activities would have an impact on soil conditions at the Wilmington Site. Approximately 91 ha (226 ac) of land would be disturbed under the proposed action, including the proposed GLE Facility site, support structures, and road construction. Construction vehicles and equipment could leak fuel, oil, or grease to site soils. Construction activities would include soil excavation, soil storage and removal, and stormwater management. Construction would not affect geologic resources because the site lacks significant geologic resources. Soil disturbance during GLE Facility operations would continue at reduced levels, as some construction projects are ongoing, while others would be completed. Impervious surfaces such as roads, parking lots, and roofs would increase stormwater runoff, increasing the erosion potential. Large storm events could create erosion along drainages or at culverts, requiring maintenance or drainage system improvement. Vehicles and equipment used in unpaved areas during facility operations could leak fuel, oil, or grease to site soils. Groundwater pumping is expected to have a minimal effect on groundwater levels, and the associated degree of subsidence is expected to be negligible. Other geologic hazards (volcano, tsunami, landslides, radon gas, methane gas, subsidence due to mining) to the site are not anticipated. Foundations, roads, and utility lines would likely be undisturbed during decontamination and decommissioning. Erosion may increase, as portions of the site are disturbed by heavy equipment.	SMALL. Preconstruction activities would have an impact on soil conditions at the Wilmington Site. Since the proposed GLE Facility would not be constructed, there would be no further impacts on geologic and soil conditions at the site

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Surface Water Resources	SMALL. Preconstruction activities would have an impact on water quality in streams located on the Wilmington Site. Excavation during construction could impact surface water quality. The access road for the proposed GLE Facility would require a new stream crossing and possibly change a jurisdictional channel, which could lead to erosion and increased sediment load. Construction vehicles and equipment pose the possibility of leaks or spills of fuels, oil, or grease, which could run off and affect nearby surface water. However, it is unlikely that a minor spill would reach the Northeast Cape Fear River or Prince George Creek. Infiltration into site soil would likely reduce or eliminate the potential for runoff. Process wastewater effluent would be discharged at an existing outfall during GLE Facility operations, increasing the site's process wastewater volume by about 7 percent. Liquid radioactive waste would be pretreated to reduce uranium to acceptable levels before transfer to the existing wastewater treatment facility. Treatment would produce an effluent similar to current process wastewaters. Treated sanitary wastewater effluent would be reused in site cooling towers. No consumption of surface water would occur during GLE Facility operations. Stormwater runoff would collect in a State-permitted detention basin before discharge and would be regulated by a National Pollutant Discharge Elimination System (NPDES) permit. Stormwater runoff from the UF_6 cylinder storage pads would collect in a lined retention pond. If monitoring demonstrates a lack of radioactivity, pond effluent would be discharged to the stormwater detention basin and ultimately, to the effluent channel. Any increase in turbidity and sediment loading to streams as a result of construction would subside during GLE Facility operations. Oil, grease, metals, and other automotive-related contaminants would be present in limited quantities due to onsite	SMALL. Preconstruction activities would have an impact on water quality in streams located on the Wilmington Site. Since the proposed GLE Facility would not be constructed, there would be no further impacts on surface water resources on or near the Wilmington Site.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Surface Water Resources (Cont.)	vehicular traffic. Herbicides used in landscaped areas of the Wilmington Site would also be present. GLE Facility process wastewater flow would cease during decontamination and decommissioning, but decontamination effluent could be generated. If the Wilmington Site treatment and industrial reuse facility could not receive sanitary discharge during the decontamination and decommissioning of the proposed GLE Facility, portable toilets would be required for workers. The collection, treatment, monitoring, and discharge of decontamination water would be designed to avoid significant environmental impact. Erosion may increase as portions of the site are disturbed by heavy equipment, and BMPs would reduce the impact.	
Groundwater Resources	SMALL. Preconstruction activities would have an impact on shallow aquifers at the Wilmington Site. Implementation of best management practices (BMPs) during the construction of the proposed GLE Facility would reduce the potential for leaks of fuel, oil, and grease to soil and groundwater. The use of portable toilets during construction would eliminate sanitary system impacts on groundwater. Tanker trucks would provide potable and nonpotable construction water. During GLE Facility operations, stormwater collected from the UF_6 cylinder storage pad is expected to have no more than trace amounts of radiological contaminants, and the liner is expected to limit infiltration to groundwater. Discharge at site outfalls would be from process and sanitary wastewater. Some portion of these effluents may potentially infiltrate the Peedee sand aquifer. However, treatment and monitoring are expected to result in no significant contaminant concentrations in the effluent channel. The proposed facility will obtain additional groundwater for potable	SMALL. Preconstruction activities would have an impact on shallow aquifers at the Wilmington Site. Since the proposed GLE Facility would not be constructed, there would be no further impacts on groundwater resources on or near the Wilmington Site.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Groundwater Resources (Cont.)	purposes from existing production wells at the Wilmington Site. Water level data show these wells to be cross-gradient of the overall Wilmington Site, and they do not result in significant drawdown. Groundwater will also be needed as a source of process water for the proposed GLE Facility. A small amount of increased drawdown is expected, without significant effect on flow directions, water quality, or availability for offsite users. Diesel tanks at the facility would have appropriate leak detection equipment. In addition, a groundwater monitoring plan would be developed after the facility is constructed. The removal of structures, utilities, materials, and products during the decommissioning of the proposed GLE Facility is not expected to have an impact on site groundwater resources.	
Ecological Resources	SMALL to MODERATE. Most impacts on ecological resources would occur during preconstruction. Most construction activities would occur in areas that would have already been disturbed by preconstruction activities. Impacts on vegetation would occur primarily from vegetation clearing, habitat fragmentation, alteration of topography, changes in drainage patterns, and soil compaction. Remaining potential impacts on vegetation include decline or mortality of trees near the construction boundary, effects related to hydrologic changes, deposition of dust and other particulate matter, introduction of invasive plant species, and accidental releases of hazardous materials (e.g., fuel spills). Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. No wetlands would be directly affected by construction of the proposed facility, but three jurisdictional wetlands and one isolated wetland occur within the corridor for the revised entrance and roadway. It is probable that the isolated wetland would be directly affected, resulting in a wetland loss. However, impacts on, or loss of, this wetland would not be significant, given the apparent low value of	SMALL. Most impacts on ecological resources would occur during preconstruction. Preconstruction impacts on wetlands, environmentally sensitive areas, and aquatic biota would be SMALL. Impacts on Federally threatened and endangered species and impacts on the Federal species of concern or State-listed species that occur within New Hanover County would also be SMALL (i.e., no adverse impacts on these species would result from the no-action alternative). Since the proposed GLE Facility would not be constructed, there would be no further impacts on ecological resources on or near the Wilmington Site.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Ecological Resources (Cont.)	the wetland under State rating guidelines. Indirect impacts on wetlands could result from increased stormwater runoff, decreased groundwater recharge, disconnected hydrologic conductivity, or changes in groundwater or surface water flow patterns. Impacts from increased or decreased runoff are expected to be negligible. Except for the probable impact on wetlands, no environmentally sensitive areas would be directly affected by construction. Only minor, localized indirect impacts on environmentally sensitive areas may occur from erosion and sedimentation or from changes in drainage patterns. Impacts on wildlife from construction would include habitat disturbance, wildlife disturbance, and injury or mortality of wildlife. Habitats within the footprint disturbed by construction would be reduced or altered, and construction activities would result in habitat fragmentation. Construction would cause a loss of habitat, which could result in a long-term reduction in wildlife abundance and richness. Although habitats adjacent to the proposed facility site would mostly remain unaffected, wildlife might make less use of these areas due to disturbance (indirect habitat loss). Habitat disturbance, including roads, could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent offsite habitats. If exposure of wildlife to fugitive dust was of sufficient magnitude and duration, the effects could be similar to those on humans. A more probable effect would be the dusting of plants, which could make forage less palatable. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Ecological Resources (Cont.)	wildlife and result in a long-term reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials. No aquatic habitats are located within the footprint of the areas that will be cleared for the proposed facility, and no significant adverse impacts on aquatic biota are expected from construction activities. No impacts would be expected on any Federally listed threatened, endangered, or other special status species from construction activities. Similarly, no impacts would be expected on any State-listed species. During operation, impacts on vegetation would include moving, hand-cutting, and chemical control of vegetation around the proposed facility, support facilities, utility corridors, and access road. No effects on vegetation would be expected from the cooling tower or air emissions, wastewaters, and solid wastes generated during operation. It is unlikely that radionuclide releases would have adverse effects on ecological resources. Facility operation would not encroach upon or have any other adverse effect on wetlands. Impervious surfaces generally result in increased runoff and reduced infiltration, but routing drainage to the stormwater detention and retention basins would minimize the potential for wetland water-level fluctuations. No environmentally sensitive areas would be affected by operations. Potential impacts on wildlife from operations would include ongoing habitat disturbance (i.e., reduction, alteration, and fragmentation of habitat), and wildlife injury or mortality. No natural water bodies occur within the immediate area of the proposed facility. During operations, aquatic habitats and biota could be affected by continued erosion and sedimentation and	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Ecological Resources (Cont.)	exposure to contaminants. Increased liquid effluent discharges could increase turbidity and sedimentation until the stream channel adjusts. Wastewater would be treated to meet NPDES permit requirements, so aquatic biota would not be adversely affected. The potential exists for toxic materials (e.g., fuel, lubricants, and herbicides) to be accidentally introduced into aquatic habitats, but an uncontained spill would probably affect only a limited area, and lubricants and fuel would not be expected to enter wetlands or waterways (due to soil infiltration and the distance from the main work area to drainages). Only trace levels of radiological contamination would be released to surface waters during operation, so adverse radiological impacts on aquatic biota would not be expected. No adverse impacts on threatened, endangered, or other special status species would be expected from facility operations due to the lack of suitable habitats within the immediate project area. Most decontamination activities would occur inside buildings, so large-scale ecological resource impacts are not expected. Removal of facilities could affect vegetation adjacent to the facilities and cause offsite erosion and sedimentation. The plant community established where facilities are removed would depend on subsequent use of the project area, and revegetation of the removed facility areas could increase wildlife habitat diversity. Decommissioning activities are not expected to directly affect wetlands or environmentally sensitive areas. There would be a temporary increase in disturbance to wildlife associated with vehicle, equipment, and worker activities. Other potential impacts would include the disposal of solid wastes and hazardous materials and the remediation of any contaminated soils. After decommissioning is complete, there would be no fuel or chemical spills associated with the facility.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Ecological Resources (Cont.)	Impacts on wildlife from decommissioning are expected to be similar to those experienced during construction. Removal of wildlife habitat (primarily landscaped lawns) would have minor impacts on wildlife populations. There would be a temporary increase in noise and visual disturbance associated with the removal and subsequent restoration of facilities. Removal of the impervious areas would decrease runoff and discharge, ceasing impacts on aquatic biota. Decommissioning would not directly affect threatened, endangered, or other special status species.	
Noise	SMALL to MODERATE. Noise impacts associated with preconstruction activities would be short-term and limited to the immediate vicinity of the proposed GLE Facility. During construction, vehicular traffic to and from the proposed GLE Facility would generate intermittent noise along local roadways. However, the noise contribution from these sources would be limited to the immediate vicinity of the Wilmington Site. Major activities would include building construction and equipment installation. Potential noise impacts on the nearest subdivision would be moderate but temporary in nature when road construction (a preconstruction activity) occurs. During GLE Facility operations, exterior equipment, such as pumps, heat pumps, transformers, and cooling towers would generate noise. Other sources of noise would include commuter vehicular and delivery truck traffic. Noise levels at the fenceline nearest to the Wooden Shoe residential subdivision would be below day and night ambient sound levels in compliance with the New Hanover County Noise Ordinance. Most decontamination activities would occur inside the GLE Facility buildings. If decommissioning includes demolition, heavy construction equipment may be required. Salvaged materials and waste/debris would be hauled offsite by truck. Noise from truck traffic on site access roads would be comparable to that during construction. Noise levels at the fenceline from truck traffic on the North access road nearest the Wooden Shoe subdivision are expected to be below the New Hanover County Noise Ordinance.	SMALL. Noise impacts associated with preconstruction activities would be short-term and limited to the immediate vicinity of the proposed GLE Facility. Since the proposed GLE Facility would not be constructed, noise from the existing GE operations at the Wilmington Site would remain unchanged.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Transportation	SMALL to MODERATE. Preconstruction activities would have an impact on traffic conditions. These impacts would be short-term and limited to site access roads and roads in the vicinity of the Wilmington Site. Construction traffic involves the movement of personnel, equipment, and material to and from the proposed GLE Facility site, and the removal of construction debris and waste. The number of truck shipments will vary over the course of construction. Construction activities are estimated to add an average of approximately 35 trucks per day, with a small impact on local traffic. Prior to start up, an average increase of up to 1428 daily trips by construction personnel is anticipated, with the heaviest traffic occurring in the immediate vicinity of the site entrance. Impacts on roads in the vicinity of the Wilmington Site could be SMALL to MODERATE; regional impacts are expected to be SMALL. Impacts would be reduced if shift changes did not coincide with peak traffic volume times. GLE Facility operations would overlap with the construction period for 5–6 years, during which time vehicular traffic from commuting operations personnel would be combined with traffic from construction workers and shipments. An average of approximately six additional truck shipments per day to and from the Wilmington Site would occur during GLE Facility operations. The average number of workers (construction and operations personnel) commuting on a daily basis during start up and construction completion is anticipated to be 590, with about 350 permanent operations personnel employed over the remainder of the operational period. The average number of additional daily vehicle trips from facility activities will increase by about 1239 at the Wilmington Site during joint construction and operations activities. Once construction is complete, the average number of daily trips associated with operations personnel is estimated to be approximately 735. The range of additional daily vehicle trips from facility operations (735 to 1239) would have a MODERATE impact	SMALL. Preconstruction activities would have an impact on traffic conditions. These impacts would be short-term and limited to site access roads and roads in the vicinity of the Wilmington Site. Since the proposed GLE Facility would not be constructed, there would be no further transportation impacts related to the proposed GLE Facility in the vicinity of the Wilmington Site.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Transportation (Cont.)	on the local road network. However, the impact on regional traffic flow is expected to be SMALL. Operations of the proposed GLE Facility will require the shipment (by truck) of various radioactive materials to and from the facility. Vehicle-related risks result from a vehicle moving from one location to another (independent of cargo characteristics), while cargo-related risk refers the risk from cargo being shipped. In the case of the uranium, cargo-related risks include exposure to ionizing radiation during normal transportation and accident conditions, as well as chemical hazards during accident conditions. Less than one latent cancer fatality is anticipated for the public and transportation crews from all shipments on an annual basis. No latent fatalities from vehicle emissions are anticipated on an annual basis. Overall annual transportation accident impacts from the proposed action are expected to be SMALL. Chemical impacts would be negligible, as past analyses of depleted UF_6 shipments have shown the estimates of irreversible adverse effects to be approximately 1 to 3 orders of magnitude lower than the estimates of public latent cancer fatalities from radiological accident exposure. No fatalities are expected from accidents (direct physical trauma) on an annual basis. Initial decommissioning activities during the last year of operations would increase the total number of workers. The number of truck shipments to offsite locations during this period is expected to be approximately the same as during construction. Local and regional transportation impacts would be SMALL after operations cease due to the decrease in workers during decommissioning. Radioactive waste from decommissioning would be sent to the appropriate storage, treatment, and disposal facilities. Impacts from radioactive waste shipments would be SMALL due to the low levels of external radiation and the low number of shipments.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Public and Occupational Health	SMALL. Occupational exposures during preconstruction would be minor and minimized using work practices and personal protective equipment. Preconstruction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust. Occupational exposures during construction would be minor and minimized using work practices and personal protective equipment. Preconstruction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust. Construction activities would not generate radiological contamination but could disturb areas previously contaminated by past and current operations. Construction workers could also be exposed to emissions from the proposed GLE Facility during the overlap of construction and operation. The maximum possible dose would be a small fraction of background radiation exposure and less than 1 mSv per year (100 mrem per year). Dose to the offsite public would be significantly less, as there is no potential for measurable exposure from existing site contamination. A total of 324 total recordable incidents, 197 lost workday incidents, and less than one fatal injury are projected for 38 years of GLE Facility operation. Lasers would normally be operated within enclosures and equipped with interlocks to prevent inadvertent worker exposure. The greatest potential for occupational exposure in the main process building would be from connecting and disconnecting UF_6 cylinders. Airborne concentrations of HF and uranyl fluoride inside facilities are expected to be insignificant, and workers would use ventilation equipment to minimize exposures. Concentrations near the release point could be as high as 10 percent of the	SMALL. Occupational exposures during preconstruction would be minor and minimized using work practices and personal protective equipment. Preconstruction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust. Since the proposed GLE Facility would not be constructed, public and occupational health risks to onsite workers and the public would remain unchanged.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Public and Occupational Health (Cont.)	Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit and would be limited by ventilation equipment. Large volumes of UF_6 would be present as feed and product material, but there would be no routine exposures to solid or liquid UF_6. Exposure to industrial chemicals would be limited by minimizing airborne releases and use of protective equipment. Potential long-term, low-level HF and uranium exposure to the public would be the primary offsite chemical exposures of concern. However, only minor quantities of UF_6 or HF would escape the facility ventilation system, and the quantity of HF passing through the emissions control devices would be below levels established in the facility air permit and protective of public health. UF_6 and HF levels at the site boundary and the location of the nearest resident would be lower than onsite levels. HF concentrations at all exposure locations are far below the most stringent state or Federal ambient air quality standards for the general public. No criteria air pollutants would be produced by the enrichment process. Facility operation could result in radiation exposure to the public via uranium releases or direct external radiation exposure. UF_6 gas released in the main process building would pass through a ventilation system to minimize external release. Liquid effluents would be treated and sampled to limit releases. Direct exposure to the public could occur from onsite uranium and transportation both onsite and offsite. Direct radiation and skyshine from airborne releases would be undetectable at offsite areas. The NRC public release limits for uranium in air and liquid effluents would be met. Radioactive materials at the proposed GLE Facility would present the possibility for onsite members of the public to receive a direct radiation dose. Because of cylinder shielding and the distance to	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Public and Occupational Health (Cont.)	receptors, stored cylinders of depleted uranium are expected to have only a minor effect on the exposure rate at the site boundary. Radioactive process wastewater would be collected and sampled before routing to a liquid effluent treatment system. Treated liquid effluent would be discharged to the existing final process lagoon facility. Water from the lagoon facility would be discharged through a permitted outfall to the site effluent channel. Sanitary wastewater would be treated in the existing sanitary wastewater treatment facility, and treated effluent would replace cooling tower blowdown. Stormwater runoff would drain into a stormwater wet detention basin before discharge. A separate holding pond would collect stormwater runoff from the UF_6 storage pads, where the runoff would be monitored before discharge to the wet detention basin. Discharges from all liquid effluent streams would be released into the Wilmington Site effluent channel and flow to the Northeast Cape Fear River through Unnamed Tributary #1. There are no public water intakes on the Northeast Cape Fear River downstream of the discharge point, so the only exposure pathways of concern are fish ingestion and those relating to recreational water use. Calculated doses to a maximally exposed individual and the surrounding population from liquid effluent releases are well below 1 millisievert per year. Decommissioning plans would involve decontamination of structures and selected facilities to free-release levels before allowing them to remain in place for future use. Leaving the buildings would minimize the number of workers required for decommissioning, which would reduce the number of injuries compared to building removal. Occupational injuries would be reduced in number in accordance with the reduced effort required for decommissioning. Residual contamination would be decontaminated to free-release levels or removed from the site and disposed of in a low-level radioactive waste facility.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Public and Occupational Health (Cont.)	The annual occupational dose during decontamination and decommissioning is expected to be in the range of 0.05–1.5 mSv millisievert (5–150 mrem), which is comparable to the average dose from the operating fuel facilities (1.3–1.5 mSv [130–150 mrem]). Therefore, the occupational dose during decontamination and decommissioning would be bounded by potential exposures during operations. Similar uranium handling would be involved during operations that purge the laser-enrichment lines. Once this decontamination is completed, the remaining quantity of UF_6 would be residual and significantly less than handled during operations. Because systems containing residual UF_6 would be opened, decontaminated, and dismantled, an active environmental monitoring and dosimetry (external and internal) program would be conducted to maintain doses As Low As Reasonably Achievable (ALARA). Chemical exposures would be similarly limited.	
Waste Management	SMALL. Preconstruction activities would occur and generate construction-related waste streams. Solid nonhazardous wastes generated during construction would be similar to wastes from other industrial construction sites and transported offsite to an approved local landfill. Construction activities would generate less than 2 percent of the waste that the New Hanover County Landfill receives annually from all other sources. Small quantities of organic solvent-based residuals could be used and may require management as hazardous waste. Hazardous wastes from construction would be packaged and shipped offsite to licensed facilities. Facility operations would result in the generation of wastewaters that would be treated onsite before discharge and solid wastes that would be treated (onsite or offsite) and shipped for disposal offsite. Sanitary wastewater would be collected by a sewer system connected to the existing Wilmington Site sanitary	SMALL. Preconstruction activities would occur and generate construction-related waste streams. Since the proposed GLE Facility would not be constructed, there would be no additional waste generated at the Wilmington Site beyond the waste generated by existing GE activities.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Waste Management (Cont.)	wastewater treatment facility, increasing the load on the existing system by about one-third. Treated sanitary wastewater effluent could be used as makeup water in onsite cooling towers. Should discharges to surface waters be necessary, the existing NPDES discharge permit would be adequate to cover the additional effluent volume. Cooling tower blowdown would be sent to the Wilmington Site's final process lagoons. Radioactive process wastewater from facility operations would be collected and treated to remove uranium, other metals, and fluoride. The treated effluent would be discharged to the process wastewater aeration basin and final process lagoon facility. Impacts from radiological exposure to depleted UF_6 in the cylinder storage pad would be SMALL, and impacts from the conversion of depleted UF_6 generated by the proposed GLE Facility would be SMALL. The waste management facilities used during operations would also be used during decontamination and decommissioning. With the decrease in workers from operations to decommissioning, sanitary wastewater treatment volumes would decline. Materials and equipment eligible for recycling or nonhazardous disposal would be sampled or surveyed to ensure that contaminant levels are below release limits. Buildings and other structures would be decontaminated and the debris shipped offsite for disposal. Radioactive material from decontamination and contaminated equipment would be packaged and shipped offsite to an appropriately licensed disposal facility. Staging and laydown areas would be segregated and managed to prevent contamination of the environment and creation of additional wastes.	

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Socioeconomics	SMALL. Preconstruction activities would increase the number of onsite construction workers resulting in a short-term increase in the demand for rental housing and public services in the vicinity of the Wilmington Site. Two types of jobs would be created by the proposed action: (1) construction and start-up related jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) operation-related jobs in support of the proposed GLE Facility operations, which have the greater potential for permanent, long-term socioeconomic impacts within the socioeconomic region of influence (ROI). The ROI covers three counties in North Carolina – Brunswick County, New Hanover County, and Pender County. During the peak year of construction (2012), 680 construction workers would be at the proposed GLE Facility site and there would be an additional 3131 indirect jobs created in the ROI. Construction activities would generate $139.8 million in income in the ROI, including $1.7 million in State income taxes and $1.2 million in State sales taxes. The number of construction workers relocating from outside the region could cause a short-term increase in the demand for temporary (rental) housing and services in the ROI. Facility start-up activities would create 200 new jobs in the ROI. Start-up activities would generate $28.0 million in income in the ROI, including $1.3 million in State income taxes and $0.92 million in State sales taxes. Again, the number of start-up workers relocating from outside the region could cause a short-term increase in the demand for temporary (rental) housing and services in the ROI. GLE Facility operations would create 350 new jobs in the ROI and would generate $51.5 million in income in the ROI, including $2.3 million in State income taxes and $1.7 million in State sales taxes. The number of GLE Facility operations workers relocating from outside the region could affect local housing markets and increase the demand for public services. However, the relatively small	SMALL. Preconstruction activities would increase the number of onsite construction workers resulting in a short-term increase in the demand for rental housing and public services in the vicinity of the Wilmington Site. Since the proposed GLE Facility would not be constructed, population and employment in the ROI would change in accordance with current projections.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Socioeconomics (Cont.)	number of operations workers (161 to 210) estimated to relocate to the ROI would limit the impact. Decontamination and decommissioning activities in the first year would create 50 new jobs at the GLE Facility site. Decommissioning would generate $6.1 million in income in the ROI in the first year. Facility decommissioning would produce less than $0.3 million in direct State income taxes and less than $0.2 million in direct State sales taxes. Decommissioning activities would constitute less than 1 percent of total ROI employment in the first year.	
Environmental Justice	Under the proposed action, preconstruction activities would result in impacts on minority and low-income populations, mostly consisting of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts would be short-term and limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased commuter vehicle traffic during shift changes. Increased demand for rental housing could disproportionately affect low-income populations. However, due to the short duration of preconstruction activities and the availability of rental housing, impacts to minority and low-income populations would be short-term and limited. The majority of environmental impacts associated with the construction and operation of the proposed GLE Facility would be SMALL to MODERATE (SMALL for all resource areas during decommissioning) and would generally be mitigated. Because impacts to the general population within 4 miles of the proposed facility would be SMALL to MODERATE, the various phases of facility development are not expected to result in disproportionately high and adverse impacts on low-income or minority residents. Even when environmental impacts are anticipated to be SMALL for the general population, some population groups, such as those	Potential impacts on minority and low-income populations from preconstruction activities would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts would be short-term and limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased commuter vehicle traffic during shift changes. Increased demand for rental housing during preconstruction could disproportionately affect low-income populations. However, due to the short duration of the preconstruction activities and the availability of rental housing, impacts on minority and low-income populations would be short-term and limited. Since the proposed GLE Facility would not be constructed, there would be no further impacts on minority and low-income populations residing in the vicinity of the Wilmington Site.

Table 2-3 Summary of Environmental Impacts for the Proposed GLE Facility and the No-Action Alternative (Cont.)

Affected Environment	Proposed Action: GLE would construct, operate, and decommission the proposed GLE Facility in Wilmington, North Carolina.	No-Action Alternative: The proposed GLE Facility would not be constructed.
Environmental Justice (Cont.)	participating in subsistence hunting and fishing could experience disproportionate exposure. However, air and liquid radiological releases from the proposed GLE Facility are projected to be extremely low, and exposure through fish consumption would be even lower. Preconstruction, construction, operation, and decommissioning of the proposed GLE Facility is not expected to result in disproportionately high and adverse impacts to minority, low-income, or subsistence consumption populations.	The no-action alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the Wilmington Site.
Accidents	SMALL. Representative accident scenarios vary in severity from intermediate- to high-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. Two of the accidents involve criticality and the other three involve the release of UF_6. If the higher consequence criticality accident were to occur, the consequence for a worker in close proximity would be high (fatality), but GLE has committed to various preventive and mitigating measures to significantly reduce these consequences. Worker radiological health consequences are low for scenarios involving the release of UF_6. Worker health consequences are low to high for scenarios involving HF exposure, and intermediate to high for scenarios involving uranium chemical exposure. Radiological consequences to a maximally exposed individual at the Controlled Area Boundary are low for the criticality accidents and all UF_6 release scenarios. Chemical consequences at the Controlled Area Boundary are low to intermediate for uranium and HF exposure scenarios. Risk to the offsite public in the direction of highest exposure is estimated to be less than one lifetime cancer fatality for all accident scenarios. Plant design, passive and active engineered controls, and administrative controls would reduce the likelihood of accidents. Therefore, the probability-weighted consequence (or risk) from accidents under these conditions is expected to be SMALL. No facility accidents would occur after the cessation of operations, so there would be no potential for facility accidents during decommissioning.	SMALL. The proposed GLE Facility would not be constructed, so there would be no potential for facility accidents during decommissioning.

of UF_6. The range of alternatives was determined by considering the underlying purpose and need for the proposed action. Specifically, the range of alternatives was determined by considering other ways to provide enriched uranium to fulfill electricity generation requirements and provide reliable and economic domestic supplies of enriched uranium for national energy security. This analysis led to the following set of alternatives:

- alternative sites outside of the Wilmington Site
- alternative sites within the Wilmington Site
- alternative sources of low-enriched uranium
- alternative technologies available for uranium enrichment

These alternatives – with the exception of gas centrifuge – were considered but eliminated from further analysis due to economic, environmental, national security, or technological maturity. The following sections discuss these alternatives and the reasons the NRC eliminated them from further consideration. The gas centrifuge alternative is discussed in Section 2.3.4.

2.3.1 Alternative Sites

This section discusses GLE's site-selection process, identifies the candidate sites for the proposed GLE Facility, and discusses the criteria used in the selection process. GLE undertook a site-selection process to identify viable locations for the proposed GLE Facility (GLE, 2008), which yielded one alternate candidate site (Morris, Illinois) in addition to the proposed site. The details of these two sites are discussed below.

Since many environmental impacts can be avoided or significantly reduced through proper site selection, the NRC reviewed the GLE site-selection process to determine if a site considered by GLE was obviously superior to the proposed site in Wilmington, North Carolina (NRC, 2002). The NRC has determined that the process used by GLE is rational and objective, and that its results are reasonable. None of the candidate sites was obviously superior to the GLE preferred site in Wilmington, North Carolina.

2.3.1.1 Alternative Sites Outside of the Wilmington Site

GLE considered two approaches for the examination of alternate candidate sites: (1) the purchase of undeveloped land (i.e., an undisturbed "greenfield" site) and (2) colocation at an existing nuclear facility site or at a site that has been previously considered for a nuclear facility (including sites where planning and construction of a nuclear facility were halted). Due to the environmental advantages, and for commercial reasons (including scheduling considerations), GLE focused on the second approach (GLE, 2008). These advantages include previous selection as environmentally suitable sites (and possibly superior, as compared to others in the surrounding region), vetting as reasonable candidates through previous site studies and regulatory licensing proceedings, community support, and existing nuclear operations infrastructure (GLE, 2008). The availability of existing infrastructure likely reduces the amount of land disturbance and the resulting environmental impacts.

GLE Site-Selection Process

GLE evaluated 22 sites throughout the eastern United States. The site-selection process, used to locate a suitable site for construction, operation, and decommissioning of the proposed GLE Facility, was based on various technical, safety, economic, and environmental factors. A multi-attribute utility-analysis methodology was used for site selection that incorporated all of these factors to assess the relative benefits of a site with multiple, often competing, objectives or criteria. Figure 2-4 shows the site-selection process used by GLE and the results from the application of the process (GLE, 2008).

The GLE multi-step site-selection process consisted of:

- identification of candidate sites
- initial screening
- coarse screening
- site-reconnaissance visits
- fine screening
- qualitative cost-benefit analysis

Because most of the fuel-cycle facilities and ports of entry for feed material are located in the eastern United States or Ontario, Canada, and because the material would be transported by truck within the borders of the United States, GLE chose its region of interest for the purposes of site selection to be the area inside a 600-mi radius that encompasses the locations of the operating fuel-cycle facilities in the eastern United States (Figure 2-5). It follows, for GLE's analysis, that the Richland, Washington, facility was excluded due to its distant location.

The 22 candidate sites considered by GLE are listed in Table 2-4. Initial screening included evaluation of "Go/No Go" criteria, including the impacts and hazards from seismic zones, proximity to Quaternary fault zones, and flood potential. This initial screening resulted in elimination of three sites from further consideration, all due to their location within a seismic hazard zone: Westinghouse Electric Company (Columbia, South Carolina); Honeywell Specialty Chemicals/ConverDyn (Metropolis, Illinois); and the DOE site in Paducah, Kentucky (GLE, 2008).

Coarse screening criteria – also "Go/No Go" – included sufficient land availability, government ownership, potential litigation or political opposition, and *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) Superfund or RCRA Corrective Action status. Government-owned sites were eliminated due to anticipated delays in the potential acquisition of public property, and CERCLA Superfund and RCRA Corrective Action sites were similarly eliminated due to anticipated difficulties with land purchase and transfer (GLE, 2008). Worker safety would also present an issue for these sites, due to the presence of hazardous substances. Application of the coarse screening criteria resulted in the elimination of 16 sites; one due to insufficient land availability, ten due to government ownership, four due to potential litigation or political opposition, and four due to CERCLA Superfund or RCRA Corrective Action status (three of which are also government-owned).

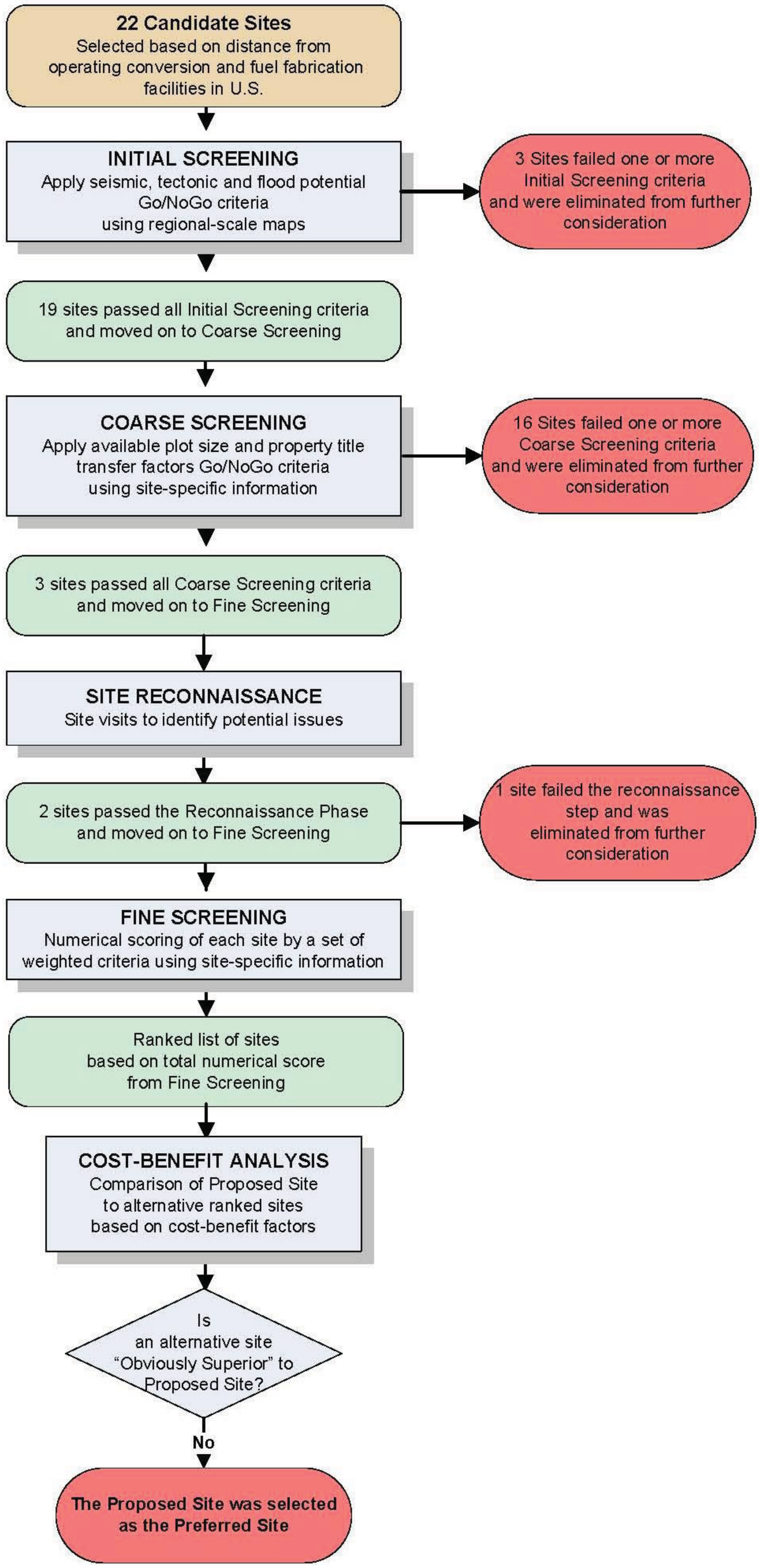


Figure 2-4 GLE Site-Selection Results Summary (GLE, 2008)

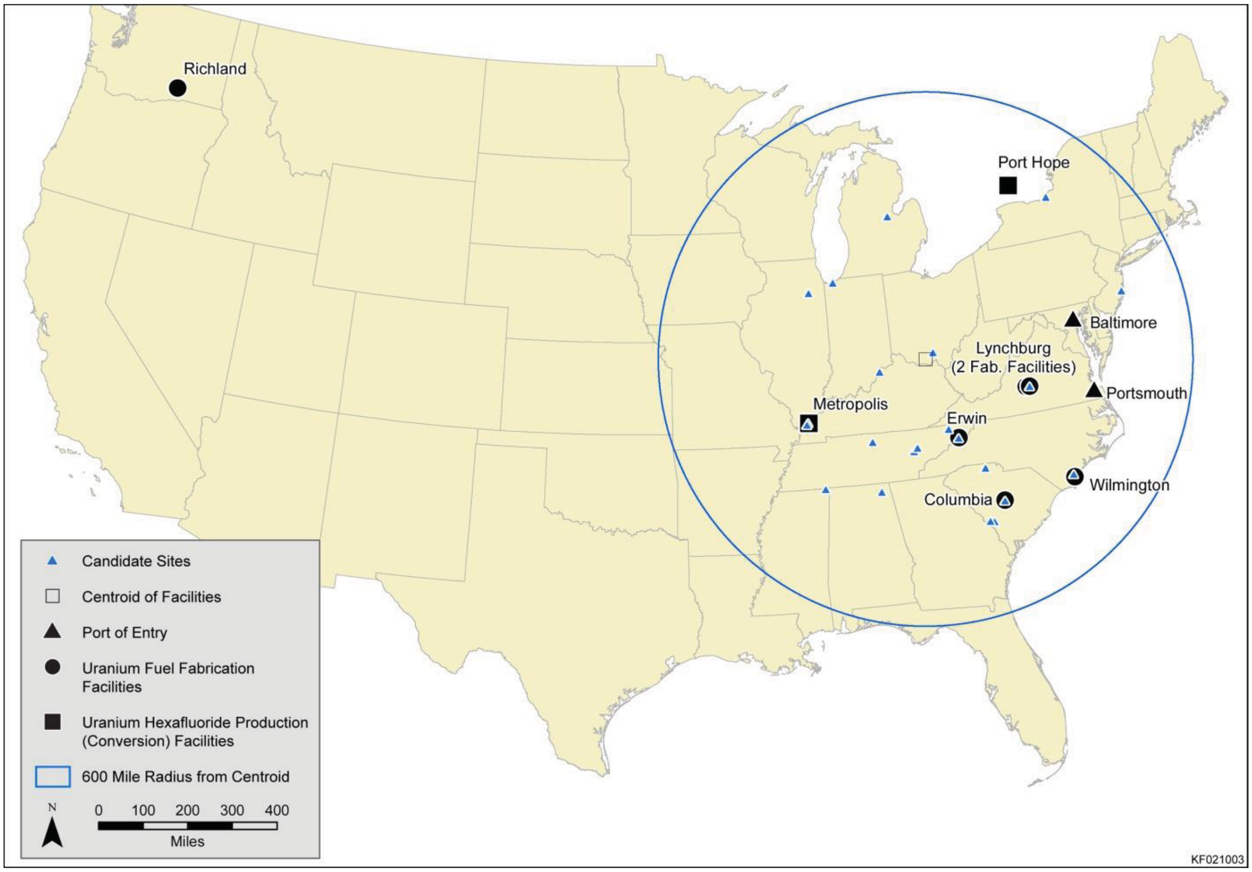


Figure 2-5 Candidate Sites for the Proposed GLE Facility (GLE, 2008)

At the conclusion of the coarse screening evaluation, three sites remained: the GE site in Wilmington, North Carolina (the proposed site); the GE-owned site in Morris, Illinois; and the Duke Energy site in Cherokee, South Carolina.

As indicated in Figure 2-3, GLE evaluated the three remaining sites in a subsequent site-reconnaissance step. The GLE team visited all three sites to identify potential issues that contributed to the “Go/No Go” decision. Among the factors considered were additional planned land use, physical layout of existing facilities and infrastructure, current and future plans at the site, and potential complications related to properties adjacent to the site. Based on these considerations, GLE determined that Duke Energy’s plans for the Cherokee site (specifically, the construction and operation of a new nuclear power plant) were not compatible with GLE’s plans and needs for the construction, operation, and decommissioning of an enrichment facility. Therefore, the Cherokee site was eliminated from further consideration.

GLE evaluated the final two candidate sites (the Wilmington Site and the 889-acre [356 hectare] Morris site), including multi-attribute decision analysis based on a set of fine screening criteria and a cost-benefit analysis. The fine screening criteria were grouped around four general clusters as shown below. Weighting factors were derived by a panel of experts considering a set of subcriteria for each of the four clusters. These subcriteria are listed below under each cluster. In most cases, the subcriteria are further subdivided into finer criteria. For example, the

Table 2-4 Candidate Sites Considered for the Proposed GLE Facility

Site Name	Existing Nuclear Facility	Description	Owner/Operator
Bailly, IN	No	The site had a construction permit to build a nuclear power plant, which was cancelled in 1981. After long delays and growing local opposition, the Northern Indiana Public Service Company (NIPSC) ended the controversy by canceling plans to build the nuclear plant at the Bailly Site.	Northern Indiana Public Service Company (NIPSC)
Barnwell, SC	Yes	Low-level waste disposal facility.	State of South Carolina/ Energy Solutions
Bellefonte, AL	Yes	Uncompleted nuclear power plant (in the Final Environmental Assessment, the Tennessee Valley Authority (TVA), in 2006, reported that it approved the cancellation of the BLN construction project pending NRC notification). The BLN plant site now is under consideration as the location of an advanced boiling water reactor. In October 2007, TVA submitted a combined license application for proposed Bellefonte Nuclear Station Units 3 and 4.	Tennessee Valley Authority
Cherokee, SC	No	The site had a construction permit under review, which was cancelled 1982–1983. In December 2007, Duke Energy filed a combined license application for proposed Units 1 and 2 at the William States Lee III Nuclear Site (formerly called the Cherokee Site).	Duke Energy
Clinch River Industrial Site, TN	No	Clinch River Breeder Reactor project was cancelled in 1983. The 687-ha (1700-ac) area is adjacent to the Clinch River, approximately 21 km (13 mi) west of Oak Ridge, and is partially developed and for sale by the TVA.	Tennessee Valley Authority
Columbia, SC	Yes	Active uranium fuel-fabrication facility.	Westinghouse Electric Company
Erwin, TN	Yes	Active uranium fuel-fabrication facility.	Nuclear Fuel Services, Inc.
Forked River, NJ	No	The site had a construction permit, which was cancelled in 1980. The 266-ha (657-ac) area is adjacent to the Oyster Creek Nuclear Generating Station (OCNGS).	AmerGen Energy Company, LLC

Table 2-4 Candidate Sites Considered for the Proposed GLE Facility (Cont.)

Site Name	Existing Nuclear Facility	Description	Owner/Operator
Hartsville, TN	No	The site had a construction permit, which was cancelled in 1982–1984. In August 2003, Louisiana Energy Services, L.P. (LES) ended efforts to build a uranium-enrichment facility in Tennessee (zoning approval issues due to local opposition to proposed facility).	Tennessee Valley Authority
Lynchburg, VA	Yes	Active uranium fuel-fabrication facilities. The Mount Athos site consists of the following facilities: the BWXT Nuclear Products Division (NPD) and AREVA NP. The NPD is a manufacturer of nuclear components for government agencies and the DOE. In addition, the NPD operates a uranium-recovery facility and a uranium-downblending facility.	AREVA NP, Inc./BWX Technologies, Inc.
Marble Hill, IN	No	The site had a construction permit, which was cancelled in 1985 due to cost overrun. In 1998, PSI Energy sold the property to Debbie and Dean Ford, who sold some buildings to a Michigan company in 2005.	Debbie and Dean Ford
Metropolis, IL	Yes	Active uranium hexafluoride production (conversion) facility. 10-year license renewal was issued in May 2007.	Honeywell Specialty Chemicals/ConverDyn
Midland, MI	No	The site had a construction permit, which was cancelled in 1986. The unfinished Midland Nuclear Power Plant was converted to a combined-cycle, natural-gas-fired cogeneration facility.	MCV Power Partners, Inc.
Morris, IL	Yes	Spent-fuel storage facility. Near Dresden Reactors.	GE Company
Oak Ridge, TN	Yes	Nuclear research facility.	DOE
Paducah, KY	Yes	Gaseous-diffusion plant.	DOE/U.S. Enrichment Corporation
Phipps Bend, TN	No	The site had a construction permit, which was cancelled in 1982. The reactor was demolished.	Tennessee Valley Authority
Portsmouth/Piketon, OH	Yes	Existing gaseous-diffusion plant; gas centrifuge plant under construction.	DOE

Table 2-4 Candidate Sites Considered for the Proposed GLE Facility (Cont.)

Site Name	Existing Nuclear Facility	Description	Owner/Operator
Savannah River, SC	Yes	Nuclear materials processing center.	DOE
Sterling, NY	No	The site had a construction permit, which was cancelled in 1980. Adjacent to operational nuclear power plant (FitzPatrick, Oswego, NY). Cayuga County purchased the property in 1994 and opened the Sterling Nature Center.	Cayuga County
Wilmington, NC	Yes	Active uranium fuel-fabrication facility.	GE Company
Yellow Creek, MS	No	The site had a construction permit, which was cancelled in 1984.	Tennessee Valley Authority

Source: GLE, 2008.

subcriterion listed as water resources under the “Impacts to the Environment” cluster was divided into physical surface water impacts, water quality impacts, and water quantity impacts (GLE, 2008).

1. Impacts to the Environment (weighting factor = 0.27)
   - public health and safety
   - socioeconomic impacts
   - ecology
   - water resources
   - air quality
   - noise
   - historic and archeological sites
   - visual impacts

2. Impacts to the Facility (weighting factor = 0.25)
   - geologic hazards
   - colocated or nearby hazardous land uses
   - meteorology and climatology
   - wildfires

3. Impacts to Time and Cost (weighting factor = 0.24)
   - contamination
   - existing infrastructure
   - colocation
   - site physical characteristics
   - site development

4. Employment and Stakeholders (weighting factor = 0.24)
   - stakeholder support
   - labor force

Using site-specific data, GLE ranked the two sites based on the above criteria and weighting factors. The results of this evaluation are discussed below and shown in Table 2-5. The Wilmington Site ranked more favorably in the "Impacts to the Environment," "Impacts to Time and Cost," and "Employment and Stakeholders" clusters, whereas the Morris site ranked more favorably in the "Impacts to Facility" category (GLE, 2008). Overall, the weighted scores for the Wilmington and Morris sites were 0.525 and 0.475, respectively.

GLE performed a qualitative cost-benefit analysis between the two sites, which indicated that the net benefits of locating the proposed GLE Facility at the Wilmington Site were slightly higher than those associated with locating the same facility at the Morris site (GLE, 2008). GLE determined that its costs would be somewhat less at the Wilmington Site than at the Morris site. This was due to lower labor cost in the Wilmington area and the fact that the colocated GE/GNF-A conversion and fuel fabrication facility would be one of the primary customers of the proposed GLE Facility, thus reducing transportation costs (GLE, 2008).

Based on the above assessment, the NRC has determined that the GLE site selection process has a rational, objective structure and is reasonable. None of the candidate sites was obviously superior to the GLE preferred site in Wilmington, North Carolina; therefore, no other site was selected for further analysis.

2.3.1.2 Alternative Locations at the Wilmington Site

GLE evaluated alternative locations at the Wilmington Site in North Carolina and selected the proposed location because, compared to other potential onsite locations, the proposed site would result in fewer environmental impacts. GLE concluded that the proposed site would result in fewer impacts to the floodplain of the North Cape Fear River (Figure 3-9). The proposed site also minimizes impacts on or avoids surface water features, wetlands, and rare ecological resources (Figure 3-8 and Section 3.8). Of the remaining site areas, GLE found the proposed location to be most suitable for accommodating the footprint (construction and laydown areas) of the proposed GLE Facility (Figure 2-2). Most of the Eastern Site Sector is populated by existing development. The NRC reviewed the alternative locations at the Wilmington Site and concurred that the proposed facility site would result in the fewer impacts to wetlands, streams, and ecological resources.

Table 2-5 Ranking Results for the Sites in Morris, Illinois, and Wilmington, North Carolina

Criterion	Morris, IL, Site	Wilmington, NC, Site
Intermediate Unweighted Scores:		
Impacts to Environment	0.484	0.516
Impacts to the Facility	0.592	0.408
Impacts to Time and Cost	0.378	0.622
Employment and Stakeholders	0.439	0.561
Final Weighted Score	0.475	0.525

2.3.2 Alternative Sources of Low-Enriched Uranium

The NRC examined three alternatives to fulfill U.S. domestic enrichment needs (as summarized below). These alternatives were eliminated from further consideration for reasons summarized below.

2.3.2.1 Re-Activate the Portsmouth Gaseous Diffusion Facility at Piketon

In 2001, USEC closed the Portsmouth GDP in Piketon, Ohio, to reduce operating costs (DOE, 2003). USEC cited long-term financial benefits, more attractive power price arrangements, operational flexibility for power adjustments, and a history of reliable operations as reasons for choosing to continue operations at the Paducah GDP. In a June 2000 press release, USEC explained that it "clearly could not continue to operate two production facilities." Key business factors in USEC's decision to reduce operations to a single production plant included long-term and short-term power costs, operational performance and reliability, design and material condition of the plants, risks associated with meeting customer orders on time, and other factors relating to assay levels, financial results, and new technology issues (USEC, 2000).

The NRC does not believe that there has been any significant change in the factors that were considered by USEC in its decision to cease uranium enrichment at the Portsmouth GDP. The staff's view is based on the following factors:

- the gaseous diffusion technology is substantially more energy-intensive than other enrichment technologies, and the higher energy consumption results in larger indirect impacts, especially those impacts that are attributable to significantly higher electricity usage (e.g., air emissions from coal-fired electricity generation plants) (DOE, 1995).
- the age of the existing plant also calls into question its overall reliability.
- DOE has awarded a contract to decommission the plant (DOE, 2010) and the first buildings have been de-leased back to DOE for decommissioning (NRC, 2010b). Additionally, in October 2011, the Certificate of Compliance for Portsmouth GDP was terminated by NRC (NRC, 2011b).

Therefore, this proposed alternative was eliminated from further consideration.

2.3.2.2 Downblending Highly Enriched Uranium

Under this alternative, a domestic uranium enrichment plant would not be constructed to replace existing production. Instead, an equivalent amount of SWU would be obtained from downblending highly enriched uranium from either United States or Russian nuclear warheads. This alternative was eliminated because U.S. reliance on foreign sources of enrichment services, as an alternative to the proposed action, would not meet the national energy policy objective of a "viable, competitive, domestic uranium enrichment industry for the foreseeable future" (DOE, 2000). Also, it does not meet the need for a reliable source of enriched uranium, as discussed in Section 1.3. Furthermore, the Megatons to Megawatts downblending agreement is set to expire in 2013.

2.3.2.3 Purchase Low-Enriched Uranium from Foreign Sources

There are several potential sources of enrichment services worldwide. However, U.S. reliance on foreign sources of enrichment services, as an alternative to the proposed action, would not meet the national energy policy objective of a "viable, competitive, domestic uranium enrichment industry for the foreseeable future" (DOE, 2000). For this reason, the NRC does not consider that this alternative meets the need for the proposed action, and therefore, has eliminated it from further study.

2.3.3 Alternative Technologies for Enrichment

A number of different processes have been invented for enriching uranium; only three (gaseous diffusion, gas centrifuge, and laser excitation) are considered candidates for commercial use, and of those, only the gaseous diffusion and gas centrifuge technologies have been deployed for large-scale industrial use. Other technologies – namely, electromagnetic isotope separation, liquid thermal diffusion, and early-generation laser enrichment – have proven too costly to operate, remain at the research and laboratory developmental scale, or in the case of laser-enrichment have been superseded by a more advanced technology. All of these technologies are discussed below.

2.3.3.1 Electromagnetic Isotope Separation Process

Figure 2-6 shows a sketch of the electromagnetic isotope separation process. In this process, a monoenergetic beam of ions of normal uranium travels between the poles of a magnet. The magnetic field causes the beam to split into several streams according to the mass of the isotope. Each isotope has a different radius of curvature and follows a slightly different path. Collection cups at the ends of the semicircular trajectories catch the homogenous streams. Because the energy requirements for this process proved very high – in excess of 3000 kilowatt hours per SWU – and production was very slow (Heilbron et al., 1981), electromagnetic isotope separation was not considered viable and has been removed from further consideration.

2.3.3.2 Liquid Thermal Diffusion

Figure 2-7 is a diagram of the liquid thermal diffusion process, which was investigated in the 1940s. It is based on the concept that a temperature gradient across a thin layer of liquid or gas causes thermal diffusion that separates isotopes of differing masses. When a thin, vertical column is cooled on one side and heated on the other, thermal convection currents are generated and the material flows upward along the heated side and downward along the cooled side. Under these conditions, the lighter UF_6 molecules diffuse toward the warmer surface and heavier UF_6 molecules concentrate near the cooler side. The combination of this thermal diffusion and the thermal convection currents causes the lighter uranium-235 molecules to concentrate on top of the thin column while the heavier uranium-238 goes to the bottom. Taller columns produce better separation. Eventually, a facility using this process

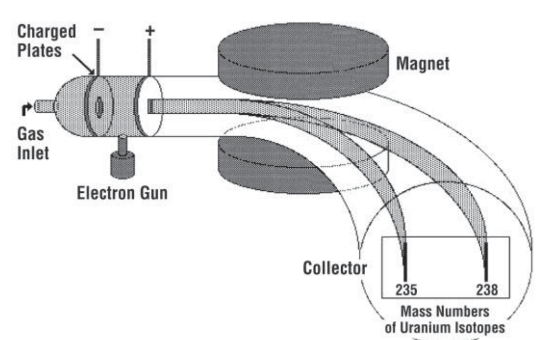


Figure 2-6 Electromagnetic Isotopic Separation Process (Milani, 2005)

was designed and constructed at Oak Ridge, Tennessee, but it was closed after about a year of operation because of cost and maintenance concerns (Settle, 2004). Based on high operating costs and high maintenance requirements, the liquid thermal diffusion process has been eliminated from further consideration.

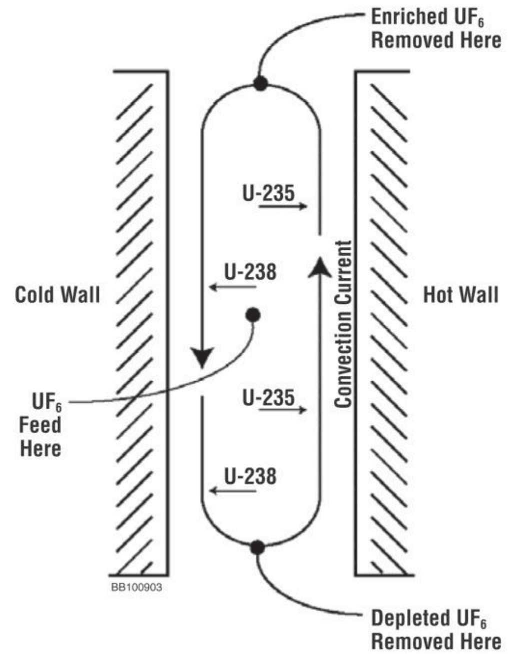


Figure 2-7 Liquid Thermal Diffusion Process (NRC, 2005b)

2.3.3.3 Gaseous Diffusion Process

The gaseous diffusion process is based on molecular effusion, a process that occurs whenever a gas is separated from a vacuum by a porous barrier. The gas flows from the high-pressure side to the low-pressure side. The rate of effusion of a gas through a porous barrier is inversely proportional to the square root of its mass. Thus, lighter molecules pass through the barrier faster than heavier ones. Figure 2-8 is a diagram of a single gas diffusion stage. The gaseous diffusion process consists of thousands of individual stages connected in series to multiply the separation factor.

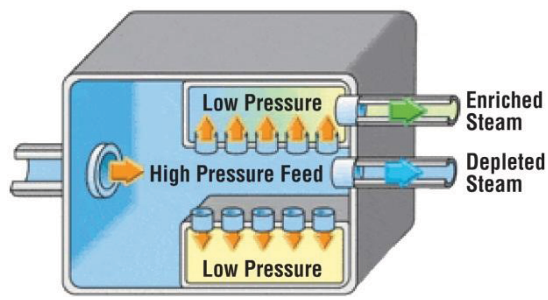


Figure 2-8 Gaseous Diffusion Stage (NRC, 2009b)

Gaseous diffusion is the only enrichment technology in commercial use in the United States, but it has relatively large resource requirements. The Paducah GDP contains 1760 enrichment stages and is designed to produce UF_6 enriched up to 5.5 percent uranium-235. The design capacity of the Paducah GDP is approximately 8 million SWU per year, but it has never operated at greater than 5.5 million SWU. Paducah consumes approximately 2200 kilowatt hours per kilogram of SWU (DOE, 2000). DOE anticipates "the inevitable cessation of all domestic gaseous diffusion enrichment operations" due to the higher cost of aging diffusion facilities (DOE, 2001). Therefore, GDP has been eliminated from further consideration.

2.3.3.4 Atomic Vapor Laser Isotope Separation

The Atomic Vapor Laser Isotope Separation (AVLIS) process, shown in Figure 2-9, is based on the circumstance that different isotopes of the same element, though chemically identical, have different electronic energies and absorb different colors of laser light. The isotopes of most elements can be separated by a laser-based process, if they can be efficiently vaporized into individual atoms or molecules. In AVLIS, uranium metal is vaporized, and the vapor stream is illuminated with a laser light of a specific wavelength that is absorbed only by uranium-235. The laser selectively adds enough energy to ionize or remove an electron from uranium-235 atoms,

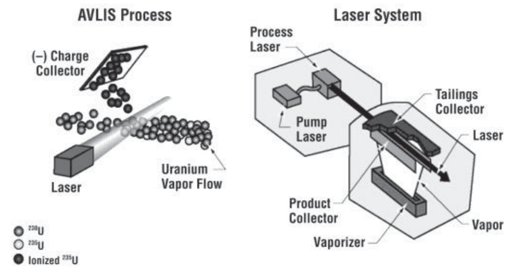


Figure 2-9 Atomic Vapor Laser Isotope Separation Process (Hargrove, 2000)

while leaving the other isotopes unaffected. The ionized uranium-235 atoms are then collected on negatively charged surfaces inside the separator unit. The collected material (enriched product) is condensed as a liquid on the charged surfaces and then drains to a caster, where it solidifies as metal nuggets.

The high separation factor in AVLIS means fewer stages to achieve a given enrichment, lower energy consumption, and smaller waste volume. However, budget constraints compelled USEC to discontinue development of the U.S. AVLIS program in 1999 (USEC, 1999). Because development of the AVLIS process was not continued, and the technology has been superseded by the laser-based technology proposed by GLE, it has been eliminated from further consideration.

2.3.3.5 Molecular Laser Isotope Separation

Like AVLIS, the Molecular Laser Isotope Separation (MLIS) process uses a tuned laser to excite uranium-235 molecules in the UF_6 feed gas. A second laser then dissociates excited molecules into UF_5 and free fluorine atoms. The enriched UF_5 then precipitates and is filtered as a powder from the feed gas. Each stage of enrichment requires conversion of enriched UF_5 back to UF_6. The advantages of MLIS include low power consumption and the use of UF_6 as a process gas. However, it is less efficient and up to four times more energy-intensive than AVLIS. Therefore, all countries except Japan have discontinued development of MLIS. Because development of the MLIS process was not continued, and the technology has been superseded by the laser-based technology proposed by GLE, it has been eliminated from further consideration.

2.3.4 Gas Centrifuge

Figure 2-10 shows the basic components of the gas centrifuge enrichment process, which is a second-generation mechanical technology. A centrifuge consists of a large rotating cylinder (rotor) with piping to feed UF_6 gas into the centrifuge, and then withdraw enriched and depleted UF_6 gas streams. The rotor spins at high speed inside a protective casing, which maintains a vacuum around the rotor and provides physical containment of the rotor in the event of a major machine failure (NRC, 2006).

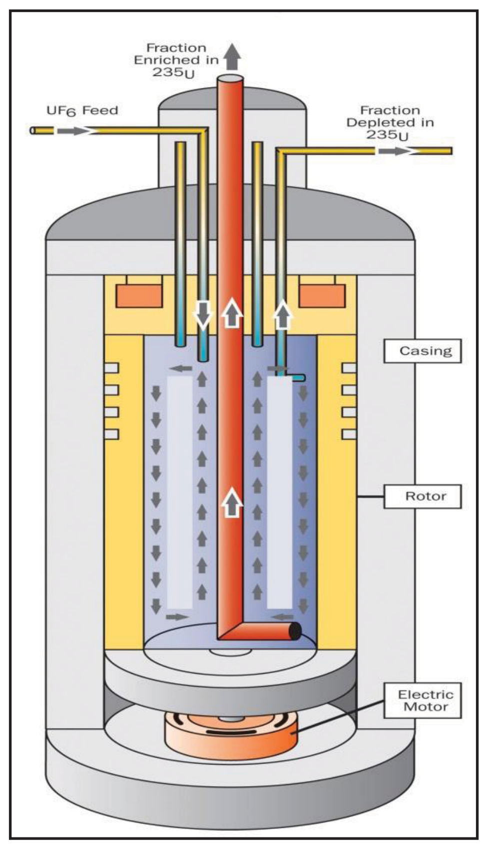


Figure 2-10 Schematic of a Gas Centrifuge (NRC, 2009b)

The enrichment level achieved by a single centrifuge is not sufficient to obtain the desired concentration of uranium-235 in a single step; therefore, a number of centrifuges are connected in series to increase the concentration of the uranium-235 isotope. Additionally, a single centrifuge (or series of centrifuges) cannot process a sufficient volume for commercial production, which makes it necessary to connect multiple centrifuges in parallel to increase the volume flow rate. The arrangement of centrifuges connected in series to achieve higher enrichment and in parallel for increased volume is known as a “cascade” (NRC, 2006).

As discussed in Section 2.2, three other commercial entities are pursuing the gas centrifuge technology for enrichment of uranium in the United States. GLE has selected the laser-based technology and eliminated the gas centrifuge technology from consideration based on the reasons described in Section 1.3.3. These reasons relate primarily to GLE’s belief that the proposed technology will result in lower cost and smaller environmental impacts when compared to the gas centrifuge technology (GLE, 2008).

The NRC recognizes that the gas centrifuge technology is commercially viable and is a reasonable alternative to the proposed laser-based technology. The impacts associated with the construction, operation, and decommissioning of a gas centrifuge enrichment facility were analyzed by NRC in three previous EISs (NRC, 2005b; NRC, 2006; NRC, 2011a). In those EISs, the NRC concluded that the impacts associated with the construction, operation, and decommissioning of the NEF in Lea County, New Mexico; the ACP in Piketon, Ohio; and the EREF in Bonneville County, Idaho; were acceptable for licensing those facilities, unless safety issues mandated otherwise. Based on NRC’s safety and environmental reviews, all of these facilities were granted licenses.

The *National Environmental Policy Act* requires Federal agencies to analyze and disclose the impacts of the proposed action and reasonable alternatives to the proposed action. Therefore, NRC has provided a comparative analysis of the environmental impacts of gas centrifuge and laser technologies (see comparison in Table 2-6). The comparison is necessarily qualitative because, in order to compare the two technologies in a quantitative sense, comparable designs at the same site and with the same throughput would be required. There is no comparable design for a gas centrifuge facility at the Wilmington Site.

The sources of information used by NRC to generate Table 2-6 include Table 2-3 (which includes a more detailed summary of impacts for each resource area for the proposed GLE Facility) and the environmental reports submitted by GLE (GLE, 2008) and AREVA (AES, 2009). This information is relevant because the EREF and the proposed GLE Facility have about the same output (design capacities of 6.6 million SWU per year and 6 million SWU per year, respectively). The NRC also used information from the NEF and ACP environmental reviews (LES, 2005; USEC, 2005; NRC, 2005b; NRC, 2006), along with professional judgment, in preparing the comparison table. Comparing the environmental impacts of different facilities with different designs and different throughputs built at different sites that have varying degrees of pre-existing infrastructure carries a high level of uncertainty. As a result, Table 2-6 is intended to identify potential differences in environmental impacts that may occur if an enrichment facility based on the gas centrifuge technology were to be constructed, operated, and decommissioned at GE’s Wilmington, North Carolina, site instead of the proposed laser-based technology.

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Land Use	The fenced-in area would be approximately 40 ha (100 ac). The disturbed area (roads, parking lots, utilities, etc.) would be approximately 91 ha (226 ac). Construction would affect land use patterns within the proposed facility footprint, but would not alter the overall current land use at the Wilmington Site or affect surrounding land use. Facility operations would be consistent with other industrial activities at the Wilmington Site. Decommissioning would not alter the use of the property or land use on adjacent properties.	The area occupied by a gas centrifuge facility with the same production capacity would be greater than the area occupied by the proposed GLE Facility. It is not clear what the increase in area would be. Similar to the proposed action, construction would affect land use patterns, but would not alter the overall current land use at the Wilmington Site or affect surrounding land use. Based on a review of the designs and area requirements of plants that use the gas centrifuge technology, it appears that the land area required for a centrifuge plant at the Wilmington Site could be 2–3 times larger than the area occupied by the proposed GLE Facility. Similarly, the disturbed area for construction and decommissioning of a gas centrifuge plant could be approximately two times greater. Facility operations would be consistent with existing activities at the Wilmington Site.	Centrifuge
Historic and Cultural Resources	Most impacts would occur prior to construction. While there is potential for ground disturbance in previously undisturbed areas, no construction activities are expected to occur in the portion of the Wilmington Site where historic and cultural resources are known to exist. GLE Facility operation has the potential to affect historic and cultural resources, but impacts are not expected. While GLE has no plans to alter the site during operations, there is a high potential for additional historic and cultural resources to be discovered during routine maintenance activities. GLE has developed procedures for addressing unanticipated discovery of human remains or artifacts. The consideration of historic and cultural resources would be made a	Most impacts would occur prior to construction. However, because of the larger footprint and larger disturbed area for a gas centrifuge facility, the potential for impacts on significant resources due to construction would be greater. The determination of adverse impacts (and the differences between the two technologies) would largely depend on where on the Wilmington Site the facility would be constructed, operated, and decommissioned, and if any significant historic and cultural resources would be present.	Centrifuge

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Historic and Cultural Resources (Cont.)	condition of the license, if issued. The North Carolina SHPO concurred that inclusion of the license condition would appropriately consider significant historic and cultural resources during operation. During decommissioning, impacts on historic and cultural resources would occur primarily during ground-disturbing activities.		
Visual and Scenic Resources	The project area, which is adjacent to existing industrial developments, has low scenic quality and the environment in the project area is not unique for the area. During construction, the greatest visual impacts (from increased vehicle traffic) would be temporary. During operation, the two most visible structures would not represent a major alteration of the existing visual environment. Decommissioning impacts on visual and scenic resources would be minimal and of short duration (use of heavy equipment and increase in worker traffic). Once decommissioning is complete, most of the visual impacts would cease.	Impacts on the visual and scenic resources during the construction, operation, and decommissioning of the two facilities would be similar.	Similar
Air Quality	Potential air quality impacts from construction activities would be highest during the initial 3-year period and would primarily include fugitive dust and engine exhaust emissions. Potential impacts of SO_2, NO_2, and CO emissions would be well below applicable standards, and construction activities would have small impacts on ambient air quality for criteria pollutants. Because continuous combustion activities will not be employed during operation, criteria pollutant and HAP emission rates would be small. Uranium and HF emissions would be minimal. Decontamination and decommissioning activities would be comparable to or less than those during construction in terms of air emission rates and associated air quality impacts.	The same types of emissions to air (e.g., emissions from construction equipment, vehicular traffic, emergency diesel generators, and fossil fuel heating equipment) are expected regardless of which facility would be constructed. However, because of the larger footprint of the gas centrifuge facility, the impacts during construction would be expected to be higher for the centrifuge facility assuming the construction period would be the same as the laser facility. On the other hand, during operations, the emissions (e.g., uranium and HF) and impacts would be expected to be similar and negligibly small with either	Centrifuge

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Air Quality (Cont.)		technology. Decontamination and decommissioning activities would be comparable to or less than those during construction in terms of air emission rates and associated air quality impacts.	
Geology and Soil Resources	Approximately 91 ha (226 ac) of land would be disturbed. Construction would not impact site geologic resources. Vehicles and equipment could leak fuel, oil, or grease to site soils during construction, operation, and decommissioning. Roads, parking lots, and roofs would create impervious surfaces and increase runoff, increasing the erosion potential. Foundations, roads, and utility lines would likely be undisturbed during decommissioning. Erosion may increase, as portions of the site are disturbed by heavy equipment.	The types of impacts on site soils (e.g., impacts of spills from vehicles and equipment and runoff from impervious surfaces) would be similar. Because of the larger land area requirements and consequently greater disturbance of soil by the centrifuge technology, the impacts on the geology and soil resources would also be expected to be larger during construction, operation, and decommissioning.	Centrifuge
Surface Water Resources	Excavation during construction could lead to short-term soil erosion with impacts on surface water quality. Vehicles and equipment pose the possibility of leaks or spills of fuels, oil, or grease, which could run off and impact nearby surface water, but infiltration into site soil would likely eliminate runoff. Process wastewater discharge would increase site process wastewater volume. Liquid radioactive waste would be treated before transfer to the existing wastewater treatment facility. Treated sanitary effluent would be reused in site cooling towers. No consumption of surface water would occur during operation. Stormwater runoff would collect in a wet detention basin before regulated discharge to the site effluent channel. Stormwater runoff from the UF_6 cylinder storage pads would collect in a lined holding pond prior to monitoring and discharge to the stormwater wet detention basin. Facility process wastewater flow would cease during decontamination and decommissioning, but decontamination effluent could be generated. Erosion may increase as portions of the site are disturbed by heavy equipment, and BMPs would reduce the impact.	The types of impacts from construction (e.g., short-term erosion, runoff of spills from vehicles) and operations (e.g., discharge of process wastewater, treated liquid radioactive waste, and treated sanitary wastewater) are expected to be similar to the impacts from construction, operation, and decommissioning of a laser-based facility. Although there may be differences between the liquid effluent emissions of the two types of facilities when they are built in different locations, significant differences in the construction or operational impacts on surface water resources would not be expected if the two facilities are assumed to be constructed on the Wilmington Site.	Similar

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Groundwater Resources	Construction equipment poses the potential for leaks of fuel, oil, and grease to groundwater. Potable and nonpotable construction water requirements would be met by transport of offsite water by tanker truck. Stormwater collected from the UF_6 cylinder storage pad would be expected to have no more than trace amounts of radiological contaminants, and the lined holding pond would limit infiltration to groundwater. A portion of discharged liquid effluents may infiltrate the Peedee sand aquifer. No significant contaminant concentrations are expected in the effluent channel. Additional groundwater will be obtained from existing production wells for process water and potable purposes. A small amount of drawdown would be expected, without significant effect on flow directions, water quality, or availability for offsite users. The removal of structures, utilities, materials, and products during the decommissioning is not expected to have an impact on site groundwater resources.	The impacts on groundwater resources during construction and decommissioning (e.g., the potential for construction equipment leaks, water use) would be about the same with either technology. Similarly, the types of impacts on groundwater resources that would occur during operations are expected to be similar (e.g., stormwater from cylinder pads, infiltration of discharged liquid effluents, and groundwater use). However, the operational water requirements of a gas centrifuge facility with the same production capacity appear to be greater than those of the proposed GLE Facility. Because the groundwater use during operations could be greater by as much as a factor of four for a gas centrifuge facility on the Wilmington Site, the impacts on groundwater are expected to be larger.	Centrifuge
Ecological Resources	Most impacts would occur prior to construction. Construction could impact ecological resources (including vegetation), although most construction would occur in areas previously disturbed by preconstruction activities. No wetlands or environmentally sensitive areas would be directly impacted by construction, but wetlands occur in the roadway corridor (possibly resulting in wetland loss). Minor, localized indirect impacts on wetlands and environmentally sensitive areas may occur. No aquatic habitats are located within the areas that will be cleared, and no significant adverse impacts on aquatic biota are expected. Construction activities (and noise) would result in wildlife injury/mortality, wildlife disturbance, and a loss of habitat. Habitat disturbance could facilitate the spread and introduction of invasive plant species. No population-level impacts would be expected on any Federally listed threatened, endangered, or other special status species, or on any State-listed species.	Most impacts would occur prior to construction. The types of impacts from construction (e.g., potential wetland loss, wildlife injury/mortality, impacts of noise to wildlife, habitat disturbance) and operations (e.g., habitat disturbance, wildlife injury or mortality, impacts on aquatic habitat by erosion, sedimentation, and exposure to contaminants) are expected to be similar to the impacts of a laser-based facility. However, because of the larger footprint and larger disturbed area for a gas centrifuge facility with the same production capacity, the impacts on ecological resources are estimated to be proportionately larger. Actual	Centrifuge

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Ecological Resources (Cont.)	No operational effects on vegetation would be expected from the cooling tower, air emissions, wastewaters, or solid wastes. Operation would not adversely affect wetlands or environmentally sensitive areas. Potential impacts on wildlife would include ongoing habitat disturbance and wildlife injury/mortality. Aquatic habitats and biota could be affected by erosion, sedimentation, and exposure to contaminants, but aquatic biota would not be adversely impacted by treated effluents or trace contamination released to surface waters. No adverse impacts on threatened, endangered, or other special status species would be expected from operations. Impacts on wildlife from decommissioning would be similar to those occurring during construction. Removal of wildlife habitat would have negligible impacts on wildlife populations.	impacts (and relative differences between the two technologies) would depend on where on the Wilmington Site the facility would be constructed or expanded during operations, and the existence of ecological resources in the affected areas.	
Noise	During construction, vehicular traffic would generate intermittent noise that would be limited to the immediate vicinity and minor in comparison to other continuous sources. Potential construction noise impacts on the adjacent residential subdivision are anticipated to be moderate, but temporary. During operation, noise sources would be primarily enclosed within buildings, and other sources would include vehicular traffic. Noise levels at the site boundary closest to the adjacent residential subdivision are estimated to be below the day and night equivalent sound level in compliance with the local noise ordinance and EPA noise guidelines. Most decontamination activities would occur inside structures. Noise from truck traffic on site access roads would be comparable to that during construction.	Noise sources during construction (e.g., vehicular traffic, construction equipment) and operations (e.g., vehicular traffic, sources within buildings) would be similar to noise sources during construction, operation, and decommissioning of a laser-based facility. Noise impacts during construction would be temporary and could be mitigated for either technology. Similarly, noise impacts during operations would not be expected to differ significantly, regardless of which technology would be employed.	Similar

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Transportation	The number and type of truck shipments will vary during construction, with the heaviest traffic occurring near the site entrance. Operations would overlap construction for 5–6 years, during which commuting operations personnel would add to increased local traffic from construction workers and shipments. Remaining operations would involve traffic from personnel, visitors, and incoming and outgoing truck shipments. The range of additional daily vehicle trips from operation would have a similar effect on the local road network as the increase due to construction traffic. Operations would require the shipment of radioactive materials to and from the facility. Cargo-related risks include exposure to ionizing radiation during normal transportation and accident conditions, as well as chemical hazards during accident conditions. Less than one latent cancer fatality (annually) would be anticipated for the public and transportation crews from all shipments. No latent fatalities from vehicle emissions would be anticipated, annually. No fatalities are expected from accidents (direct physical trauma), annually. Initial decommissioning activities during the last year of operations would increase the total number of workers. The number of truck shipments to offsite locations during this period is anticipated to be approximately the same as during construction.	The types of transportation impacts from construction (e.g., traffic from construction equipment, material shipments, and commuting construction workers) and operations (e.g., impacts of radioactive material shipments, traffic due to commuting operational workers) would be expected to be similar for both types of facilities. Differences in transportation requirements for materials and labor during construction, operations, and decommissioning for the two types of facilities are not significant. Therefore, the transportation impacts would be expected to be similar during construction, operation, and decommissioning.	Similar
Public and Occupational Health	Occupational exposures during construction would be minor, as construction would not be expected to cause any exceedances of ambient air quality criteria (with the possible exception of fugitive dust). Construction activities could disturb previously contaminated areas, and construction workers could be exposed to emissions during the overlap of construction and operation. The maximum possible dose would be a small fraction of background radiation exposure. Dose to the offsite public would be significantly less, as they have no potential for measurable exposure from existing site contamination.	The types of impacts from construction (e.g., fugitive dust exposure, exposure due to disruption of previously contaminate areas, exposures during the overlap of construction and operations) and operations (e.g., work-place injuries, potential UF_6 exposure, potential public exposure to air and liquid effluent releases) are expected to be similar except that there would be no potential for worker injury due to laser accidents. Although the estimated air emissions from operation of a gas centrifuge facility could be	Similar

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Public and Occupational Health (Cont.)	A total of 324 total recordable incidents, 197 lost workday incidents, and less than one fatal injury are projected for 38 years of operation. Lasers would be operated within enclosures, equipped with interlocks to prevent inadvertent exposure. The greatest potential for occupational exposure would be from UF_6 cylinders, although airborne concentrations of HF and uranyl fluoride inside the facility are expected to be insignificant. The estimated HF and uranium concentrations at onsite locations would be orders of magnitude below safe levels, and UF_6 and HF levels at the site boundary (and the nearest resident) would be even lower. Operation could result in exposure to the public via uranium releases or direct external radiation exposure. UF_6 would pass through a ventilation system to minimize external release and liquid effluents would be treated and sampled to limit releases. Radioactive materials would present the potential for onsite members of the public to receive a direct radiation dose, but measurements from existing sources indicate no readings above background at the site boundary. Skyshine from airborne releases would be undetectable at offsite areas. The maximum dose to a member of a public from liquid effluent releases would occur just south of the site boundary and would be well below the applicable regulatory limit. The annual occupational dose during decontamination and decommissioning is expected to be in the range of 0.05 millisievert (5–150 millirem). Occupational dose during decontamination and decommissioning would be bounded by potential exposures during operations.	5–10 times higher than those of the proposed GLE Facility, the releases would be small enough that the impacts on public and occupational health from either technology would be well below all applicable regulatory limits and standards. No difference in the rate or total number of occupational incidents and injuries would be expected, given a similar-sized workforce. Therefore, the impacts on the public and occupational health would be about the same with either technology during construction, operation, and decommissioning.	

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Waste Management	Solid nonhazardous wastes generated during construction would be similar to wastes from other industrial construction sites. Construction activities would generate less than 2 percent of the waste that the local landfill receives annually. Hazardous wastes from construction would be packaged and shipped offsite to licensed facilities. Operations would generate wastewaters that would be treated onsite prior to discharge and solid wastes that would be treated (onsite or offsite) and shipped offsite for disposal. Sanitary wastewater would be treated at the existing site treatment facility, increasing the load by about one-third. Treated sanitary wastewater effluent could be used as makeup water in onsite cooling towers, and cooling tower blowdown would be sent to the existing final process lagoon facility. The existing discharge permit would be adequate to cover the additional effluent discharge to surface waters. Radioactive process wastewater would be collected and treated to remove uranium, metals, and fluoride. Treated effluent would be discharged to the final process lagoon facility. The waste management facilities used during operations would be used during decontamination and decommissioning. With the decrease in workers from operations to decommissioning, sanitary wastewater treatment volumes would decline. Buildings and other structures would be decontaminated and the debris shipped offsite for disposal. Radioactive material from decontamination and contaminated equipment would be packaged and shipped offsite to an appropriately licensed facility.	The types of waste generated during construction (e.g., hazardous and non-hazardous solid waste), operations (e.g., solid waste, process wastewater, sanitary wastewater), and decommissioning (e.g., building debris) would be expected to be treated and disposed of similarly for both types of facilities. Because of the larger footprint of the gas centrifuge facility, the quantities of waste generated during construction and decommissioning would likely be somewhat greater for gas centrifuge than for laser technology. However, the amount of waste generated by a gas centrifuge facility during operations is estimated to be considerably less than the proposed GLE Facility. The potential difference could be on the order of a factor of two for LLW and hazardous waste, and a factor of five or six for solid non-radioactive/nonhazardous waste.	Laser

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Socioeconomics	Construction activities in the peak year would employ 680 construction workers at the facility site and an additional 3131 indirect jobs in the region of influence (ROI). Construction activities would generate $139.8 million in income in the ROI in 2012, $1.7 million in State income taxes, and $1.2 million in State sales taxes. Start-up activities would employ 200 workers and an additional 218 indirect jobs in the ROI. Start-up would generate approximately $28.0 million in income in the ROI in 2014, approximately $1.3 million in State income taxes, and approximately $0.9 million in State sales taxes. Operations would employ 350 new jobs and an additional 382 indirect jobs in the ROI. Operations in 2020 would generate approximately $51.5 million in income in the ROI, $2.3 million in State income taxes, $8.7 million in property taxes, and $1.7 million in State sales taxes. Corporate income taxes would also be collected by the State during the operating period, totaling approximately $52.7 million annually. The number of construction workers relocating from outside the region could cause a short-term increase in demand for temporary housing and services in the ROI. However, the relatively small number of operations workers estimated to relocate to the ROI would limit the impact. Decontamination and decommissioning activities in the first year would create 50 new jobs. Decommissioning would generate $6.1 million in income in the ROI in the first year. Facility decommissioning would produce less than $0.3 million in direct State income taxes and less than $0.2 million in direct State sales taxes. Decommissioning activities would constitute less than 1 percent of total ROI employment in the first year.	The estimated direct employment numbers for construction, operation, and decommissioning of a gas centrifuge facility are expected to be about the same as for the proposed GLE Facility. Consequently, the socioeconomic impacts in the region during construction, operation, and decommissioning would be expected to be similar.	Similar

Table 2-6 Comparison of Environmental Impacts of the GLE Laser-Based Technology and Centrifuge Technology (Cont.)

Resource Area	Laser-Based Technology (proposed action)	Gas Centrifuge Technology	Greater Impact
Environmental Justice	Although potential impacts could be SMALL to MODERATE in a number of resource areas during construction, operation, and decommissioning, the impacts are not expected to be disproportionately high or adverse for minority or low-income populations. The majority of environmental impacts would be mitigated and any remaining environmental impacts would primarily affect residents in the immediate vicinity. The neighborhood immediately surrounding the site includes a mix of minority and nonminority residents, as well as a mix of low-income and more affluent residents. Because impacts on the general population are SMALL to MODERATE, and because the greatest impact would be expected to occur in the immediate vicinity (and in an area with a mix of ethnicities and income levels), construction, operation, and decommissioning are not expected to result in disproportionately high or adverse impacts on low-income or minority residents. Even when environmental impacts are anticipated to be SMALL for the general population, some population groups, such as those participating in subsistence hunting and fishing could experience disproportionate exposure. However, air and liquid radiological releases are projected to be extremely low, and indirect exposure through fish consumption would be even lower.	The types of potential environmental justice concerns for a gas centrifuge facility would be expected to be the same as the potential environmental justice impacts of a laser-based facility. Because of the mix of residents in the area surrounding the Wilmington Site, and because impacts on each resource area are expected to be SMALL to MODERATE, there would not be any expected environmental justice impacts of the gas centrifuge technology, if employed at the Wilmington Site, during construction, operation, or decommissioning.	Similar
Accidents	The consequence of a criticality accident would be high for a worker in close proximity. Worker radiological health consequences are low for scenarios involving the release of UF_6. Worker health consequences are low to high for scenarios involving HF exposure, and intermediate to high for scenarios involving uranium chemical exposure. Radiological consequences to a maximally exposed individual at the Controlled Area Boundary are low for the criticality accidents and for all UF_6 release scenarios. Chemical consequences at the Controlled Area Boundary are low to intermediate for uranium and HF exposure scenarios. Risk to the offsite public in the direction of highest exposure would be less than one lifetime cancer fatality for all accident scenarios.	The potential for criticality accidents and the release of UF_6 are expected to be similar at both types of facilities. The consequences of accidents taking place in a gas centrifuge facility for workers and for offsite members of the public are not expected to differ significantly from those of the proposed GLE Facility. Consequently, the accident impacts in the region are expected to be similar.	Similar

The impacts presented in Table 2-6 are based on the assumption that an exemption request would be granted if a gas centrifuge facility were to be constructed at the Wilmington Site, similar to the exemption request granted for the proposed GLE Facility. Therefore, most construction would take place on ground previously disturbed by preconstruction activities.

2.4 Staff Recommendation Regarding the Proposed Action

After weighing the impacts of the proposed action and comparing alternatives, the NRC, in accordance with 10 CFR 51.91(d), sets forth its NEPA recommendation regarding the proposed action.

The NRC recommends that, unless safety issues mandate otherwise, the proposed license be issued to GLE. In this regard, the NRC has concluded that environmental impacts are generally SMALL, and taken in combination with the applicable environmental monitoring program described in Chapter 6 and the proposed mitigation measures discussed in Chapter 5, would eliminate or substantially lessen any potential adverse environmental impacts associated with the proposed action.

The NRC has concluded the overall benefits of the proposed GLE Facility outweigh the environmental disadvantages and costs based on consideration of the following:

- The need for an additional, economical, domestic source of enrichment services; and
- The environmental impacts from the proposed action are generally SMALL, although they could be as high as MODERATE in the areas of historic and cultural resources, air quality, ecological resources, noise, and transportation.

2.5 References

(AES, 2009) AREVA Enrichment Services, LLC. “Eagle Rock Enrichment Facility Environmental Report.” April.

(ANSI, 1990) American National Standards Institute. (ANSI) N14.1, “Uranium Hexafluoride-Packaging for Transport ANSI N14.1 Standard for Packaging of Uranium Hexafluoride for Transport,” 1971, 1982, 1987, and 1990 Editions. 49 CFR 171.7; 173.417; 173.420. .

(BWCS, 2011) Babcock & Wilcox Conversion Services, LLC. News Release: “Depeleted Uranium Hexafluoride (DUF_6) Fully Operational at the Portsmouth and Paducah Gaseous Diffusion Sites.” October 20. <http://www.pppo.energy.gov/pdf/pppo_news/EM%20Update%20fully%20operational%2010-20-11.pdf> (Accessed December 1, 2011).

(DNFSB, 1995) Defense Nuclear Facilities Safety Board. “Integrity of Uranium Hexafluoride Cylinders.” Technical Report DNFSB/TECH-4. May 5.

(DOE, 1995) U.S. Department of Energy. “Electricity Generation and Environmental Externalities: Case Studies.” DOE/EIA-0598. Energy Information Administration, Office of Coal, Nuclear Electric, and Alternative Fuels, Coal and Electric Analysis Branch. September. <http://www.eia.doe.gov/cneaf/electricity/external/external.pdf> (Accessed January 29, 2010).

(DOE, 1999) U.S. Department of Energy. "Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride." DOE/EIS-0269. Volume 1. Office of Nuclear Energy, Science, and Technology. Washington, D.C. April. <http://web.evs.anl.gov/uranium/documents/nepacomp/peis/index.cfm> (Accessed February 10, 2012).

(DOE, 2000) U.S. Department of Energy. "Report to Congress on Maintenance of Viable Domestic Uranium, Conversion and Enrichment Industries." December.

(DOE, 2001) U.S. Department of Energy. "Effect of U.S./Russia Highly Enriched Uranium Agreement." December. <http://www.ne.doe.gov/pdfFiles/HEUAgreement2001.pdf> (Accessed March 29, 2009).

(DOE, 2003) U.S. Department of Energy. Office of Inspector General, Office of Audit Services. "Cold Standby Program at the Portsmouth Gaseous Diffusion Plant." DOE-0634. Audit Report. December. <http://energy.gov/sites/prod/files/igprod/documents/CalendarYear2003/ig-0634.pdf> (Accessed April 28, 2010).

(DOE, 2004a) U.S. Department of Energy. "Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky Site." DOE/EIS-0359. June. <http://www.gc.doe.gov/nepa/downloads/eis-0359-final-environmental-impact-statement> (Accessed January 26, 2012).

(DOE, 2004b) U.S. Department of Energy. "Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site." DOE/EIS-0360. June. <http://www.gc.doe.gov/nepa/downloads/eis-0360-final-environmental-impact-statement> (Accessed January 26, 2012).

(DOE, 2010) U.S. Department of Energy, Portsmouth/Paducah Project Office. "DOE Awards Cleanup Contract for Portsmouth Decontamination and Decommissioning." August 16. ADAMS Accession No. ML103500151.

(GLE, 2008) GE-Hitachi Global Laser Enrichment LLC. "Environmental Report for the GLE Facility." December. ADAMS Accession No. ML090910573.

(GLE, 2009a) GE-Hitachi Global Laser Enrichment LLC. "GE-Hitachi Global Laser Enrichment LLC Commercial Facility, Wilmington, North Carolina: License Application April 2009." April 30. ADAMS Accession No. ML091871003.

(GLE, 2009b) GE-Hitachi Global Laser Enrichment LLC. "Global Laser Enrichment Environmental Report Supplement 2." November. ADAMS Accession No. ML093240935.

(GLE, 2009c) GE-Hitachi Global Laser Enrichment LLC. Letter from A.E. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to B. Smith (U.S. Nuclear Regulatory Commission) dated December 28. "Subject: Response to Request for Additional Information Dated November 19, 2009 for Global Laser Enrichment License Application – Public Responses." ADAMS Accession Nos. ML093620823 and ML093620841.

(Hargrove, 2000) Hargrove, S. “Laser Technology Follows in Lawrence’s Footsteps.” Science and Technology Review. May 2000. Lawrence Livermore National Laboratory. <http://www.llnl.gov/str/Hargrove.html> (Accessed March 31, 2009).

(Heilbron et al., 1981) Heilbron, J.L., et al. “Lawrence and His Laboratory: Nuclear Science at Berkeley 1931–1961.” University of California, Office for History of Science and Technology. September.

(LES, 2005) Louisiana Energy Services. “National Enrichment Facility Environmental Report.” Revision 4. NRC Docket No. 70-3103. April. <http://www.nrc.gov/materials/fuel-cycle-fac/licapp-envir-rpts.html> (Accessed February 4, 2010).

(Milani, 2005) Milani, K. “The Scientific History of the Atomic Bomb.” Hibbing Community College. <http://www.hcc.mnscu.edu/chem/abomb/page_id_4755.html> (Accessed December 3, 2009).

(NRC, 1991) U.S. Nuclear Regulatory Commission. Policy Issue “Disposition of Depleted Uranium Tails from Enrichment Plants.” SECY-91-019. January 25. ADAMS Accession No. ML052920628.

(NRC, 2002) U.S. Nuclear Regulatory Commission. “Denial of Petition for Rulemaking to Eliminate Review of Alternative Sites, Alternative Energy Sources, and Need for Power in Nuclear Power Reactor Siting and Licensing Reviews (PRM-52-2).” SECY-02-0175. September 27. ADAMS Accession No. ML022200469.

(NRC, 2003) U.S. Nuclear Regulatory Commission. “Consolidated NMSS Decommissioning Guidance, Volume 3, Financial Assurance, Recordkeeping, and Timeliness.” NUREG-1757. September. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1757/v3/sr1757v3.pdf> (Accessed January 29, 2010).

(NRC, 2005a) U.S. Nuclear Regulatory Commission. “Memorandum and Order.” CLI-05-05. NRC Docket No. 70-3103. January 18. <http://www.nrc.gov/reading-rm/doc-collections/commission/orders/2005/2005-05cli.html> (Accessed January 29, 2010).

(NRC, 2005b) U.S. Nuclear Regulatory Commission. “Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico.” NUREG-1790. June. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/> (Accessed March 26, 2009).

(NRC, 2006) U.S. Nuclear Regulatory Commission. “Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio, Final Report.” NUREG-1834. April. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/> (Accessed March 26, 2009).

(NRC, 2009a) U.S. Nuclear Regulatory Commission. Letter from D.H. Dorman (U.S. Nuclear Regulatory Commission) to A.E. Kennedy (GE-Hitachi Global Laser Enrichment LLC) dated May 8. “Subject: Approval of GE-Hitachi Exemption Request Related to Commencement of Construction.” ADAMS Accession No. ML083510647.

(NRC, 2009b) U.S. Nuclear Regulatory Commission. "Enrichment Processes." <http://www.nrc.gov/images/reading-rm/photo-gallery/20080922-013.jpg> (Accessed August 20, 2009).

(NRC, 2010a) U.S. Nuclear Regulatory Commission. News Release: "NRC to Hold Public Meeting Jan. 14 in Hobbs, N.M., to Discuss License Review of Proposed Uranium De-Conversion Plant." ADAMS Accession No. ML100040480.

(NRC, 2010b) U.S. Nuclear Regulatory Commission. Letter from M. Bailey (U.S. Nuclear Regulatory Commission) to S.A. Toelle (United States Enrichment Corporation) dated September 9. "Subject: Approval of Certificate Amendment Request Regarding Deletion of Technical Safety Requirements for Facilities at Portsmouth Gaseous Diffusion Plant (TAC NO. L32746)." ADAMS Accession No. ML102250346.

(NRC, 2010c) U.S. Nuclear Regulatory Commission. Memorandum from J. Davis (U.S. Nuclear Regulatory Commission) to D. Skeen (U.S. Nuclear Regulatory Commission) dated November 9. "Subject: September 3, 2010, Teleconference Summary: Regarding the Proposed General Electric-Hitachi Global Laser Enrichment Facility." ADAMS Accession No. ML103060397.

(NRC, 2011a) U.S. Nuclear Regulatory Commission. "Environmental Impact Statement for the Proposed Eagle Rock Enrichment Facility in Bonneville County, Idaho, Final Report." NUREG-1945. February. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1945/> (Accessed March 3, 2011).

(NRC, 2011b) U.S. Nuclear Regulatory Commission. Letter from J. Kinneman (U.S. Nuclear Regulatory Commission) to R. Van Namen (United States Enrichment Corporation) dated October 12. "Subject: Part 76 Certificate of Compliance Termination for the United States Enrichment Corporation, Portsmouth Gaseous Diffusion Plant (TAC No. L32771)." ADAMS Accession No. ML11257A078.

(OECD, 2001) Organization for Economic Co-Operation and Development. "Management of Depleted Uranium." A joint report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency.

(Settle, 2004) Settle, F. "Nuclear Chemistry, Uranium Enrichment." Kennesaw State University. <http://chemcases.com/nuclear/nc-07.html> (Accessed March 31, 2009).

(Sparks, 2011) Personal communication from K. Sparks (Performance Results Corporation) to H. Avci (Argonne National Laboratory). March 24. ADAMS Accession No. ML110840038.

(USEC, 1999) United States Enrichment Corporation. News Release: "USEC Inc. Suspends AVLIS Technology Development." June 9, 1999. <http://www.usec.com/NewsRoom/NewsReleases/USECInc/1999/1999-06-09-USEC-Inc-Suspends-AVLIS.htm> (Accessed December 3, 2009). ADAMS Accession No. ML101790149.

(USEC, 2000) United States Enrichment Corporation. News Release: “USEC to Cease Uranium Enrichment at the Portsmouth, Ohio, Facility in June 2001.” June 21, 2000. <http://www.usec.com/NewsRoom/NewsReleases/USECInc/2000/2000-06-21-USEC-To-Cease-Uranium.htm> (Accessed December 3, 2009). ADAMS Accession No. ML101790160.

(USEC, 2005) USEC Inc. “Environmental Report for the American Centrifuge Plant in Piketon, Ohio.” Revision 6. NRC Docket No. 70-7004. November. <http://www.nrc.gov/materials/fuel-cycle-fac/usec-american-cent-plant-lic-app.html> (Accessed February 4, 2010).

3 AFFECTED ENVIRONMENT

This chapter describes the existing conditions at and near the site of the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility in Wilmington, North Carolina (Figure 2-1), prior to the proposed action and before any preconstruction activities are performed. After an initial overview of the site location and activities, information is presented on surrounding land use; historic and cultural resources; visual and scenic resources; climatology, meteorology, and air quality; geology, minerals, and soils; water resources; ecological resources; noise levels; transportation systems; public and occupational health conditions; current waste generation and management practices; socioeconomic conditions; and environmental justice considerations. This information forms the basis for assessing the potential impacts (see Chapter 4) of the proposed action.

3.1 Site Location and Description

The proposed GLE Facility would be located approximately 10 kilometers (6 miles) north of the City of Wilmington in New Hanover County, North Carolina, on the General Electric Company (GE)/Global Nuclear Fuel – Americas (GNF-A), property also referred to as the Wilmington Site (Section 2.1.1). The site is bordered on the east by North Carolina Highway 133 (NC 133) (Castle Hayne Road), on the southeastern corner by U.S. Interstate Highway 140 (I-140), on the southwestern perimeter by the Northeast Cape Fear River, and for most of the north and south property lines by undeveloped forestlands. A small segment of the north property line borders a residential subdivision. The Wilmington International Airport is located approximately 5.2 kilometers (3.5 miles) southeast of the Wilmington Site (Figure 1-2).

The Wilmington Site occupies approximately 656 hectares (1621 acres). The proposed GLE Facility site comprises 106 hectares (263 acres) of the Wilmington Site (GLE, 2009c). It includes approximately 40 hectares (100 acres) for the proposed GLE Facility in the North-Central Site Sector, approximately 5 hectares (13 acres) for support structures to the east, and approximately 12 hectares (29 acres) for the North access road (Figure 2-2).

Nuclear fuel assemblies for commercial light water-cooled nuclear power reactors are currently fabricated at the Wilmington Site. The fuel manufacturing complex includes the Fuel Manufacturing Operation (FMO/FMOX) buildings, the Dry Conversion Process (DCP) building, the Waste Treatment Facility, process basins, and other support facilities. Other existing facilities on the Wilmington Site include the GE Aircraft Engines/Service Component Operation (AE/SCO) facility, the Fuel Components Operation (FCO) facility, and the Wilmington Field Services Center (WFSC). Nonradioactive reactor components are manufactured in the SCO facility, and nonradioactive components for reactor fuel assemblies are manufactured in the FCO facility. In the WFSC, equipment used at reactor sites is cleaned and refurbished. Fuel manufacturing operations are not conducted at the AE facility. The existing facilities are located in the eastern portion of the Wilmington Site (Figure 2-1).

The proposed GLE Facility would occupy approximately 40 hectares (100 acres) within the main portion of the site (see Figure 2-2), and would include the main GLE operations building, several administrative and other facility-support buildings, a parking lot, natural and depleted uranium hexafluoride (UF_6) storage areas, and maintained landscaped areas. The proposed GLE Facility would be connected to NC 133 and existing GNF-A facilities either by improving

the existing roads or by building` a new road segment within the proposed GLE Facility site (GLE, 2008).

3.2 Land Use

This section describes the land uses on and near the proposed GLE Facility site. The discussion covers the region within 8 kilometers (5 miles) of the proposed GLE Facility site, which includes New Hanover, Brunswick, and Pender Counties.

3.2.1 Proposed GLE Facility Site

The location of the proposed GLE Facility is part of the 656-hectare (1,621-acre) Wilmington Site, which is owned by GE. The proposed GLE Facility site is undeveloped and is currently covered by mixed pine forest. The western boundary of the Wilmington Site is the Northeast Cape Fear River. The southern boundary is I-140. Residential developments are found to the northeast and south of the Wilmington Site. The closest residence to the proposed GLE Facility site is northeast of the proposed facility on Dekker Road in the Wooden Shoe Subdivision. East of the Wilmington Site across Castle Hayne Road is the North Carolina State University Horticultural Crops Research Station, which has existed in this location since 1947. Several mobile homes are located north of the Wilmington Site along Castle Hayne Road. None of the Wilmington Site is designated prime farmland. No properties listed on the *National Register of Historic Places* (NRHP) are located within 8 kilometers (5 miles) of the proposed GLE Facility site.

The proposed GLE Facility site is located in an unincorporated portion of New Hanover County, North Carolina. The proposed GLE Facility site is 10.4 kilometers (6.5 miles) north of Wilmington, North Carolina, and on the eastern bank of the Northeast Cape Fear River. The zoning of the proposed GLE Facility site is under the jurisdiction of the New Hanover County Planning Board and is zoned I-2, heavy industrial zone (New Hanover County, 2009b). This zoning class is the least restrictive, in that it allows the widest range of land uses. Examples of current industries within this zoning are the BASF Corporation and the Elementis Chromium manufacturing plants, and the L.V. Sutton Steam Electric Plant to the west. Several sand and gravel quarries are northeast of the proposed GLE Facility site, including the Martin Marietta Materials operation, which is a crushed stone mining and processing facility. The area to the southwest is also zoned I-2 (Figure 3-1). The area immediately to the south of the proposed GLE Facility site is zoned PD, planned development district. This designates an area with mixed uses, including residential, commercial, industrial, office, and institutional. The entire area north of the proposed GLE Facility site is zoned RA, rural agriculture, which allows for low-density residential with an emphasis on farming and open space. The areas to the east and southeast are zoned R-20, which indicates low-density residential (New Hanover County, 2009b).

Several residential developments are proposed in the vicinity of the Wilmington Site. These include a 600-lot residential development called Rose Hill Plantation south of the Wilmington Site, which would include a nursing home. Other proposals are for the Sunset Reach 53-lot residential development, the Blue Clay Farms development of 1800 units, and Parson's Mill with 300 lots for residential development (New Hanover County, 2009c). In addition, a new elementary school and middle school are in the process of being completed in the Castle Hayne community to the northeast of the proposed GLE Facility site (Figure 1-1).

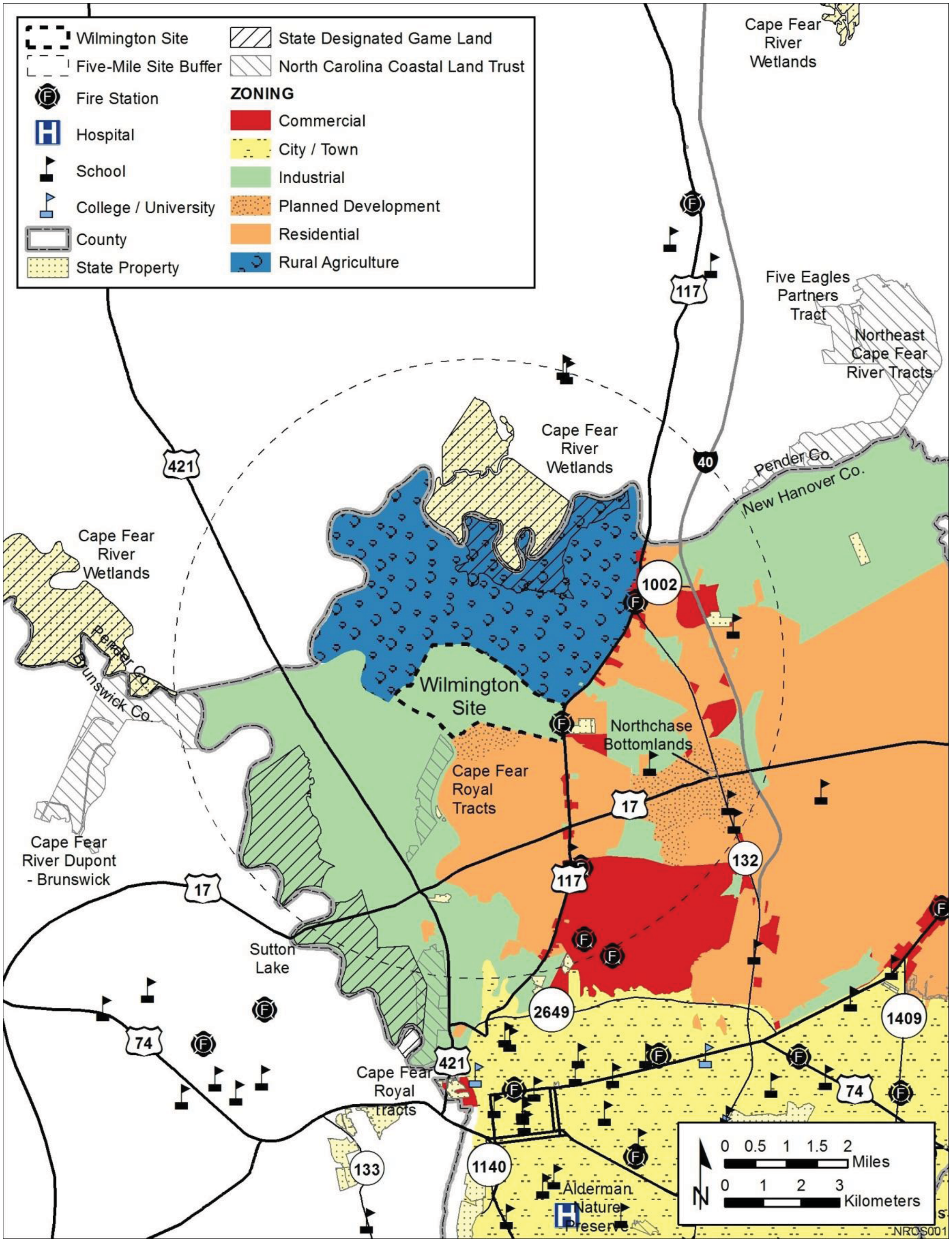


Figure 3-1 Land Use within 8 kilometers (5 miles) of the Project Area

To implement the Federal Coastal Zone Management Act (CZMA), North Carolina passed a Coastal Area Management Act (CAMA) in 1974 that requires coastal counties to develop land use plans. New Hanover County and the City of Wilmington chose to develop a joint land use plan. The Wilmington–New Hanover County Joint Coastal Area Management Plan 2006 Update was approved in May 2006 by the North Carolina Coastal Resources Commission. This update identifies the proposed GLE Facility site as a Wetland Resource Protection Area, with the eastern portion of the proposed GLE Facility site in an Aquifer Resource Protection Area (City of Wilmington and New Hanover County, 2006). The purpose of the Wetland Resource Protection Area is to minimize the loss or degradation of wetlands. The Aquifer Resource Protection Area is intended to protect areas from diminished recharge of the aquifer and to prevent contamination of the aquifer. The area north and northwest of the proposed GLE Facility site was designated a Conservation Area by the 2006 Wilmington–New Hanover Plan. The purpose of the conservation class is to provide long-term management and protection of significant natural resources, taking into consideration the rights of property owners.

3.2.2 New Hanover County

New Hanover County is a coastal county in southeastern North Carolina. The county is bordered on the east and south by the Atlantic Ocean, on the southwest by Brunswick County, and on the north by Pender County. The Cape Fear River forms the boundary between New Hanover and Brunswick Counties. The proposed GLE Facility site is located in the northwestern corner of New Hanover County. The largest municipality in the county is Wilmington, which has a population of 97,135 (City of Wilmington and New Hanover County, 2006) and serves as the county seat. The next three largest communities are Carolina Beach (population 4701; 31 kilometers [19 miles] from the proposed GLE Facility site), Kure Beach (population 1507; 32 kilometers [20 miles] from the proposed GLE Facility site), and Wrightsville Beach (population 2593; 18 kilometers [11 miles] from the proposed GLE Facility site) (USCB, 2000).

Land cover in New Hanover County is primarily developed land (35 percent), followed by wetlands (26 percent), forest (16 percent), and grassland/cultivated fields (15 percent). The remaining 8 percent is comprised of open water (EPA, 2001).

Four State-designated use areas are within 8 kilometers (5 miles) of the proposed GLE Facility site. Two of these areas are the Cape Fear River Wetlands Game Land and the Sutton Lake Game Land, which are leased by the North Carolina Wildlife Resources Commission from Progress Energy. These areas are managed for the benefit of hunters. The other two areas are the North Chase Bottomlands Preserve and the Cape Fear Royal Tracts, which are maintained by the North Carolina Land Trust (Figure 3-1). The land trust manages its properties to retain their natural qualities.

3.2.3 Brunswick County

Brunswick County is located west of the proposed GLE Facility site. The county's population in 2000 was 73,141 (Brunswick County, 2006). The county's population concentrates in the eastern portion of the county along the Cape Fear River and along the Atlantic shoreline to the south. The major municipalities in Brunswick County are Oak Island (population 6571; 51 kilometers [31 miles] from the proposed GLE Facility site), Southport (population 2351; 47 kilometers [29 miles] from the proposed GLE Facility site), Leland (population 1938;

13 kilometers [8 miles] from the proposed GLE Facility site), and Boiling Spring Lakes (population 3866; 37 kilometers [23 miles] from the proposed GLE Facility site) (USCB, 2000). The county seat is Bolivia. The county has developed a CAMA plan that was approved in 2007. Several of the municipalities in the county have chosen to develop their own CAMA plans, including Bald Head Island, Calabash, Caswell Beach, Holden Beach, Shallotte, Southport, Sunset Beach, and Varnamtown (NCDENR, 2010).

Land cover in Brunswick County is primarily forest (35 percent), wetlands (32 percent), and grassland/cultivated fields (23 percent). The remaining land cover is split between development (8 percent) and open water (2 percent) (EPA, 2001).

3.2.4 Pender County

Pender County is located north of the proposed GLE Facility site and covers roughly 241 square kilometers (93 square miles). The total population is 48,724. Development in Pender County is concentrated in the center of the county along I-40 and in the southeast along the coast. The county seat for Pender County is Burgaw (23 kilometers [14 miles] from the Wilmington Site). The closest Pender County municipality is St. Helena (19 kilometers [11.8 miles] to the Wilmington Site). The portion of Pender County nearest the Wilmington Site is zoned as conservation area, rural, and rural clusters (Pender County, 2006).

The land cover in Pender County is primarily wetlands (41 percent), forests (27 percent), and grassland/cultivated fields (27 percent). The remaining land covers are development (4 percent) and open water (1 percent) (EPA, 2001).

3.3 Historic and Cultural Resources

This section discusses the cultural background and the known historic and cultural resources at the proposed GLE Facility and in the surrounding area.

3.3.1 Prehistoric

Prehistory in North America ranges from roughly 10,000 B.C. to A.D. 1500. Prehistory is divided into several periods that are marked by changes in technology (e.g., projectile point shapes, pottery types) and changes in subsistence patterns, which often reflect wider changes in the environment. The following is a description of the various prehistoric periods found in southeastern North America.

3.3.1.1 Paleo-Indian Period

The Paleo-Indian period (10,000 B.C. to 8000 B.C.) contains the first confirmed evidence of people in southeastern North America. The Paleo-Indian period is poorly understood. The Paleo-Indian period was a time of climatic change and of glacial retreat. Large mammals that were adapted to the colder climate were plentiful but in decline. The overall climate was cooler than today, with ocean levels more than 61 meters (200 feet) lower because of the water trapped in the glaciers. Intact evidence of these early people in North America is scarce. It is theorized that much of the evidence of human activity from this period is now submerged under the ocean. Human activity tended to concentrate in coastal regions. The coastal shoreline during the Paleo-Indian period was much farther out than the modern coast. Once the glaciers

retreated, sea levels rose and inundated the sites. On the basis of variations observed in projectile point types, there appears to have been some societal shift as the Paleo-Indian period progressed. All projectile points found in the Paleo-Indian period are of the spear or lance type and include the Clovis, Cumberland, Suwanee, Simpson, Dalton, and Hardaway point types (ESI, 2008).

3.3.1.2 Archaic Period

The Archaic period (8000 B.C. to 1000 B.C.) covers the period following the end of the glacial retreat. During this period, the climate began stabilizing, modern flora and fauna were developing, and populations across North America were increasing. Subsistence strategies expanded to include capturing smaller game, such as rabbits, than was seen in the big game hunting cultures of the Paleo-Indian period. A greater reliance on gathering nuts and seeds also is evident during the Archaic period. These adaptations suggest a more intensive use of the landscape, which may have been a result of greater population sizes. These adaptations are significant since the Paleo-Indian cultures were largely homogeneous across North America.

The Archaic period is divided into Early, Middle, and Late periods. The Early Archaic period (8000 B.C. to 6000 B.C.) saw the continuation of the trends established during the Paleo-Indian period. Glacial retreat, sea level rise, and a moderating of the climate are all indicative of the Early Archaic period. A change in projectile points and other stone (lithic) artifacts led to the defining of an Archaic period. A significant climatic shift to drier and warmer weather accompanies the Middle Archaic period (6000 B.C. to 3000 B.C.). In North Carolina, there appears to have been a shift away from the subsistence use of the higher elevations of the Appalachians and Piedmont region to the lower coastal plain and major river valleys (ESI, 2008). The first widespread evidence of shellfish use is noted during the Middle Archaic period. Regional adaptations become evident during the Middle Archaic period. The modern climate develops in the Late Archaic period (3000 B.C. to 1000 B.C.). Temperatures moderate and rainfall increases during the Late Archaic period. Ocean levels stabilized and wetlands increased significantly (ESI, 2008). The first ceramics appear toward the latter half of the Late Archaic period. Evidence of long-distance trade also is evident in the Late Archaic period. Site types include villages, short-term use sites, resource procurement camps, and cemeteries.

3.3.1.3 Woodland Period

The Woodland period (1000 B.C. to A.D. 1000) in Eastern North America is usually associated with three major technological innovations – horticulture, pottery, and the bow and arrow. Along with the development of horticulture comes a more sedentary way of life. In the Southeastern portion of North America, reliance on horticulture came late in the Woodland period, roughly around A.D. 200 to A.D. 400 and was not widespread until around A.D. 1000 (ESI, 2008). Pottery use began in the Late Archaic period but became widespread during the Woodland period. Pottery styles are used to differentiate between the Early, Middle, and Late Woodland periods in the region. Another defining factor for the Woodland period was burial practices. Burials become more elaborate during the Woodland period and involve mounds and in some cases ceramic ossuaries. Most Native groups encountered by Europeans practiced Woodland cultural patterns (Claggett, 1996).

A group known as the Mississippian Culture (A.D. 1000 to A.D. 1650) was also found in North Carolina in the late prehistoric period. Mississippian cultural groups engaged in many of the

practices associated with the Woodland period; however, there is evidence for a higher level of social and political hierarchy. Mississippian cultural groups were living in North Carolina alongside Woodland peoples.

3.3.2 Ethno-Historic

Information on the native populations preceding European contact is poor for several reasons. Native groups from this part of North Carolina left or were removed shortly after European contact. Early European records provide an inaccurate description of the native groups that were encountered. Through research and archaeological excavation, some information is available. The groups living in south-central North Carolina fell between two well-defined cultural traditions, those of the southeast and the northeast. Cultural traditions in the region appear to be consistent with Woodland cultures. Mississippian influences are possible but are not easily identifiable in the archaeological record. Excavation in the Cape Fear River area suggests that there may be ties to the Piedmont region and the tribes that resided there (Russ and Postlewaite, 2008). Modern tribal organizations that claim ancestral ties to North Carolina include the Indians of Persons County, Haliwa-Saponi, Coharie, Cumberland County Association of Indian People, Lumbee, Waccamaw-Siouan, Guilford Native American Association, Metrolina Native American Association, and the Eastern Band of Cherokee Indians (NCCIA, 2004).

3.3.3 Historic Euro-American

European presence in the North American southeast began in 1524 when Giovanni da Verrazzano traveled along the coast of what would become North Carolina. Spanish and English exploration of the area continued throughout the latter half of the 16th century. The English attempted to establish a colony on Roanoke Island in 1587; the colony failed within 3 years. The first successful European settlement in the region was the English colony of Jamestown in 1607. The first settlement on the Cape Fear River came in the 1660s by English settlers; however, the settlement only lasted a few years. Permanent settlement on the Cape Fear River did not occur until the eighteenth century. The town of Brunswick was established at the mouth of the Cape Fear River in 1726. New Hanover County was created in 1729. In the 1730s, the town of Newton was settled at the juncture of the Northeast and Cape Fear Rivers. In 1740, the town of Newton was incorporated as Wilmington. Once Wilmington was established, the town of Brunswick deteriorated and was eventually abandoned after 1781. Wilmington became an important town for supplying the shipping trade. During the American Revolution, the British commander Lord Cornwallis occupied Wilmington for three weeks in 1781. After the revolution, an agrarian economy based on plantations flourished along the Cape Fear River. Wilmington became one of the major ports along the eastern seaboard. Railroads were built to the city in the 1840s. Wilmington served as a key part of the Confederate supply line during the American Civil War. Fort Fisher protected the port, but Union troops took it in the winter of 1864 to 1865. Union troops took possession of Wilmington in February 1865. After the Civil War, Wilmington became a major textile port. Several textile factories operated in Wilmington. In the twentieth century, the economy diversified further to include large shipyards. The shipyards expanded during World War II (ESI, 2008).

The region containing the proposed GLE Facility site was once part of the Rose Hill plantation, which was first established in 1736. Other nearby plantations included Castle Hayne, The Hermitage, Point Pleasant, Rocky Run, and Rock Hill. The first major structure built at the

plantation was constructed in 1769. Indications are that the plantation focused mainly on rice production. The property remained intact until after the American Civil War. With the abolition of slavery, the property was eventually sold off in 20-hectare (50-acre) plots. The land was owned by Gore Estate Corporation in the 1920s and is currently owned by GE (ESI, 2008).

3.3.4 Historic and Archaeological Resources at the Proposed GLE Site

There are 799 archaeological sites recorded in New Hanover County, North Carolina. Fifteen archaeological sites and one shipwreck are within 500 meters (1640 feet) of the proposed GLE Facility site. Archaeological surveys conducted in 1978 and 1994 examined areas in the vicinity of the proposed GLE Facility site and identified numerous prehistoric archaeological sites. The 1978 research conducted by Wilde-Ramsing identified numerous archaeological sites; however, the methods used during the survey make the findings difficult to verify (Wilde-Ramsing, 1978). The 1994 survey (Klein et al., 1994) was undertaken for the construction of a Wilmington Bypass and reinvestigated some of the sites identified in 1978 that are in close proximity to the proposed GLE Facility site. The 1994 survey identified a cluster of Middle Woodland archaeological sites that the authors recommended as an archaeological district (Klein et al., 1994). The district, which consists of 11 sites, is partially located on the Wilmington Site.

Archaeological surveys conducted for the proposed action identified three archaeological sites (ESI, 2008). The surveys relied on a combination of pedestrian investigation of exposed soils and shovel testing at 30-meter (100-foot) intervals with 15-meter (50-foot) intervals used for archaeological site investigations. The three discovered sites, 31NH800, 31NH801, and 31NH804, are the remains of two historic-age sites and a prehistoric site. Site 31NH800 appears to be the remains of a farmstead, consisting of artifacts from the eighteenth to twentieth centuries. Site 31NH801 is the remains of a Middle Woodland prehistoric site. Artifacts recovered from the site include ceramics, lithic tools, and animal bone fragments. Site 31NH804 is a historic site dating to the late 19th to mid-20th century. In consultation with the North Carolina State Historic Preservation Office (SHPO), it was determined that sites 31NH800 and 31NH804 are not eligible for listing on the NRHP, while site 31NH801 is eligible for listing.

3.4 Visual and Scenic Resources

Visual impacts occur when contrasts are introduced into the existing environment. Consideration when determining visual or scenic effects from a project are its proximity to viewing locations and the number of people expected to view the project. The proposed GLE Facility site is within the boundaries of GE’s existing Wilmington Site. The existing GE facilities (GNF-A FMO and GE AE/SCO) are most visible from the east and southeast near the I-140/Castle Hayne Road interchange. Figure 3-2 shows one of the two entrances to the Wilmington Site (North Entrance) from Castle Hayne Road just north of the I-140 interchange. The tallest existing site feature is a water tower that is 39.6 meters (130 feet) tall (Figures 3-2 and 3-3). The closest residences are located northeast of the site and back to Sledge Road, which forms the northeastern boundary of the Wilmington Site (Figure 2-1). Existing vegetation largely blocks the view to Sledge Road from these locations (Figure 3-4). At the closest visible point, features of the site that are perceivable can only be seen from the rear of the residences. The GE facilities are not visible from Dekker Road. A stand of pine trees lies between Sledge Road and the main portion of the existing Wilmington Site and largely screens the existing facilities from these residences.

Figure 3-2 South Entrance from Castle Hayne Road to the Wilmington Site (GLE, 2008)

Figure 3-3 Existing Site Water Tower Viewed from South of I-140 (GLE, 2008)

Figure 3-4 Closest Residence to the Proposed GLE Facility Site Viewed from the North Access Road (GLE, 2008)

The proposed GLE Facility would be located to the west-northwest of the existing GE Facilities on the Wilmington Site. The facility would be visible from the residences along the south side of Dekker Road and from I-140 to the south. The entrance to the facility would be visible along Castle Hayne Road. However, the bulk of the proposed GLE Facility would be blocked from view by existing site structures.

The topography of the Wilmington Site is relatively flat. The area gently slopes down toward the Cape Fear River. The existing site is visually screened on the north and west by a pine plantation. Since the trees are evergreens, there is no seasonal variation in the visual screen surrounding the site. However, the understory does change in the winter months.

To the west of the Wilmington Site lies the Northeast Cape Fear River. The L.V. Sutton Steam Electric Plant is on the western bank of the Northeast Cape Fear River across from the site. Portions of the power plant are visible from the river. The existing Wilmington Site is not visible from the Cape Fear River because of vegetation and the change in elevation.

The U.S. Department of the Interior's (DOI's) Bureau of Land Management (BLM) has developed a process for considering visual resources (BLM, 2009). While the BLM's Visual Resource Management system is officially only applicable to BLM land, it provides a useful framework for considering visual resources. The BLM process involves conducting an inventory of the visual landscape to determine the sensitivity of the location to visual intrusions, the scenic qualities of a location, and the distance from which the location would be viewed. Sensitivity refers to the public's concern or expectation for scenic quality. Sensitivity is based on the types of users that would view the location (e.g., recreational users, commuters, and workers), the

amount of use, public interest, and adjacent land uses. Scenic quality is a subjective rating of the visual setting. The scenic quality criteria applied to a landscape are presented and described in Table 3-1. Examples of how to apply the criteria are presented in Table 3-2. Distance considerations are a factor primarily when considering large vistas. It is not expected that any portion of the proposed GLE Facility would be perceivable beyond 8 kilometers (5 miles) (BLM, 2009).

Sensitivity is the main factor to be considered, because it addresses the expectation for pristine environments. The Wilmington Site is located in an industrialized area and is adjacent to a power plant, existing manufacturing facilities, and quarries. The expectation for a pristine natural viewshed would be low for such an area. Most users of the area would be commuters and workers, neither of which would be very sensitive to alterations to the visual quality of the area. The closest recreational users would be those using the Northeast Cape Fear River. Because of the vegetation cover and sloping topography, the proposed GLE Facility site would not visible from the river. The users most affected would be homeowners along Dekker Road. While the changes would be most evident for these residential viewers, they represent a very small fraction of users. The sensitivity of the proposed GLE Facility site is low.

The scenic quality of the area is determined through application of the scenic quality rating criteria, which include landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modification. These criteria are explained in Table 3-1. Table 3-2 explains how numerical ratings are assigned for each criterion. For the proposed GLE Facility site, the landform is gently sloping river floodplain that does not contain any dramatic elements (Rating = 1). The vegetation is uniformly pine trees with leafy understory (Rating = 1). The closest water to the proposed GLE Facility site is the Northeast Cape Fear River. However, the river is not visible from the proposed GLE Facility site because of slope and vegetation cover (Rating = 0). The color range in the proposed GLE Facility site is uniform and consists entirely of evergreen trees (Rating = 1). Adjacent scenery is similar to that found in the proposed GLE Facility site and does not influence the visual quality (Rating = 0). There are no rare features associated with the proposed GLE Facility site; it is consistent with much of the surrounding region (Rating = 1). Cultural modifications would alter the view but are consistent with what is found in the surrounding area (Rating = −2). The overall scenic quality rating (i.e., the sum of the ratings for each criterion) is 2, which would make the scenic quality a C or lower. This rating, which is the lowest relative scenic quality rating, indicates that the project area has little scenic quality compared to other locations in the region. The sum would need to be 12 or more for a scenic quality rating of B, and 19 or more for a scenic quality rating of A.

3.5 Climatology, Meteorology, and Air Quality

This section describes the climatology, meteorology, and air quality in the area surrounding the proposed GLE Facility in Wilmington, North Carolina. This information provides general background conditions and would be used as baseline conditions for the potential impact analysis under various alternatives in Chapter 4.

3.5.1 Regional Climatology

With a 2042-meter (6700-foot) range in elevation and 483-kilometer (300-mile) range in distance from the ocean, North Carolina experiences one of the most diverse climates of any eastern

Table 3-1 Explanation of Scenic Quality Rating Criteria

Landform	Topography becomes more interesting as it gets steeper or more massive, or more severely or universally sculptured. Outstanding landforms may be monumental, as the Grand Canyon, the Sawtooth Mountain Range in Idaho, the Wrangell Mountain Range in Alaska, or they may be exceedingly artistic and subtle as certain badlands, pinnacles, arches, and other extraordinary formations.
Vegetation	Give primary consideration to the variety of patterns, forms, and textures created by plant life. Consider short-lived displays when they are known to be recurring or spectacular. Consider also smaller scale vegetational features which add striking and intriguing detail elements to the landscape (e.g., gnarled or windbeaten trees and joshua trees).
Water	That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration in selecting the rating score.
Color	Consider the overall color(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) as they appear during seasons or periods of high use. Key factors to use when rating "color" are variety, contrast, and harmony.
Adjacent Scenery	Degree to which scenery outside the scenery unit being rated enhances the overall impression of the scenery within the rating unit. The distance which adjacent scenery will influence scenery within the rating unit will normally range from 0 to 8 kilometers (0 to 5 miles), depending upon the characteristics of the topography, the vegetative cover, and other such factors. This factor is generally applied to units which would normally rate very low in score, but the influence of the adjacent unit would enhance the visual quality and raise the score.
Scarcity	This factor provides an opportunity to give added importance to one or all of the scenic features that appear to be relatively unique or rare within one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often it is a number of not so spectacular elements in the proper combination that produces the most pleasing and memorable scenery – the scarcity factor can be used to recognize this type of area and give it the added emphasis it needs.
Cultural Modifications	Cultural modifications in the landform/water, vegetation, and addition of structures should be considered and may detract from the scenery in the form of a negative intrusion or complement or improve the scenic quality of a unit. Rate accordingly.

Source: BLM, 2009.

Table 3-2 Scenic Quality Inventory and Evaluation Chart

Key Factors	Rating Criteria and Score		
Landform	High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers. (5)	Steep canyons, mesas, buttes, cinder cones, and drumlins; or interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional. (3)	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features. (1)
Vegetation	A variety of vegetative types as expressed in interesting forms, textures, and patterns. (5)	Some variety of vegetation, but only one or two major types. (3)	Little or no variety or contrast in vegetation. (1)
Water	Clear and clean appearing, still, or cascading white water, any of which are a dominant factor in the landscape. (5)	Flowing, or still, but not dominant in the landscape. (3)	Absent, or present, but not noticeable. (0)
Color	Rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields. (5)	Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element. (3)	Subtle color variations, contrast, or interest; generally mute tones. (1)
Adjacent Scenery	Adjacent scenery greatly enhances visual quality. (5)	Adjacent scenery moderately enhances overall visual quality. (3)	Adjacent scenery has little or no influence on overall visual quality. (0)
Scarcity	One of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc. (5+)	Distinctive, though somewhat similar to others within the region. (3)	Interesting within its setting, but fairly common within the region. (1)
Cultural Modification	Modifications add favorably to visual variety while promoting visual harmony. (2)	Modifications add little or no visual variety to the area, and introduce no discordant elements. (0)	Modifications add variety but are very discordant and promote strong disharmony. (-4)

Source: BLM, 2009.

State (NCDC, 2009a). The climate of North Carolina varies from the Atlantic Coast in the east to the Appalachian Range in the west. The mountain range in the west often blocks cold temperatures and storms from the Midwest and Canada. Most of the State has a humid subtropical climate (Cfa) by Koppen climate classification, except higher elevations in the west (University of Idaho, 2009).

Warm and humid maritime tropical air from the Gulf of Mexico flows into North Carolina during all seasons, while cold and dry continental polar air masses from Canada penetrate into the area but rarely in summer (Robinson, 2005). These air masses, the jet stream and its accompanying polar front and the Bermuda High pressure system, influence the weather system in North Carolina, depending on their relative positions and intensities. In the summer, the jet stream is situated near the United States–Canadian border, while the Bermuda High is mostly centered over Bermuda. Accordingly, North Carolina is more affected by the Bermuda High than the polar front. In some summers, the Bermuda High expands or moves westward and sits on the Coastal Plain, causing drought there. In the winter, the Bermuda High weakens as it shrinks south and east. This allows the jet stream to push far south well into the east-central United States, which causes the polar front to move into a position to directly influence weather in the Carolinas with deep lows and extensive frontal systems. In addition, the warm Gulf Stream and cold Labrador Current play a pivotal role in the weather of coastal North Carolina (NCDC, 2009a). The confluence of two opposite currents at the north of the Outer Banks of North Carolina produces a wide variety of weather, including the development of major storms, which cause rains along the coast and inland areas as well. At the Outer Banks, the Labrador Current passes between the Gulf Stream lying 80 kilometers (50 miles) offshore and the coast, which offsets most of the general warming effect that the Gulf Stream might otherwise have on coastal temperatures.

The proposed GLE Facility would be located in the tidewater section of southeastern North Carolina, near the Atlantic Ocean, which is located about 16 kilometers (10 miles) to the southeast. Because of its proximity to the Atlantic Ocean, the area experiences an unusually mild climate and small diurnal and seasonal temperature ranges, compared with a continental type of climate at a comparable latitude. In general, the summers are quite warm and humid with rare excessive heat. During the winter, numerous polar air masses can penetrate the Atlantic Coast and result in abrupt drops in temperatures (NCDC, 2009b). However, these cold outbreaks are considerably moderated by long trajectories from the source regions, the effects of passing over the Appalachian Range, and the moderating effects of the ocean air in the area. Accordingly, most winters in the area are short and quite mild.

3.5.2 Site and Regional Meteorology

Real-time meteorological data (e.g., wind speed and direction, barometric pressure) are collected by GNF-A at a level of 6.1 meters (20 feet) for emergency response purposes, but these data are not recorded. In view of the longer period of record available at the Wilmington/New Hanover County Airport, the NRC used that data to assess the meteorological and climatological conditions representative of the general region surrounding the proposed GLE Facility. The airport is located approximately 8 kilometers (5 miles) southeast of the proposed GLE Facility. The general topography of the Wilmington area is flat, with little to no change in elevation.

3.5.2.1 Temperature

Table 3-3 presents monthly average and daily extreme temperatures at the Wilmington/New Hanover County Airport, North Carolina. Compared with farther inland stations, temperatures around the proposed GLE Facility are moderate because of proximity to the Atlantic Ocean. For the 1971 to 2000 period, the annual average temperature was 17.7° Celsius (63.8° Fahrenheit), ranging from 11.9 to 23.3° Celsius (53.5° Fahrenheit to 74.0° Fahrenheit) (NCDC, 2009b).

January is the coldest month, averaging 7.8° Celsius (46.1° Fahrenheit) with temperature ranging from 2.1° Celsius to 13.5° Celsius (35.8° Fahrenheit to 56.3° Fahrenheit), and July is the warmest month, averaging 27.3° Celsius (81.1° Fahrenheit) with temperature ranging from 22.4° Celsius to 32.2° Celsius (72.3° Fahrenheit to 89.9° Fahrenheit). During the last 57 years, the lowest temperature, –17.8° Celsius (0° Fahrenheit), was reached in December 1989, and the highest, 40.0° Celsius (104° Fahrenheit), in June 1952. About 46.3 days have a maximum temperature greater than or equal to 32.2° Celsius (90° Fahrenheit), while 39.3 days have a minimum temperature less than or equal to 0° Celsius (32° Fahrenheit).

Table 3-3 Monthly Average and Daily Extreme Temperaturesat the Wilmington/New Hanover County Airport, North Carolina

	Monthly Averages[a]			Daily Extremes[b]			
	Mean	Minimum	Maximum	Lowest Minimum		Highest Maximum	
Month	° Celsius (° Fahrenheit)	° Celsius (° Fahrenheit)	° Celsius (° Fahrenheit)	° Celsius (° Fahrenheit)	Year	° Celsius (° Fahrenheit)	Year
Jan.	7.8 (46.1)	2.1 (35.8)	13.5 (56.3)	-15.0 (5)	1985	27.8 (82)	1975
Feb.	9.2 (48.5)	3.1 (37.5)	15.3 (59.5)	-11.7 (11)	1996	29.4 (85)	1962
Mar.	12.8 (55.0)	6.5 (43.7)	19.0 (66.2)	-12.8 (9)	1980	31.7 (89)	1974
Apr.	17.1 (62.7)	10.7 (51.2)	23.4 (74.1)	-1.7 (29)	2007	35.0 (95)	1967
May	21.2 (70.2)	15.4 (59.8)	27.0 (80.6)	3.3 (38)	1989	36.7 (98)	1953
June	25.0 (77.0)	19.8 (67.6)	30.2 (86.4)	8.9 (48)	1983	40.0 (104)	1952
July	27.3 (81.1)	22.4 (72.3)	32.2 (89.9)	12.8 (55)	1988	38.9 (102)	1977
Aug.	26.5 (79.7)	21.7 (71.0)	31.3 (88.3)	12.8 (55)	2004	39.4 (103)	1999
Sept.	23.9 (75.0)	18.8 (65.9)	28.9 (84.1)	6.7 (44)	1981	36.7 (98)	1975
Oct.	18.2 (64.8)	12.2 (53.9)	24.2 (75.6)	-2.8 (27)	1962	35.0 (95)	1986
Nov.	13.6 (56.5)	7.3 (45.1)	19.9 (67.8)	-6.7 (20)	1970	30.6 (87)	1974
Dec.	9.4 (48.9)	3.4 (38.1)	15.3 (59.6)	-17.8 (0)	1989	27.8 (82)	1998
Annual	17.7 (63.8)	11.9 (53.5)	23.3 (74.0)	-17.8 (0)	Dec. 1989	40.0 (104)	June 1952

[a] 1971 to 2000 climate normals.
[b] Period of record is 57 years (1952 to 2008).
Source: NCDC, 2009b.

3.5.2.2 Precipitation and Relative Humidity

Generally, precipitation in North Carolina is relatively ample in most parts of the State (greater than 102 centimeters [40 inches]). The mean annual precipitation is heaviest in the southeastern corner of the State, which includes the proposed GLE Facility, and gradually decreases toward the north and west. Table 3-4 presents summaries of monthly mean and extreme precipitation and snowfall at the Wilmington/New Hanover County Airport. Annual precipitation averages about 145.0 centimeters (57.07 inches) (NCDC, 2009b). Precipitation in the area is well distributed throughout the year; it is driest in April and wettest in July. By season, precipitation is the highest in summer, accounting for about 36 percent of the annual total, and precipitation is comparable in other seasons. Summer rainfall is associated primarily with thunderstorms, and is therefore usually of a short duration, but often heavy and unevenly distributed. Minimum and maximum monthly precipitations are 0.4 centimeters (0.16 inches) and 59.5 centimeters (23.41 inches), respectively. The highest 24-hour precipitation was 37.7 centimeters (14.84 inches) in September 1999. Measurable precipitation of 0.025 centimeters (0.01 inches) or more occurred about one-third of the time (118.1 days per year).

Appreciable wintry precipitation, such as snow, sleet, or freezing rain, is a rarity and, when it occurs, remains on the ground for a short time. Light snow typically occurs from December through March, and the annual average snowfall in the area is about 5.3 centimeters (2.1 inches). The greatest amounts of snow reported in a single month and in a 24-hour period were 38.9 centimeters (15.3 inches) in December 1989, and 29.7 centimeters (11.7 inches) in February 1973, respectively (NCDC, 2009b).

Because of the proximity to the Atlantic Ocean, Wilmington experiences higher relative humidity and smaller monthly variations than farther-inland locations at a comparable latitude. The annual average relative humidity is about 74 percent, with the lowest monthly average of 68 percent in April and the highest monthly average of 80 percent in August (NCDC, 2009b). During the day, the lowest annual-average relative humidity of 57 percent occurs in the early afternoon and the highest of 85 percent in the early morning and the middle of the night.

3.5.2.3 Winds, Atmospheric Stability, and Temperature Inversions

Figure 3-5 presents a wind rose at the 10-meter (33-foot) level of Wilmington/New Hanover County Airport based on 2004 to 2008 wind data. The average annual wind speed is about 3.4 meters per second (7.6 miles per hour), and calm winds (less than 0.5 meters per second [1.1 miles per hour]) are recorded about 18 percent of the time (NCDC, 2009c). Albeit not prominent, the prevailing wind direction is from the southwest (about 9.7 percent of the time) and secondarily from the north-northeast (9.0 percent) and south-southwest (8.8 percent). Wind speed tends to be highest in spring and lowest in summer (NCDC, 2009c). Occurrences of calm winds are lowest (about 12 percent frequency) in spring and high (about 20 percent frequency) in all other seasons. In general, southwesterly winds prevail in winter through summer, while northerly winds prevail in fall. The southwesterly winds are strongly influenced by general synoptic-scale[1] wind patterns of the Bermuda High. In contrast, northerly winds reflect the influences of penetrating polar air masses and changes in global circulation (Robinson, 2005).

[1] The synoptic scale is the scale of high- or low-pressure systems in the lower atmosphere as seen on weather maps; typically with a horizontal scale on the order of 1000 kilometers (620 miles) or more.

Table 3-4 Monthly Mean and Extreme Precipitation and Snowfall at the Wilmington/New Hanover County Airport, North Carolina

	Precipitation							Snowfall				
	Mean[a]	Minimum[b]		Maximum[b]		Maximum 24-hour[b]		Mean[a]	Maximum[b]		Maximum 24-hour[b]	
Month	cm (in.)	cm (in.)	Year	cm (in.)	Year	cm (in.)	Year	cm (in.)	cm (in.)	Year	cm (in.)	Year
Jan.	11.5 (4.52)	1.7 (0.68)	2001	26.0 (10.22)	1991	7.8 (3.08)	1982	1.5 (0.6)	15.5 (6.1)	2000	12.7 (5.0)	1988
Feb.	9.3 (3.66)	2.6 (1.01)	1976	28.5 (11.22)	1998	12.7 (5.00)	1998	1.3 (0.5)	31.8 (12.5)	1973	29.7 (11.7)	1973
Mar.	10.7 (4.22)	2.4 (0.93)	1967	21.0 (8.27)	1994	12.2 (4.81)	1994	1.0 (0.4)	16.8 (6.6)	1980	14.5 (5.7)	1980
Apr.	7.5 (2.94)	0.4 (0.16)	1995	20.9 (8.21)	1961	8.9 (3.52)	1961	0.0	Trace	1996	Trace	1996
May	11.2 (4.40)	2.4 (0.95)	1987	23.2 (9.12)	1956	12.8 (5.02)	1999	0.0	Trace	1998	Trace	1998
June	13.6 (5.36)	2.3 (0.89)	1984	32.7 (12.87)	1962	19.6 (7.73)	1966	0.0	Trace	1995	Trace	1995
July	19.4 (7.62)	4.2 (1.65)	1961	38.4 (15.12)	1966	16.7 (6.58)	1988	0.0	0.0	NA[c]	Trace	1996
Aug.	18.6 (7.31)	4.2 (1.66)	1968	47.8 (18.83)	2006	24.3 (9.56)	2006	0.0	0.0	NA	0.0	NA
Sept.	17.2 (6.79)	1.8 (0.70)	1986	59.5 (23.41)	1999	37.7 (14.84)	1999	0.0	0.0	NA	0.0	NA
Oct.	8.2 (3.21)	0.4 (0.17)	1953	38.3 (15.07)	2005	20.7 (8.15)	2005	0.0	0.0	NA	0.0	NA
Nov.	8.3 (3.26)	1.2 (0.49)	1973	20.0 (7.87)	1972	12.2 (4.82)	1969	0.0	Trace	1976	Trace	1976
Dec.	9.6 (3.78)	1.2 (0.48)	1955	17.9 (7.06)	1989	9.9 (3.88)	1980	1.5 (0.6)	38.9 (15.3)	1989	24.6 (9.7)	1989
Annual	145.0 (57.07)	0.4 (0.16)	Apr. 1995	59.5 (23.41)	Sep. 1999	37.7 (14.84)	Sep. 1999	5.3 (2.1)	38.9 (15.3)	Dec. 1989	29.7 (11.7)	Feb. 1973

[a] 1971 to 2000 climate normals.
[b] Period of record is 57 years (1952 to 2008).
[c] NA = not applicable.
Source: NCDC, 2009b.

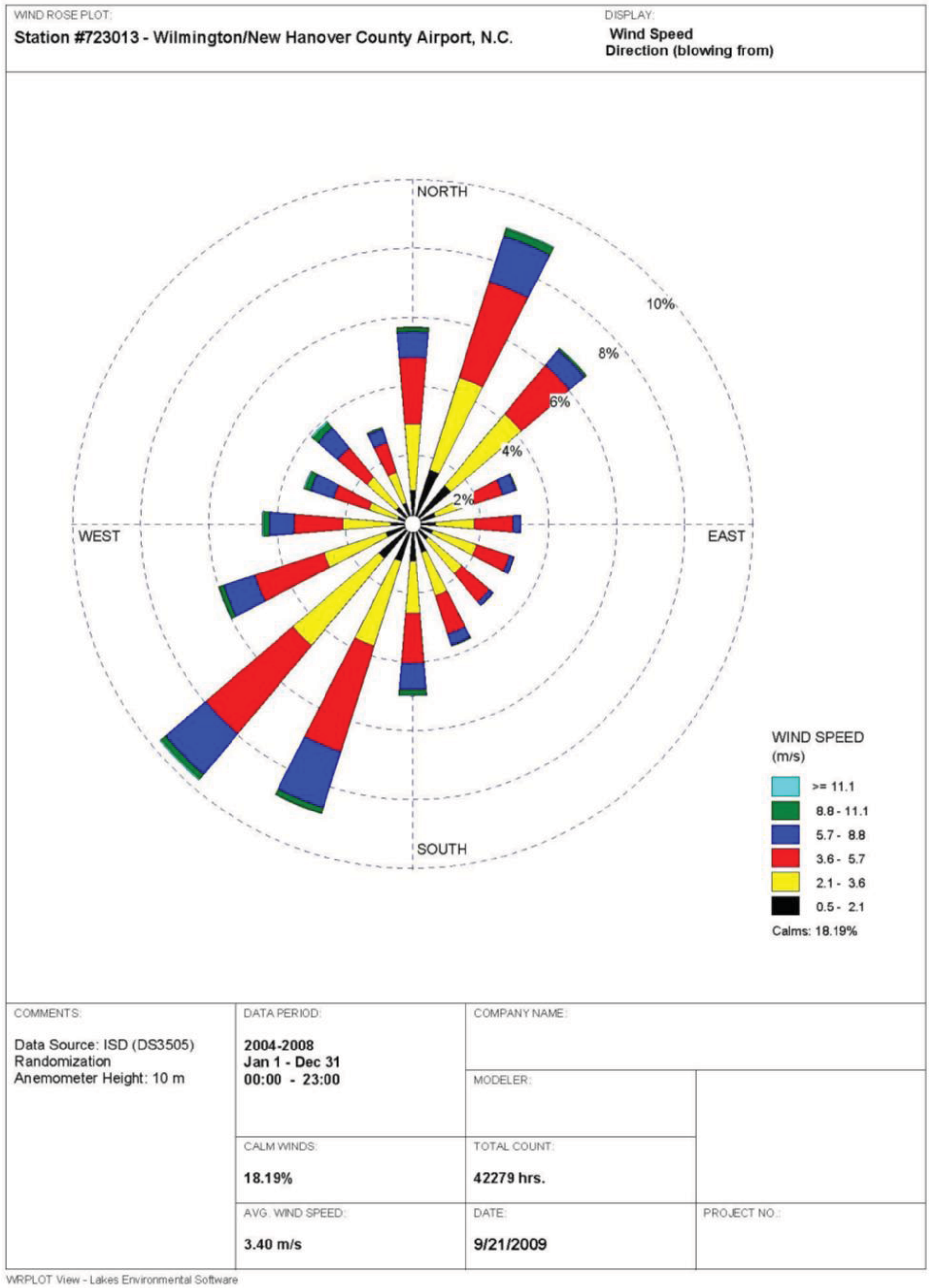


Figure 3-5 Wind Rose (10-meter [33-foot] level) for the Wilmington/New Hanover County Airport, 2004 to 2008 (NCDC, 2009c)

Atmospheric stability affects the extent to which gases or particulates are dispersed. Vertical motions and pollution dispersion are enhanced in an unstable atmosphere, while suppressed in a stable atmosphere. Stability is usually classified by Pasquill stability, ranging from Class A through F (Turner and Schulze, 2007), which depends on solar insolation (the amount of solar radiation energy received by a given area in a given time), wind speed, and cloud cover. Class A stability (most unstable) conditions occur in low winds with high incoming levels of solar radiation typically during the daytime. Class E stability (slightly stable) and Class F stability (moderately stable) conditions arise on clear nights with little wind. Class D stability (neutral) conditions occur with higher wind speeds and/or greater cloud cover, irrespective of day or night. Figure 3-6 presents the frequency distribution of stability classes for a 9-year period (1984 to 1992) at the Wilmington/New Hanover County Airport (EPA, 2009a). The neutral (Class D) condition is most prevalent, which accounts for about 43.2 percent of the time. The unstable conditions (Class A to Class C) occur approximately 20.1 percent of the time, while the stable conditions (Class E and Class F) occur about 36.7 percent of the time.

Normally, the temperature in the atmosphere decreases with height above the ground. A temperature inversion occurs when there is an increase in temperature with height above the ground. An inversion suppresses convection, which can lead to air pollutants being trapped close to the ground, thereby causing possible adverse health effects. The length of time an inversion lasts (its persistence) is an important factor for determining its impact on air dispersion. One type of inversion is “surface inversion,” which is due primarily to a loss of long-wave radiation near the surface and common on any night, and strong and deep around sunrise and in winter. On the basis of Class E and Class F stability,[2] surface inversion occurs frequently in the Wilmington area, about 36.7 percent of the time. After sunrise, the temperature surface inversion breaks up due to the sun’s heating the ground on a time scale of hours.

Another type of inversion is the “subsidence inversion,” which can develop aloft as a result of air gradually sinking over a wide area and being warmed by adiabatic compression, usually associated with subtropical high-pressure systems. Subsidence inversions are principal causes of air stagnation, which is characterized by poor ventilation due to persistent light and calm winds, and by the presence of inversions. Stagnant air could accumulate air pollutants and cause poor air quality over a wide area for a prolonged period, resulting in what is called an “air pollution episode.” An air pollution episode may adversely affect the health of individuals at higher risk (e.g., the young, elderly, or those with respiratory or cardiovascular diseases). The Wilmington area has a mean of 10 to 20 air stagnation days per year and of 2 to 4 air stagnation episodes per year (Wang and Angell, 1999). On average, stagnation episodes last about 5 days.

[2] The Pasquill stability classes presented here are based on solar insolation, wind speed, and cloud cover, not temperature gradients at two different heights. Temperature gradients are −0.5 to 1.5° Celsius (−0.9 to 2.7° Fahrenheit) per 100 meters (328 feet) for Class E and >1.5° Celsius (2.7° Fahrenheit) per 100 meters (328 feet) for Class F. Accordingly, the frequency of surface inversion presented here, defined as temperature increase with height (i.e., >0° Celsius (0° Fahrenheit) per 100 meters [328 feet]), might be overestimated.

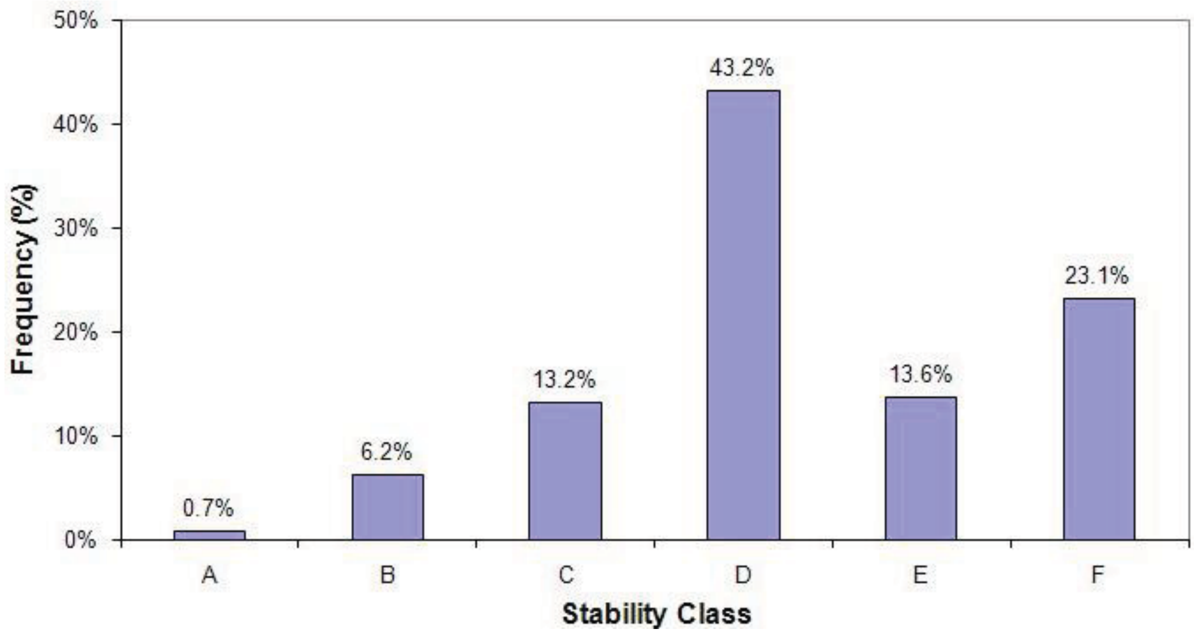


Figure 3-6 Distribution of Stability Classes for the Wilmington/New Hanover County Airport, 1984 to 1992 (EPA, 2009a)

3.5.2.4 Mixing Heights

The mixing height is defined as the height above the ground surface through which relatively vigorous vertical mixing occurs, primarily through the action of atmospheric turbulence. All other parameters being equal, ground-level (at the surface) concentrations of emitted pollutants under low mixing height will be relatively high because pollutants are prevented from dispersing upward. Mixing heights commonly go through large diurnal variations because of solar heating during the day and surface cooling at night. Mixing heights are generally lowest late at night or early morning and highest during mid to late afternoon. At the locations near large water bodies (e.g., Wilmington), diurnal and seasonal mixing heights show little difference, compared with considerable differences at inland stations because of the moderating effects of the large water bodies. Seasonal variations of morning mixing heights are generally not large. However, afternoon mixing heights display a large seasonal variation, and mixing heights in summer are typically higher than those in winter.

Mixing heights are not measured directly but calculated approximately from routine surface and upper air observations. Holzworth (1972) developed mean seasonal and annual mixing heights throughout the contiguous United States by using 1960 to 1964 observation data. No site-specific mixing height data are available for the Wilmington Site. Thus, mean seasonal and annual data were taken from the isopleths of mixing heights in Holzworth (1972). As shown in Figure 3-7, the mean annual morning and afternoon mixing heights for the Wilmington Site are approximately 540 meters (1770 feet) and 1160 meters (3810 feet), respectively. As mentioned previously, because of the moderating effects of the Atlantic Ocean, seasonal variations in mixing heights are small, and differences between morning and afternoon mixing heights are not considerable compared with farther inland stations.

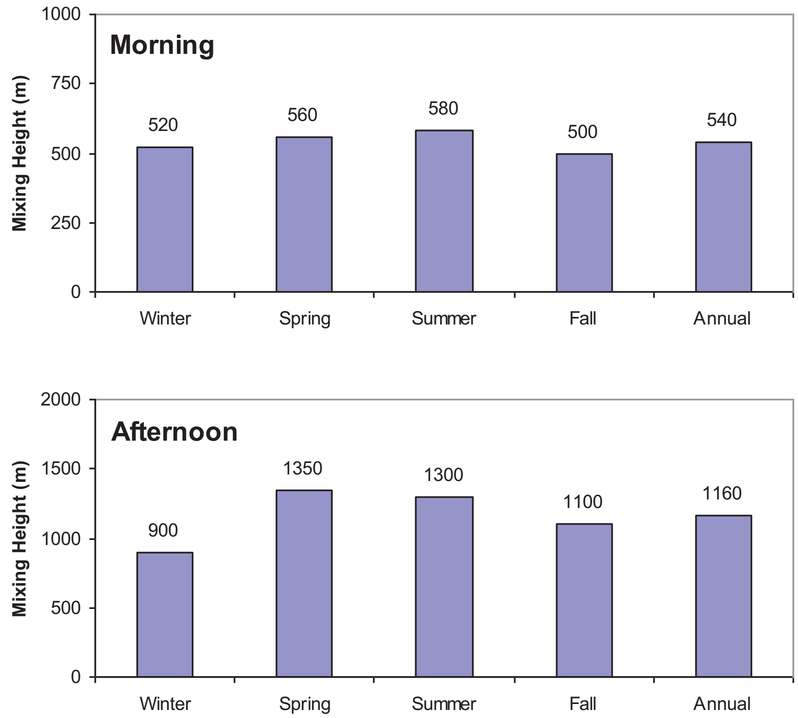


Figure 3-7 Mean Morning and Afternoon Mixing Heights for the Wilmington Site, North Carolina (Holzworth, 1972)

3.5.2.5 Severe Weather Conditions

In common with most Atlantic coastal localities, the area is subject to the effects of coastal tropical storms and occasional hurricanes causing high winds, above-normal tides, heavy rains, and even tornadoes (NCDC, 2009b). In addition, thunderstorms in the area are associated with large-scale synoptic fronts approaching from the north and west. Thunderstorms are the most active during the summer months, occurring about 1 out of 3 days from June through August. The Wilmington area experiences about 4 days per year of damaging severe thunderstorms with straight winds greater than 50 knots (26 meters per second [58 miles per hour]) (NSSL, 2009). Another hazard of thunderstorms is lightning, which can strike up to 16 kilometers (10 miles) away from the rain of a thunderstorm. Some lightning strikes have caused either numerous injuries, including fatalities, or property damage such as disruption of electric circuits and wildfires. From 1996 through 2005, the Wilmington area experienced about four to eight lightning flashes per square kilometer per year (NOAA, 2009).

Tornadoes are rare in the area surrounding the proposed GLE Facility, and are less frequent and destructive than those in the “tornado alley” of the central United States. For the period 1950 to 2008, 1126 tornadoes were reported in North Carolina, with an average of 19.1 tornadoes per year (NCDC, 2009d). For the same period, a total of 16 tornadoes with an average of 0.3 tornadoes per year were reported in New Hanover County. Six of the 16 tornadoes that hit New Hanover County occurred during a 2-year period (1998 to 1999). However, most tornadoes occurring in New Hanover County between 1950 and 2008 were

relatively weak; that is, all F0 or F1, except one F2[3] on the Fujita tornado scale,[4] and caused five injuries and no fatalities in total.

Most hurricanes form over warm ocean waters near the equator and usually travel west and slightly north while strengthening. Many storms curve to the northeast near the Florida peninsula. Hurricanes are sustained and strengthened by energy from warm waters (water temperature higher than 27° Celsius [80° Fahrenheit]). Because of the proximity of New Hanover County to the Gulf Stream, this area has a high potential for hurricanes advancing from the tropics to sustain or intensify their strengths. Hurricanes come close enough to affect North Carolina about twice in an average year (NCDC, 2009a). Most storms that hit most or part of the State do little damage, but some storms are powerful enough to cause extreme damage and loss of life. Coastal properties occasionally suffer severe damage from associated high tides. The area of New Hanover County could expect the following return periods for each category of hurricanes passing within 75 nautical miles (139 kilometers [86 miles]): Category 1,[5] 10 years; Category 2, 24 years; Category 3, 43 years; Category 4, 96 years; and Category 5, 250 years (NHC, 2009). Between 1950 and 2007, many tropical storms have passed within 75 nautical miles of the proposed GLE Facility and 15 of them were classified as hurricanes (CSC, 2009). Ten hurricanes made landfall along the stretch of the coastline within 75 nautical miles (139 kilometers [86 miles]) of the proposed GLE Facility. The strongest of the 10 hurricanes recorded since 1950 were Category 3 storms Hazel (1954) and Fran (1996), which caused mass destruction along the coast. Category 4 Hurricane Helene (1958) was within 75 nautical miles (139 kilometers [86 miles]) but did not make landfall and moved northeastward along the Atlantic Coast. Hurricane Diana (1984) approached offshore of New Hanover County as a Category 4 hurricane but made landfall as a Category 1 hurricane after making one full turn offshore; it was then downgraded to a tropical storm while advancing inland. The southern coastline in North Carolina was affected by more hurricanes than any other State bordering the Atlantic Ocean and the Gulf of Mexico between 1996 and 1999.

3.5.3 Air Quality

Regulations governing air pollution sources at the Wilmington Site have been promulgated by the U.S. Environmental Protection Agency (EPA) per the Federal *Clean Air Act* (CAA). These regulations are implemented through several EPA programs. The North Carolina Division of Air

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3 An F2 tornado was reported in neighboring Brunswick County on June 13, 1962, but its location is within the New Hanover County (NCDC 2009d).

4 The Fujita tornado scale is classified with the fastest 0.40-km (0.25-mi) wind speeds: 18–32 m/s (40–72 mph) for F0 (gale); 33–50 m/s (73–112 mph) for F1 (moderate); 51–70 m/s (113–157 mph) for F2 (significant); 71–92 m/s (158–207 mph) for F3 (severe); 93–116 m/s (208–260 mph) for F4 (devastating); and 117–142 m/s (261–318 mph) for F5 (incredible). The new Enhanced Fujita (EF) scale based on 3-second wind gusts was implemented on February 1, 2007. Since that date, all tornadoes in the United States have been rated by using EF categories. Similar to the original Fujita scale, the ratings are from EF0 to EF5. However, historical tornadoes recorded on or before January 31, 2007, are still categorized with the original Fujita scale.

5 Maximum sustained surface (peak 1-minute wind at 10-m [33-ft] level) wind speeds are 33–42 m/s (74–95 mph) for Category 1, 43–49 m/s (96–110 mph) for Category 2, 50–58 m/s (111–130 mph) for Category 3, 59–69 m/s (131–155 mph) for Category 4, and greater than 69 m/s (155 mph) for Category 5.

Quality (NCDAQ) under the North Carolina Department of Environment and Natural Resources (NCDENR) has authority, as delegated by the EPA, to administer these regulatory programs in the State. The major programs are summarized below.

The EPA has set National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM; PM_{10} and $PM_{2.5}$),[6] and lead (Pb), as shown in Table 3-5 (EPA, 2010a). Primary NAAQS specify maximum ambient (outdoor air) concentration levels of the criteria pollutants with the aim of protecting public health with an adequate margin of safety. Secondary NAAQS specify maximum concentration levels with the aim of protecting public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The NAAQS specify different averaging times as well as maximum concentrations. Some of the NAAQS for averaging times of 24 hours or less allow the standard values to be exceeded a limited number of times per year; others specify other procedures for determining compliance.

North Carolina has its own State Ambient Air Quality Standards (SAAQS) (Title 15A, Chapter 2, Subchapter D of the *North Carolina Administrative Code* [15A North Carolina (NC) Administrative Code 02D.0401-410]), which are almost the same as the NAAQS, as shown in Table 3-5. Currently, the State has the standard for total suspended particulates (TSP), which used to be one of the criteria pollutants but was replaced by PM_{10} in 1987. If a State has no standard corresponding to one of the NAAQS, the NAAQS apply.

An area where air quality is above NAAQS levels is called a nonattainment area. Previously, nonattainment areas where air quality has improved to meet the NAAQS were redesignated maintenance areas, subject to an air quality maintenance plan. None of the coastal counties in North Carolina, including New Hanover County (where the proposed GLE Facility will be located) and two neighboring counties, are nonattainment or maintenance areas for criteria pollutants (EPA, 2009b). Several inland counties are nonattainment areas for 8-hour O_3 and $PM_{2.5}$, and maintenance areas for CO.

In areas with pollutant levels below the NAAQS (i.e., attainment areas), the Federal Prevention of Significant Deterioration (PSD) program places limits on the total increase in ambient pollutant levels above established baseline levels for SO_2, NO_2, and PM_{10} (40 CFR 51.166). This prohibits "polluting up to the limits" specified in the NAAQS for these pollutants. Under these regulations, the allowable increases are smallest in Class I areas (e.g., national parks and wilderness areas). The rest of the country is subject to larger Class II increments. Most areas, including the proposed GLE Facility and its vicinity, are classified as Class II areas. EPA typically recommends that the permitting authority notify the Federal Land Managers (FLMs) when a proposed PSD source would locate within 100 kilometers (62 miles) of a Class I area (EPA, 2010b). If the source's emissions are considerably large (subjective), EPA recommends that sources beyond 100 kilometers (62 miles) be brought to the attention of the FLMs. The FLMs then become responsible for demonstrating that the source's emissions could have an

[6] Particulate matter (PM) is dust, smoke, and other solid particles and liquid droplets in the air. The size of the particulate is important and is measured in micrometers (μm). A micrometer is 1 millionth of a meter (0.000039 in.). PM_{10} is PM with an aerodynamic diameter less than or equal to 10 μm and can reach the lower sections of the respiratory system. $PM_{2.5}$ is PM with an aerodynamic diameter less than or equal to 2.5 μm and is small enough to penetrate deep into the lower, most sensitive parts of the lung.

Table 3-5 National Ambient Air Quality Standards (NAAQS) and North Carolina State Ambient Air Quality Standards (SAAQS) for Criteria Pollutants

		NAAQS[b]		
Pollutant[a]	Averaging Time	Value	Type[c]	North Carolina SAAQS
SO_2	3-hour	0.5 ppm (1,300 μg/m^3)	S	1300 μg/m^3 (0.5 ppm)
	24-hour	0.14 ppm	P	365 μg/m^3 (0.14 ppm)
	Annual	0.03 ppm	P	80 μg/m^3 (0.03 ppm)
NO_2	1-hour	0.100 ppm[d]	P	NS[e]
	Annual	0.053 ppm (100 μg/m^3)	P, S	0.053 ppm (100 μg/m^3)
CO	1-hour	35 ppm (40 mg/m^3)	P	35 ppm (40 mg/m^3)
	8-hour	9 ppm (10 mg/m^3)	P	9 ppm (10 mg/m^3)
O_3	1-hour	0.12 ppm[f]	P, S	NS
	8-hour	0.075 ppm (2008 standard)	P, S	0.075 ppm
	8-hour	0.08 ppm (1997 standard)[g]	P, S	NS
TSP	24-hour	NS	NS	150 μg/m^3
	Annual (geometric)	NS	NS	75 μg/m^3
PM_{10}	24-hour	150 μg/m^3	P, S	150 μg/m^3
$PM_{2.5}$	24-hour	35 μg/m^3	P, S	35 μg/m^3
	Annual	15.0 μg/m^3	P, S	15.0 μg/m^3
Lead	Rolling 3-month	0.15 μg/m^3 [h]	P, S	0.15 μg/m^3
	Calendar quarter	1.5 μg/m^3	P, S	NS

[a] CO = carbon monoxide, NO_2 = nitrogen dioxide, O_3 = ozone, $PM_{2.5}$ = particulate matter ≤ 2.5 μm, PM_{10} = particulate matter ≤ 10 μm, SO_2 = sulfur dioxide, and TSP = total suspended particulates.

[b] NAAQS, other than those for NO_2, O_3, PM_{10}, and $PM_{2.5}$ and those based on annual averages, are not to be exceeded more than once per year. The 1-hour NO_2 standard is attained when the 3-year average of the 98th percentile of the daily maximum 1-hour average at any monitor within an area must not exceed 0.100 ppm. The 1 hour O_3 standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is ≤1. The 8-hour O_3 standard is attained when the 3-year average of the fourth-highest daily maximum 8-hour average concentrations measured at each monitor within an area over each year does not exceed the standard. The 24-hour PM_{10} standard is not to be exceeded more than once per year on average over 3 years. The 24-hour $PM_{2.5}$ standard is attained when the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area does not exceed the standard. The annual $PM_{2.5}$ standard is attained when the 3-year average of the weighted annual mean concentrations from single or multiple community-oriented monitors does not exceed the standard. Refer to Title 40, Part 50 of the *Code of Federal Regulations* (40 CFR Part 50) for detailed information on attainment determination and reference method for monitoring.

[c] P = primary standard whose limits were set to protect public health; S = secondary standard whose limits were set to protect public welfare.

[d] Effective April 12, 2010.

[e] NS = no standard exists.

[f] As of June 15, 2005, the EPA revoked the 1-hour O_3 standard in all areas except 8-hour O_3 nonattainment Early Action Compact (EAC) areas.

[g] The 1997 standard – and the implementation rules for that standard – will remain in place for implementation purposes as the EPA undertakes rulemaking to address the transition from the 1997 O_3 standard to the 2008 O_3 standard.

[h] Effective January 12, 2009.

Sources: EPA, 2010a; 15A NC Administrative Code 02D.0401-410.

adverse effect on air quality-related values (AQRVs), such as scenic, cultural, biological, and recreational resources (EPA, 2010b). The nearest Class I areas are the Swanquarter Wilderness Area in North Carolina and Cape Romain Wilderness Area in South Carolina, both of which are beyond 177 kilometers (110 miles) from the proposed facility (40 CFR 81.422 and 40 CFR 81.426) (FWS, 1998).

Section 112 of the CAA specified a list of hazardous air pollutants (HAPs), also called air toxics. Unlike criteria air pollutants, no Federal ambient air quality standards have been established for air toxics. Rather, the EPA has issued National Emission Standards for Hazardous Air Pollutants (NESHAPs) requiring control of sources of these pollutants. These standards are based on a technology, rather than a health-based approach, but still require an assessment of the residual health risk remaining after the controls are in place.

North Carolina has its own “risk-based” regulatory program, independent of the Federal program, designed to protect the public health by limiting emissions of toxic air pollutants (TAPs). Many chemicals on the State TAPs list overlap with those on the Federal hazardous air pollutants (HAPs) list, but the State includes additional substances not on the Federal list. As part of its program, North Carolina has also developed Acceptable Ambient Levels (AALs) for 97 TAPs, “above which the substance may be considered to have an adverse effect on human health” (15A NC Administrative Code 02D.1104). In contrast to the NAAQS, which are applied to outdoor air throughout the country, the AALs are applied on a much smaller scale. North Carolina’s AALs are used in air permitting to ensure that TAPs from new or modified facilities do not cause or contribute beyond the premises (adjacent property boundaries) to any significant concentration levels that may adversely affect human health, on a case-by-case basis. Generally, monitoring for TAPs is limited to specific areas and specific pollutants.

3.5.3.1 Current Emissions at the Wilmington Site

Air quality permits are legally binding documents that include enforceable conditions with which the source owner/operator must comply. As discussed in Section 3.5.3, depending on the air regulatory program, the State has both independent authority and authority delegated from the EPA to issue these permits. The NCDAQ issues the permits to source owners/operators for the construction and operation of air emission sources in the State. Construction permits ensure that proposed projects can meet air pollution standards before construction. Operating permits set emission limits and establish monitoring, record-keeping, and reporting requirements. For air permitting purposes, a source is classified as one of three categories: “major,” “synthetic minor,” and “small.” A facility that has the potential to emit 91 metric tons (100 tons) or more per year for one or more of the criteria pollutants, or 9.1 metric tons (10 tons) or more per year of any of the listed HAPs, or 23 metric tons (25 tons) or more per year of an aggregate total of HAPs is defined as a “major” source. Major sources are subject to Title V of the *Clean Air Act* (42 U.S.C. 7401 et seq.), which standardizes air quality permits and the permitting process across the United States. A “synthetic minor” (or “conditional major”) source has the potential for exceeding major source emission thresholds but is the one that avoids major source requirements by accepting permit conditions that limit emissions below major source thresholds. The “small” (or “minor”) source has no potential for exceeding major source emission thresholds.

Currently, the Wilmington Site has two active “synthetic minor” operating permits. Permit 1161R19 was issued to GE to operate air emission sources associated with the AE operations and one air emission source related to the SCO (NCDAQ, 2004a). The primary emission is PM_{10} from metal cleaning systems. Permit 1756R17 was issued to GNF-A to operate air emission sources associated with the FMO facility and the FCO (NCDAQ, 2004b). Primary emission sources include a natural gas-fired chambered incinerator for combustible LLRW, three natural gas or No. 2 fuel oil-fired boilers, and one emergency and two load-shedding generators burning diesel fuel.

Table 3-6 presents annual point source emissions of criteria pollutants and volatile organic compounds (VOCs) for New Hanover County, neighboring Brunswick and Pender Counties, and for the Wilmington Site (NCDAQ, 2009a-d). Annual point source emissions for New Hanover County are the highest among the three counties, about 2 to 7 times higher than for Brunswick County. Pender County, with the lowest population among the three counties and no major industries, has negligible point source emissions. Point source emissions from current operations at the Wilmington Site are well below the major source threshold of 91 metric tons (100 tons) per year for one or more of the criteria pollutants, and are insignificant compared with the annual total emissions in New Hanover County and the three counties combined.

Table 3-6 Annual Point Source Emissions of Criteria Pollutants and VOCs in New Hanover County, Neighboring Brunswick and Pender Counties for 2007, and at the Wilmington Site for 2004

	Annual Emission Rates (tons/yr)[a]			
Pollutant	Brunswick County	New Hanover County	Pender County	Wilmington Site[b]
SO_2	7407	26,055	NA[c]	0.2
NO_x	2612	7170	NA	7
CO	6299	12,156	NA	3.5
VOC	1426	2371	NA	0.4
TSP	292	1790	6.4	0.4
PM_{10}	201	1328	2.6	0.4
$PM_{2.5}$	134	782	NA	0.1

[a] To convert tons to metric tons, multiply by 0.9072.
[b] Point source emissions reported to and accepted by NCDAQ for compliance with current site permits.
[c] NA = not available.
Source: NCDAQ, 2009a-d.

Annual emissions in 2007 for large point sources with any one of the criteria pollutants and/or VOCs of greater than 91 metric tons (100 tons) per year in New Hanover County and neighboring Brunswick and Pender Counties are presented in Table 3-7. Many large point source emitters are in operation in Wilmington, New Hanover County, while no large emitters exist in Pender County. A coal-fired electric plant owned by Carolina Power and Light Company in Wilmington, New Hanover County, accounts for more than half of the three-county total point source emissions of SO_2, NO_x, and all PMs (TSP, PM_{10}, and $PM_{2.5}$). Invista, S.a.r.l., a manufacturer of industrial organic chemicals, is a primary contributor to emissions of CO and VOCs and a secondary contributor to emissions of all PMs. Invista, S.a.r.l. is also a secondary contributor to SO_2, along with a coal-fired cogeneration plant in Southport, Brunswick County, owned by EPCOR USA. DAK Americas LLC, a manufacturer of organic fibers in Leland, Brunswick County, is a secondary contributor to NO_x, CO, and VOC emissions.

As shown in Table 3-8, nitric acid, at 178 kilograms (393 pounds), was the highest among the air toxics emitted from the Wilmington Site in 2004, followed by ammonia at 108 kilograms (237 pounds). The Wilmington Site also emitted about 27 kilograms (60 pounds) of total fluorides and 15 kilograms (32 pounds) of hydrogen fluoride. Total air toxic emissions from the Wilmington Site in 2004 were about 546 kilograms (1203 pounds). Accordingly, toxic emissions from the Wilmington Site are well below the major source thresholds of 9.1 metric tons per year (10 tons per year) for a single HAP and 23 metric tons (25 tons per year) for any combination of listed HAPs.

No total greenhouse gas (GHG) emissions data are available at the county level in North Carolina. Greenhouse gas emissions and sinks in North Carolina are presented in Section 4.2.18.4.

Facilities in North Carolina are encouraged by the NCDAQ to report their GHG emissions voluntarily. No facilities in New Hanover County have voluntarily reported their GHG emissions to date. On October 30, 2009, the EPA promulgated the *Mandatory Greenhouse Gases (GHGs) Reporting Rule* (74 FR 56260). This rule mandates the reporting of annual GHG emissions for over 10,000 facilities that account for 85 percent of the national GHG emissions. The rule, which became effective on December 29, 2009, focuses on large emitters of GHGs, including power generation facilities, and other industrial entities. Facilities that emit GHGs from certain sources – such as the production of cement, aluminum, and lime – are required to comply with the rule regardless of emission rate. Other GHG sources must be reported only if the facility's GHG emissions exceed 25,000 metric tons (MT) of carbon dioxide equivalent (CO_2e). Combustion units are included in the sources which must report if aggregate emissions exceed this level. At this time, no action other than reporting must be taken.

3.5.3.2 Current Air Quality Conditions

Currently, three State monitoring sites as part of the North Carolina Ambient Monitoring Program are operating in New Hanover County; no monitoring sites are in operation in neighboring Brunswick and Pender Counties. Three criteria pollutants (O_3, PM_{10},[7] and $PM_{2.5}$)

[7] The NCDAQ began manual one-in-six-day PM_{10} monitoring at the Castle Hayne site in February 2008 to provide the necessary PM_{10} data for PSD modeling associated with industrial expansion in the coastal area, because it shut down the PM_{10} monitoring site in Jacksonville, Onslow County, on December 31, 2007.

Table 3-7 Annual Emissions for Large Point Sources in New Hanover County and Neighboring Brunswick and Pender Counties for 2007 (tons)[a,b,c]

Facility Name	County	City	SO_2	NO_x	CO	VOC	TSP	PM_{10}	$PM_{2.5}$	Industry Type (SIC)
DAK Americas LLC	Brunswick	Leland	3254	1409	5955	1112	121	76	49.4	2824 – Organic fibers, noncellulosic
EPCOR USA North Carolina LLC – Southport Plant	Brunswick	Southport	4113	1144	266	15.2	73.5	72.7	50.7	4911 – Electric services
Technical Coating International, Inc.	Brunswick	Leland	NR[d]	0.3	0	170	0	0	0	3089 – Plastics products, NEC[e]
Carolina Power and Light Company	New Hanover	Wilmington	20,393	5358	343	40.5	1161	827	445	4911 – Electric services
Corning Incorporated	New Hanover	Wilmington	0.1	213	3.7	62.8	16.7	9.1	NR	3229 – Pressed and blown glass, NEC
Elementis Chromium	New Hanover	Castle Hayne	534	414	14.6	55.1	140	103	75.4	2819 – Industrial inorganic chemicals
Invista, S.a.r.l.	New Hanover	Wilmington	4107	924	11,701	1151	326	285	196	2869 – Industrial organic chemicals, NEC
MeadWestvaco Packaging Systems, LLC	New Hanover	Wilmington	NR	1	0.8	664	0.2	0.2	0.2	2671 – Paper coated and laminated packaging

[a] Presented large point sources with any one of the criteria pollutants and/or VOCs of greater than 100 tons per year.
[b] None of the point sources in Pender County generate emissions of any one of the criteria pollutants and/or VOCs of greater than 100 tons per year.
[c] To convert tons to metric tons, multiply by 0.9072.
[d] NR = not reported.
[e] NEC = not elsewhere classified.
Source: NCDAQ, 2009a-d.

Table 3-8 Annual Toxic Air Pollutant Emissions at the Wilmington Site in 2004

		Annual Emissions	
Pollutant[a]	CAS[b] Code	kg	lb
Acetaldehyde	75-07-0	0.5	1.1
Acrolein	107-02-8	0.05	0.1
Ammonia (as NH_3)	7664-41-7	108	237
Benzene	71-43-2	0.7	1.5
Butadiene, 1,3-	106-99-0	0.05	0.1
Chromic acid (VI) (component of SolCR6 and CRC)	7738-94-5	0.001	0.002
Chromium (VI) soluble chromate compounds (component of CRC)	SolCR6	0.001	0.002
Chromium — all/total (includes chromium (VI) categories, metal and others)	CRC	0	0
Fluorides (sum of all fluoride compounds as mass of F ion)	16984-48-8	27	60
Formaldehyde	50-00-0	3.2	7
Hydrogen chloride (hydrochloric acid)	7647-01-0	2.7	6
Hydrogen fluoride (hydrofluoric acid as mass of HF) (component of 16984488/fluorides)	7664-39-3	15	32
MEK (methyl ethyl ketone, 2-butanone)	78-93-3	0.5	1
Methylene diphenyl diisocyanate (MDI) (component of 83329/POMTV)	101-68-8	0.05	0.1
Nitric acid	7697-37-2	178	393
Polycyclic organic matter (includes PAH, dioxins, etc., NC & AP 42 historic)	POM	0.1	0.3
Polycyclic organic matter (specific compounds from OAQPS for Title V)	83329/POMTV	0.05	0.1
Sulfuric acid	7664-93-9	1.8	4
Toluene	108-88-3	1.4	3
Trichloroethane, 1,1,2-	79-00-5	29	63
Xylene (mixed isomers)	1330-20-7	0.2	0.4
Total		546 (0.60 tons)	1,203

[a] SolCR6 = soluble chromium (VI) compounds; CRC = total chromium compounds; POMTV = polycyclic organic matter for Title V; PAH = polycyclic aromatic hydrocarbon; AP 42 = EPA emission factor database; QAQPS = EPA Office of Air Quality Planning and Standards.
[b] Chemical Abstracts Service.
Source: NCDAQ, 2009a-d.

are currently measured at Castle Hayne station located about 10 kilometers (6 miles) northeast of the Wilmington Site, while only SO_2 is measured at the New Hanover County monitoring station located about 10 kilometers (6 miles) south of the Wilmington Site. The Battleship monitoring station, located about 10 kilometers (6 miles) south of the Wilmington Site, began collecting HAPs/TAPs in 2004. The Oleander & College monitoring station, located about 13 kilometers (8 miles) south–southeast of the Wilmington Site, was shut down in 2005 because consistently low CO concentrations (well below the NAAQS) had been collected. Currently, the NCDAQ is monitoring NO_2 at two urban centers in North Carolina (Charlotte and Winston-Salem), but is not monitoring lead in the statewide compliance monitoring network because of consistently low readings Statewide.

Table 3-9 gives the highest background concentrations for SO_2, CO, O_3, PM_{10}, and $PM_{2.5}$ collected at monitoring stations in New Hanover County, along with ambient air quality standards (EPA, 2009c). Because New Hanover County is in attainment for criteria pollutants (see Section 3.5.3), ambient air quality is considered relatively good. Monitoring data for SO_2, CO, and PM_{10} are well below the applicable standards (less than or equal to 30 percent of the standard), while data for 1-hour O_3 and $PM_{2.5}$ levels are around 70 percent of their respective standards.[7] However, monitoring data for 8-hour O_3, which is of regional concern, has ranged from 84 to 100 percent of the standard.

3.6 Geology, Minerals, and Soil

This section describes regional and local geology and soils, seismicity, geologic hazards, and mineral resources. Detailed safety analyses relative to seismicity are not presented within this EIS, but rather, are part of the NRC's Safety Evaluation Report (SER).

3.6.1 Regional Geology, Structure, and Seismicity

The Wilmington Site is located in the Atlantic Coastal Plain physiographic province. Generally, this low-relief province has a subsurface that is composed of unconsolidated sediments (layers of sand, silt, marl, and clay) and limestone that rest on a crystalline basement. The sediments dip and thicken toward the east.

Site stratigraphy comprises Quaternary sediments over Cretaceous sediments over crystalline basement rock (Table 3-10). Detailed surficial mapping is not available, but examples of the types of uppermost Quaternary deposits include beach, sand dune, tidal marsh, swamp, and alluvium. Because of nearshore depositional environments and changing sea level, the unconsolidated sediments are variable areally and vertically. The Cretaceous formations at the site are considered to include the Peedee, Black Creek, and Cape Fear formations. The Peedee is a silty, fine to very fine-grained sand with traces of oyster shells and pyrite (Lautier, 1998). It overlies the Black Creek formation, which is approximately 300 feet of

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[7] The highest 24-hour $PM_{2.5}$ concentration recorded in 2008 was 41.6 $\mu g/m^3$, primarily due to a forest fire. PM monitors were removed in April 2008 and never started back (NCDAQ, 2009b). Only 16 measurements were made in 2008, and thus, this value falls in the 98th percentile concentration. This reading, considered to be an exceptional event, is not a representative 98th percentile concentration for 2008. The second-highest concentration recorded in 2008 was 15.2 $\mu g/m^3$, which is well below the standard of 35 $\mu g/m^3$.

Table 3-9 Highest Background Concentrations at Monitoring Stations in New Hanover County, North Carolina, during the Period 2004 to 2008

Pollutant	Averaging Time	NAAQS/ SAAQS	Monitored Background Concentrations[a]					
			Data Format	2004	2005	2006	2007	2008
SO_2	3-hour	0.5 ppm	2nd maximum	0.072 (14%)[b]	0.061 (12%)	0.065 (13%)	0.082 (16%)	0.069 (14%)
	24-hour	0.14 ppm	2nd maximum	0.022 (16%)	0.022 (16%)	0.030 (21%)	0.027 (19%)	0.028 (20%)
	Annual	0.03 ppm	Annual average	0.005 (17%)	0.003 (10%)	0.005 (17%)	0.006 (20%)	0.006 (20%)
CO	1-hour	35 ppm	2nd maximum	3.3[c] (9.4%)	NA[d]	NA	NA	NA
	8-hour	9 ppm	2nd maximum	2.3[c] (26%)	NA	NA	NA	NA
O_3	1-hour	0.12 ppm	2nd maximum	0.081 (68%)	0.088 (73%)	0.085 (71%)	0.083 (69%)	0.082 (68%)
	8-hour	0.075 ppm	4th highest daily maximum	0.070 (93%)	0.075 (100%)	0.072 (96%)	0.071 (95%)	0.063 (84%)
PM_{10}	24-hour	150 $\mu g/m^3$	2nd maximum	NA	NA	NA	NA	20[e] (13%)
$PM_{2.5}$	24-hour	35 $\mu g/m^3$	98th percentile	22.8 (65%)	25.0 (71%)	25.8 (74%)	25.4 (73%)	41.6[e,f] (119%)
	Annual	15.0 $\mu g/m^3$	Annual average	10.5 (70%)	10.3 (69%)	9.8 (65%)	9.0 (60%)	10.4[e] (69%)

[a] The NCDAQ monitors NO_2 at two urban centers (Charlotte and Winston-Salem), for which the highest annual average concentration is 0.015 ppm, about 28 percent of the NAAQS of 0.053 ppm. However, the NCDAQ does not monitor Pb in the State of North Carolina because statewide attainment with applicable ambient air quality standards has been demonstrated.

[b] Values in parentheses are monitored concentrations as a percentage of NAAQS or SAAQS.

[c] CO monitoring was discontinued from 2005 due to consistently low CO concentrations.

[d] NA = no measurement data are available.

[e] Because of a prolonged fire, the PM monitors were removed in April 2008 and never restarted (NCDAQ, 2009e). On the basis of monitoring data in Wilmington for the 1998 to 2002 period, the highest background 24-hour and annual average concentrations were 45 and 20 $\mu g/m^3$, respectively.

[f] This concentration is the highest (also falls in the 98th percentile) out of only 16 measurements recorded in 2008. This reading, which was primarily caused by a forest fire and considered to be an exceptional event, is not the representative 98th percentile in 2008. The second highest in 2008 was 15.2 $\mu g/m^3$.

Source: EPA, 2009c.

Table 3-10 Geologic Units at the North–Central Sector of the Wilmington Site

Formation	Geologic Age	Description	Approx. Thickness (ft)[a]	Approx. Depth to Top (ft)
Surficial sediments	Quaternary	Beach, sand dune, tidal marsh, swamp, and alluvial deposits	10–30	0
Peedee	Cretaceous	Mainly silty fine-grained sand	330	10–30
Black Creek	Cretaceous	Mainly alternating fine-grained sand and clay, clay lenses, variable sands	300	350
Cape Fear	Cretaceous	Clay interbedded with clayey sand and sandy clay	400	650
Crystalline basement	Pre-Mesozoic	Igneous and metamorphic rocks	Large	1050

[a] To convert feet to meters, multiply by 0.305.
Sources: Lautier, 1998; Harden et al., 2003.

alternating beds of fine-grained sands and clays with organic matter (Harden et al., 2003). Clayey sand lenses are present that contain shells, glauconite, and organic material. In the lower portion of the formation, kaolinitic clay and cross-bedded sand, silty clay, channel sands, and laminated beds of sand and clay of a nonmarine river-delta environment are present. The Cape Fear formation comprises about 400 feet of clays interbedded with clayey sand to sandy clay. These materials were deposited in shallow seas and in deltaic and estuarine settings. The basement rock elevation is approximately 1050 feet below ground surface (bgs) (Harden et al., 2003).

3.6.1.1 Regional Earthquakes

North Carolina does not have concentrated seismic zones; however, in neighboring states are the Middleton Place-Summerville Seismic Zone (near Charleston, South Carolina), the Eastern Tennessee Seismic Zone, the Giles County (Virginia) Seismic Zone, and the Central Virginia Seismic Zone (Dart et al., 2010; Tarr and Wheeler, 2006). North Carolina's historical earthquakes have taken place in the western portion of the State (Petersen et al. 2008).

In the seismic zones of nearby states, some historical and recent earthquakes of significance have taken place. An August 23, 2011, earthquake with a magnitude of 5.8 occurred more than 400 kilometers (250 miles) north of the Wilmington Site near the town of Mineral, Virginia (USGS, 2011), in the Central Virginia Seismic Zone. According to the U.S. Geological Survey (USGS) ShakeMaps for this earthquake, little or no ground shaking was felt in Wilmington from this earthquake (USGS, 2011). Other historical earthquakes in this zone include a magnitude 4.5 earthquake in 2003, with no detection in the Wilmington area (Tarr and Wheeler, 2006). An event of magnitude 5.6 occurred in western Virginia's Giles County Seismic Zone in 1897, also with no detection in the Wilmington area (Tarr and Wheeler, 2006). A magnitude 6.7 earthquake took place in 1886 at Charleston, South Carolina (Dart et al., 2010). This earthquake had Modified Mercalli Intensity in the Wilmington area of VI (slight damage) to VII (damage negligible to considerable, depending on construction and design) (Dart et al., 2010).

The GLE site vicinity does not have a significant seismic hazard. Crone and Wheeler (2000) assessed the Cape Fear Arch, a regional structural feature, approximately located along the Cape Fear River, and noted the lack of evidence for Quaternary faulting. The peak acceleration at the site is 3–4 percent of gravity (Frankel et al., 2005), which is relatively low.

Because of the geologic and seismic setting of the site and its low relief, natural hazards such as volcanism and landslides are not considered to be credible.

Tsunamis are uncommon along the eastern coast of the United States. A database maintained by the National Oceanic and Atmospheric Administration (NOAA, 2011) lists all possible tsunamis along the eastern seaboard since colonial times. These have included six definite tsunami events (with a maximum tsunami runup water height of 0.68 meter [2.2 feet] occurring in Atlantic City, New Jersey in 1929, due to a Newfoundland earthquake); three probable tsunami events (one having a maximum size of 3.6 meters [11.8 feet] occurring in Boothbay Harbor, Maine in 2008, though the origins are unclear and likely not due to seismic activity); and five questionable tsunami events (one having a maximum size of 3 meters [9.8 feet] occurring at Bernard, Maine, in 1926, though that was likely due to a local landslide). For the probable and questionable categories, the second-highest runup water heights were significantly less than those at these particular Maine locations. No tsunami runup locations were listed for North Carolina, but two were noted in South Carolina. These included an 1886 event at the Cooper River at Charleston resulting from the Charleston earthquake (unspecified runup water height), and a 1929 event at Charleston due to the Newfoundland earthquake (definite tsunami with runup water height of 0.12 meter [0.4 feet], compared to 0.68 meter [2.2 feet] in Atlantic City, as noted above)..

3.6.1.2 Mineral Resources

Regional mineral resources include sand and gravel, clay, limestone, phosphate, and peat. The U.S. Geological Survey (USGS) notes the location of several active or former sandpits, a clay pit, and a quarry for crushed stone within 10 miles of the site (USGS, 2005). Fluorine and titanium operations occur outside of northern New Hanover County. At the site area, mineral resources have not been extracted, and significant economic value is not likely.

3.6.2 Site Geology

Across the Wilmington Site, Quaternary sediments blanket the surface. These deposits vary in texture and include silty fine sands, silty fine clayey sands, fine sandy silts, and fine sandy clays. The Peedee clay is present in the eastern portion of the proposed GLE site, while the underlying Peedee sands are present across the Wilmington Site. A total of ten soil borings were drilled in 1980 and 2007 at or near the North–Central Site Sector to provide preliminary geotechnical information for a proposed landfill and for foundation design, respectively (GLE, 2008). The depths of the borings were roughly 35 to 60 feet. These drilling data indicate that the Peedee Clay has been eroded (GLE, 2008). Here, the Peedee Formation’s sandy material is found at a depth of roughly 10 to 30 ft. Farther to the west, at the Northwest Site Sector, a drilling program showed that no clay is present to a depth of at least 60 feet (RTI, 1997).

Carbonate bedrock is present elsewhere in New Hanover County and in adjoining Pender and Brunswick Counties (NCGS, 2007). In a karst terrain, dissolution of carbonate bedrock such as

limestone leads to sinkholes and ground collapse. The site, however, is not underlain by the limestone formations that are susceptible to karst (NCGS, 2007; Lautier, 1998; GLE, 2008).

3.6.3 Site Soils

Soils in the region have developed on the recent Quaternary sediments. The North-Central Site Sector, as well as most of the Wilmington Site, has soils of the Meggett-Johnston-Dorovan association. Typical characteristics are very poorly drained, very little slope, high flooding frequency due to poor drainage, and moderate permeability (GLE, 2008). Most of the North-Central Site Sector is mapped as the Murville fine sand and the Leon sand soil types. The Murville is formed in sandy marine and fluvial sediments on broad interstream uplands or in interstream areas. Slopes are less than 2 percent, drainage is very poor, and permeability is high in the surface layer and moderately high in the subsoils. The seasonal high water table is at or near the surface. The soil is strongly to extremely acidic. The Leon sand is found in various settings, including uplands and stream terraces. It is deep, with high permeability at the surface, moderate to moderately high permeability in the subsoil, and very high permeability at depth. The seasonal high water table is at or near the surface.

Differential settlement of foundations occurs in clayey soils with particular properties. The potential for differential settlement at the proposed construction site is not a concern because of the sandy soils.

Section 3.7.4.3 provides information on historical releases to site groundwater at various facilities at the Wilmington Site. These have included historical VOCs, calcium fluoride, uranium, nitrate, and metals. Remediation has been conducted or is being conducted in response to these contaminants. Residual contaminants are presumably present in the unsaturated or saturated site soils.

3.7 Water Resources

This section discusses both surface water and groundwater, including descriptions of the resources, their use, and natural and anthropogenic quality issues.

3.7.1 Surface Water Features and Quality

The Wilmington Site is in the Northeast Cape Fear River subbasin of the Cape Fear River basin. The Northeast Cape Fear River is the nearest named surface water body to the Wilmington Site. It forms the southwestern border of the Wilmington property, where it is 600 to 1300 feet wide. The river is tidally influenced (Weaver and Pope, 2001). Flow measurements of the river in the immediate vicinity of the Wilmington Site are unavailable. The nearest flow monitoring stations for the Northeast Cape Fear River are upstream from the Wilmington Site. At Burgaw (approximately 18 miles north of the site), limited data provide an average flow of 620 cubic feet per second in 2005 (USGS, 2010a). Farther upstream at Chinquapin (approximately 34 miles north of the site), data from 1941 to 2009 indicate an annual average flow of 712 cubic feet per second (USGS, 2010b). The 2005 average, for comparison with the Burgaw data, was 423 cubic feet per second. The Northeast Cape Fear River basin comprises more than 1740 square miles, while the overall Cape Fear River basin covers 9090 square miles and is the largest watershed in North Carolina (Weaver and Pope, 2001). There are no dams (other than

the site dam on the effluent channel), reservoirs, or surface water intakes within the Northeast Cape Fear watershed.

Surface water is used in the region for various purposes; the predominant use is nonconsumptive cooling water for thermoelectric power generation. In New Hanover, Pender, and Brunswick Counties, there are no public supply intakes; however, the Wilmington area is served by an intake on the Cape Fear River in Bladen County. In New Hanover, Pender, and Brunswick Counties, the dominant surface water uses are irrigation and industry (USGS, 2009). Groundwater is the water source for domestic, municipal, and industrial users.

The site is drained by several small streams and an effluent channel (Figure 3-8). The effluent channel begins in the Eastern Site Sector and flows to the site dam west and then connects to an unnamed perennial tributary to the Northeast Cape Fear River. Another tributary to the same river drains portions of the western and northwestern site sectors. Two unnamed streams flow north from the property to Prince George Creek, a tributary to the Northeast Cape Fear River. One of these originates in the Eastern Site Sector and receives site stormwater; the other has headwaters just north of the Northwestern Site Sector.

The effluent channel receives treated process wastewater effluent subject to NPDES water quality standards. It also receives stormwater runoff from the developed Eastern Site Sector.

Other onsite natural surface water bodies include three ephemeral woodland ponds. Created features include two active final process lagoons, their associated aeration basin, four inactive

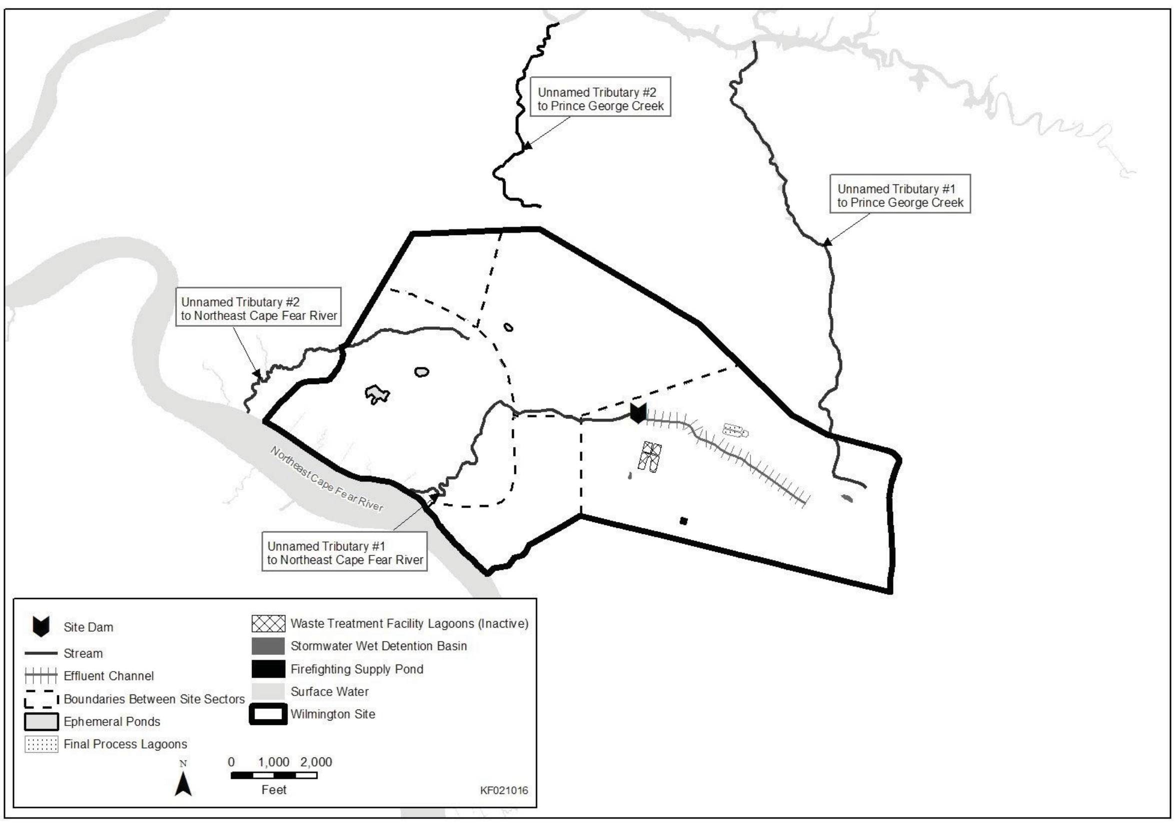

Figure 3-8 Surface Water Features at the Wilmington Site (Modified from GLE, 2008)

wastewater treatment facility lagoons, one firewater pond, and two stormwater wet detention basins.

The process lagoons and aeration basin are for the treatment of process wastewater from the FMO facility. Adjustment of wastewater pH causes precipitation of chemicals and the resulting floc is disposed of as low-level waste. The lagoons are periodically dredged and inspected. The water discharged from the lagoons is cooled to ambient air temperature prior to discharge to Outfall 001 (Figure 3-20).

Dredging of stormwater ponds and the effluent channel are not covered under the *Clean Water Act* (CWA) because they are created features for industrial purposes. Large trees along the banks of the effluent channel suggest that dredging is not frequent and has not taken place for many years.

The wastewater lagoons are being decommissioned because wastewater is being reused at the facility, as described later in this section.

The State classifies surface waters and wetlands to specify the required types of protection (15A NC Administrative Code 2B.0101). The Northeast Cape Fear River near the Wilmington Site is State-designated as Class C swamp water. A Class C designation means that the water is protected for secondary recreation (boating, but not swimming), fishing, and wildlife. The supplemental classification "swamp water" describes water of low velocity, low pH, and low dissolved oxygen. The tributaries draining the site are also considered Class C swamp water. The lower portions of these tributaries, as well as the Northeast Cape Fear River near the site, are tidally influenced and therefore contain some saltwater. The balance of fresh and saltwater is dynamic and dependent on the tide and the flow of freshwater from upstream.

The North Carolina Division of Water Quality (NCDWQ) maintains two monitoring stations along the Northeast Cape Fear River. One station is about 17 miles upstream of the Wilmington Site; another is 6 miles downstream. The GLE Environmental Report (GLE, 2008; Table 3.4-6) contains tabulated summaries of water quality monitoring results from these stations. Results include the chloride mean and maximum values exceeding the evaluation limit at the downstream location, the copper and zinc maximum values exceeding the evaluation limit at both the upstream and downstream locations, the iron maximum value exceeding the evaluation limit at the upstream location, the minimum pH below the evaluation limit at the downstream location, and the minimum dissolved oxygen below the evaluation limit at both the upstream and downstream locations. A third station is located at the GE dock near the Wilmington Site's south border, less than 2500 feet downstream of the tributary fed by the effluent channel. This station is monitored by the Lower Cape Fear River Program, a collaborative effort among academia, government, industry, and the public. The GLE Environmental Report (GLE, 2008; Table 3.4-7) contains a tabulated summary of water quality monitoring results from this station. Of the water quality parameters listed, the minimum dissolved oxygen is the only one outside the evaluation limit.

GE monitors water quality, gross alpha, gross beta, and uranium concentrations in the effluent channel at the site dam, the Northeast Cape Fear River significantly upstream of the Wilmington Site (at a location consistent with the upstream NCDWQ station), and the Northeast Cape Fear River at the GE dock. These three surface water stations are also monitored by the North Carolina Radiation Protection Section (NCRPS) through monthly sampling. Summary data from

1997 to 2006 are presented for water quality parameters, total uranium, gross alpha, and gross beta (GLE, 2008; Tables 3.4-8 and 3.4-9).

Non-radiological results include the copper mean and maximum values exceeding the evaluation limit at both the upstream location and the GE dock, the fecal coliform maximum exceeding the evaluation limit at the upstream location, and the dissolved oxygen minimum value below the evaluation limit at both the upstream location and the GE dock. Evaluation limits are not applied to the site dam data because it is an industrial waterway not subject to 15A NC Administrative Code 02B.0211. Although a segment of the Northeast Cape Fear River (ending approximately 8.5 miles upstream of the Wilmington Site) is listed by the State as mercury-impaired, the segment of the river contiguous to and immediately downstream of the Site is not listed as mercury-impaired. GEH does not monitor the effluent channel or the Northeast Cape Fear River for mercury.

Radiological results at the site dam include mean total uranium concentration of 0.024 milligrams per liter, maximum total uranium concentration of 0.13 milligrams per liter, mean gross alpha of 49.9 picocuries per liter, maximum gross alpha of 329 picocuries per liter, mean gross beta of 58.7 picocuries per liter, and maximum gross beta of 330 picocuries per liter. State standards are annual averages of 15 picocuries per liter for gross alpha and 50 picocuries per liter for gross beta (15A NC Administrative Code 02B.0211); however, these standards do not apply to an industrial waterway such as the effluent channel. Results on the upstream and downstream river stations are significantly lower and often below detection limits, and the annual averages are below the standards for gross alpha and gross beta. NCRPS data with detailed monthly summary tables for 2000, 2002, and 2006 were obtained for comparison with GE and NCRPS results for gross alpha and gross beta (NCDENR, 2009b). These comparisons showed NCRPS results to be generally higher than the GE results, and the difference in many cases was significant. No NCRPS data were available for total uranium. North Carolina does not have a water quality standard for uranium in 15A NC Administrative Code 02B.0211.

The Wilmington Site has two National Pollutant Discharge Elimination System (NPDES) permits: one for wastewaters (process and sanitary) and another for stormwater.

The process and sanitary wastewater permit (Klimek, 2004) expired February 28, 2009. The Wilmington Site operates under a renewal draft permit (NCDENR, 2009d), which allows the Site to continue operating under the conditions of the previous permit. A renewal draft permit is an interim permit issued by the State that allows a permittee to operate under the previous permit (the terms of which may be modified by the State) until the final draft permit is issued. The permit addresses two outfalls. Outfall 001 (Figure 3-20) is for process wastewater. It is monitored prior to discharge to the effluent channel for various parameters and has limitations on total suspended solids (TSS), total nitrogen, fluoride, cyanide, pH, metals (total cadmium, lead, chromium, copper, nickel, silver, zinc), oil and grease, and total toxic organics. The permit lists a number of equipment systems that contribute flow to the outfall, including treatment tanks, lime slurry system, hydrofluoric acid equipment, etc. The permitted maximum flow at the outfall is 1.8 million gallons per day. Outfall 002 (Figure 3-20) was used for treated domestic (sanitary) wastewater until April 2008. Permit limitations included biochemical oxygen demand (BOD), TSS, and fecal coliform, and a maximum allowed flow of 75,000 gallons per day (Klimek, 2004).

The current sanitary wastewater treatment facility is a new system that does not release effluent. The Wilmington Site obtained a permit for the construction and operation of a 75,000-gallons-per-day reverse osmosis water treatment facility to treat the wastewater prior to reuse (Klimek, 2007a). This system's treated sanitary effluent is routed to the FMO facility for industrial process use and to Wilmington Site cooling towers (for the SCO heating, ventilation and air-conditioning, the FCO facility, and the FMO facility). Effluent limits for both monthly average and daily maximum values include turbidity, nitrogen, BOD, TSS, and fecal coliform.

The NCDWQ web site does not list NPDES-related Notices of Violation (NOVs) at facilities. At the site audit, representatives described the history of NOVs for discharges. From approximately 1995 to 1997, the site received several NOVs for BOD. GLE had two reporting violations (one for weekly ammonia, one for weekly coliform) but could not provide written documentation from the State regarding these occurrences (GLE, 2009a). None of the NOVs have recurred.

The effluent channel receives effluent from the final process lagoons, which receive alkaline water from the alkaline cleaners used in processing at the FCO facility (GLE, 2009a). The optimum pH of the lagoons is 8 to 10 to facilitate the settling of solids. The permit for the process wastewater limits pH to a minimum of 6.0 and a maximum of 9.0 at Outfall 001 upstream of the site dam (Klimek, 2004). The adjustment is made using sulfuric acid prior to release at the outfall (GLE, 2009a). The site dam has a monitoring station for pH. A gate can be closed to stop flow through the dam if there is an alarm caused by pH outside the range of 6 to 9. GE data for 1997 to 2006 include statistics for 874 pH samples: a minimum pH of 6.10, a maximum pH of 12.50, and an average pH of 7.31 determined by using the hydrogen ion concentrations (GLE, 2008). In the last 10 years, the dam has had no reportable pH excursions (GLE, 2009a). The pH may exceed the range of 6 to 9 for 60 minutes in one event or 7.2 hours in a month (Klimak, 2004). If the pH alarm at the dam sounds, GLE implements a procedure to investigate (GLE, 2009a). An operator closes the dam within five minutes and manually checks the pH at the outfall with pH paper and a handheld pH meter. If the pH is not within the allowable range, the operator closes the final process lagoons and the pH is retested within 60 minutes. If the pH were still not within the allowable range, the cause would be investigated and a remediation plan would be developed to adjust the pH. The pH alarms have been attributed to an error with the probe at the dam or the system has recovered within 60 minutes.

Overflow at a closed dam could occur if the effluent channel receives more than 8.6 million gallons of water, which would be expected with a 25-year storm event (GLE, 2009b). During dry conditions, the retention capacity at the dam would allow time for pH adjustments. Dilution of out-of-specification pH would occur during large rainfall events.

The NPDES stormwater permit (Klimek, 2007b) requires a stormwater pollution prevention plan, with components that include a description of site operations such as storage and waste disposal, a list of spills or leaks in the prior 3 years, secondary containment information, a description of best management practices with regard to controlling pollutants in stormwater discharge, and a spill prevention and response plan. The Wilmington Site has three stormwater outfalls: two discharge to the Northeast Cape Fear River (Figure 3-20), and one discharges to the Prince George Creek. Semiannual sampling is required during a storm event, with analysis for lead, oil and grease, pH, and TSS. The 2007 results were within the allowable ranges, with the exception of a TSS value that was driven high because of construction activities. Quarterly stormwater sampling took place during 2003 and included analyses for ammonia, combined

nitrite and nitrate, fluoride, uranium (up to 9.9 picocuries per liter), dichloroethylene (DCE), trichloroethylene (TCE), and vinyl chloride (VC) (GLE, 2008). The VOCs were at very low or nondetectable levels. In the current stormwater permit (Klimek, 2007b), uranium has been dropped as a monitoring requirement.

3.7.2 Floodplains

The North-Central Site Sector, the location of the proposed GLE Facility, is above the 100-year and 500-year floodplains of the Northeast Cape Fear River (Figure 3-9). Employees at the Wilmington Site did not observe flooding in 1999 during Hurricane Floyd (GLE, 2008).

3.7.3 Wetlands

Several small wetlands have been identified (GLE, 2008) and were visited during the site audit. Section 3.8.2 describes these features in detail.

3.7.4 Groundwater

3.7.4.1 Site and Regional Hydrogeology

The geologic units discussed in Section 3.6 comprise the aquifers and aquitards of the site vicinity. Table 3-10 gives the thicknesses and approximate contact elevations. The discussion below focuses on the Quaternary sediments and the Peedee and Black Creek aquifers because they represent the near-surface flow system and because fresh water is present in the Quaternary and portions of the Peedee.

The unconfined surficial aquifer consists of the Quaternary sediments, which vary greatly in texture and permeability over short lateral or vertical distances. Well yields are limited and usually are sufficient only for domestic wells. The aquifer’s groundwater is generally fresh, away from coastal barrier islands (Lautier, 1998). Regional hydraulic conductivity measurements range between 18.2 and 607 feet per day, with an average of 130 feet per day (Lautier, 1998).

The Peedee aquifer is an important regional water source and is the water source for the Wilmington Site (see Section 3.7.4.2). Its hydraulic conductivity varies spatially but is generally high. Regional hydraulic conductivity measurements range between 1.02 and 243 feet per day with an average of 38.26 feet per day (Lautier, 1998). Its groundwater is generally transitional between freshwater and saltwater, though at the Wilmington Site, the shallow Peedee groundwater is fresh. Recharge may occur from the surficial aquifer and as upward leakage from the Black Creek aquifer (Harden et al., 2003). In the eastern portion of the Wilmington Site, the overlying Peedee clay is of variable thickness and functions as a semiconfining unit, but it thins to the west. Site drilling logs (GLE, 2008) indicate that the Peedee clay is not present at the proposed GLE site.

The underlying Black Creek aquifer at the site is nonpotable because of saltwater content, and is therefore not relied on as a water resource in the Wilmington Site vicinity. A confining unit of clay, silt, and thin sand beds separates the Black Creek aquifer from the overlying Peedee aquifer. Below the Black Creek formation is the Cape Fear formation, which contains upper and lower aquifers. Both are nonpotable due to salt content.

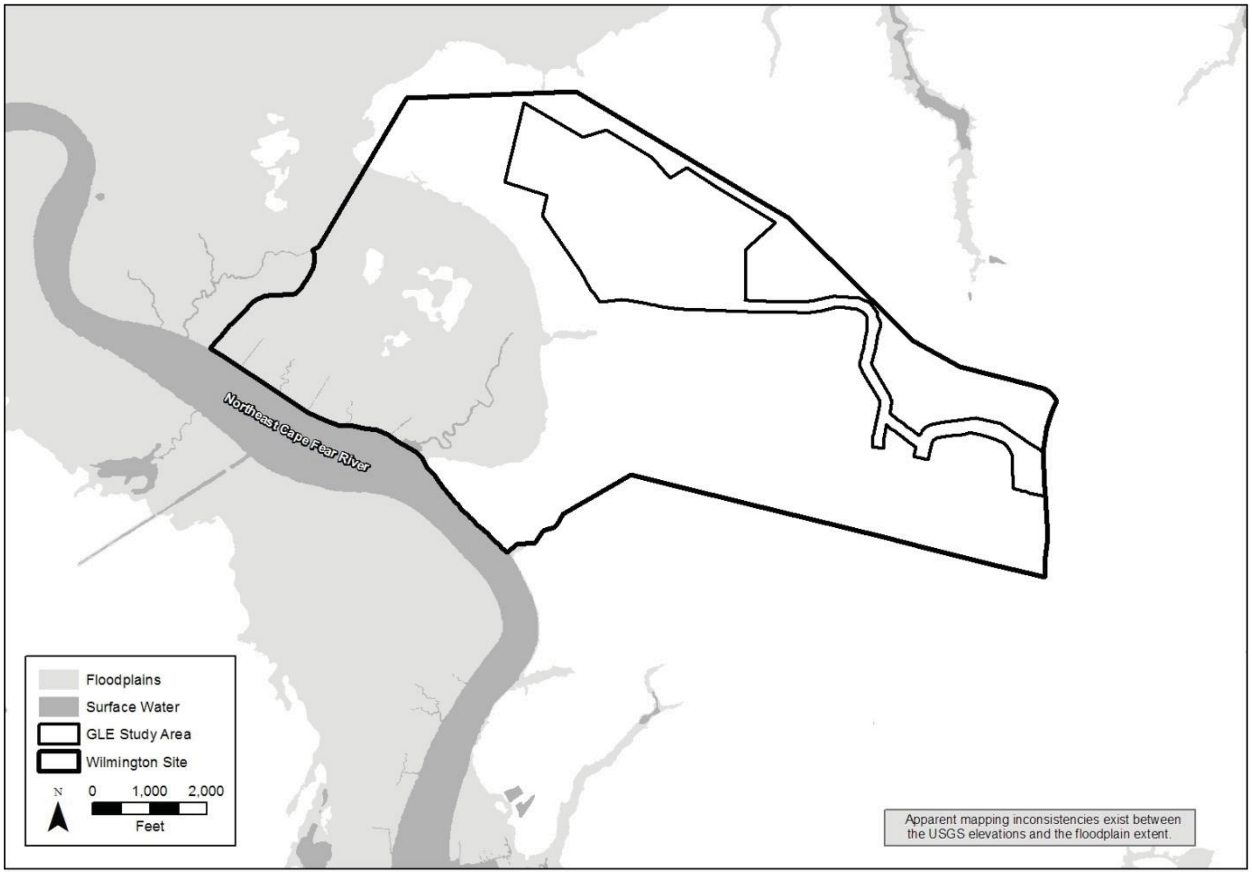

Figure 3-9 Floodplains at the Wilmington Site (Modified from GLE, 2008)

At the proposed GLE Facility site, the surficial aquifer discharges to surface water bodies, including streams, drainage canals, and swamps. It also leaks groundwater into the underlying upper Peedee aquifer. Potentiometric mapping of the surficial aquifer (GLE, 2008) indicates a water table mound centered on the north-central site sector, with shallow groundwater discharging directly toward the surrounding low areas in all directions. Flow to the east eventually diverts to the north or south. Water levels generally fluctuate over a range of several feet in response to seasonal changes or precipitation events.

Water level data from the upper portion of the Peedee sand at the proposed GLE site support flow patterns similar to those of the surficial aquifer. A mound is present at the north-central site sector, with flow toward the surface water bodies on the north, west, and south. To the east, however, flow is captured by remediation/containment wells and process water wells in the central GLE property (GLE, 2008).

3.7.4.2 Groundwater Use

Much of the regional groundwater withdrawal for public systems and private users is from the Peedee aquifer.

For potable water supply, the Wilmington Site has three production wells completed in the Peedee aquifer. They are located east of the site and NC 133 (Castle Hayne Road) on a

separate GE property. The average pumping rate from this system is approximately 47,000 gallons per day (GLE, 2008). In comparison, the rate of groundwater usage for public supply in New Hanover County in 2000 was nearly 8 million gallons per day, while the overall groundwater withdrawal was about 17 million gallons per day, with the main categories of public supply, domestic wells, industrial wells, and irrigation (USGS, 2009). Much of the regional groundwater withdrawal is from the Peedee aquifer.

Approximately 15 extraction wells and two sumps are at the site. They are located within the eastern site sector and are used for remediation, specifically hydraulic containment. Extracted groundwater is treated and used as the process water at Wilmington facilities, with an average pumping rate of approximately 565,000 gallons per day (GLE, 2008).

Together, the potable and remedial/process pumping systems withdraw a combined 612,000 gallons per day of groundwater. Nonagricultural users of more than 100,000 gallons per day of groundwater are required to register with the North Carolina Environmental Management Commission, and to update their registrations every 5 years thereafter, under *North Carolina General Statutes* 143-215.22H. GE operations have been registered under this program (GLE, 2008).

3.7.4.3 Groundwater Quality

Natural groundwater quality varies with location and depth. While the surficial and Peedee aquifers are generally of good quality in the Wilmington region, the lower portion of the Peedee in eastern areas has a high chloride concentration because of saltwater intrusion and is consequently nonpotable (Lautier, 1998). The deeper Black Creek aquifer and underlying units are generally nonpotable due to saltwater intrusion.

Groundwater monitoring takes place at the Wilmington Site to assess groundwater contamination, which may be any combination of organic, inorganic, radiological, or water quality parameters. Figure 3-10 shows the locations of monitoring areas and wells. The GLE Environmental Report provides a tabular summary of monitoring results based on historical site databases and identifies exceedances, which have included chromium, fluoride, nitrate, nitrite, various organic compounds, gross alpha, and high pH (GLE, 2008; Tables 3.4-3, 3.4-4, and 3.4-5). The State standards are also included in these tables. The impacted groundwater does not flow offsite, given proper functioning of the groundwater extraction systems that provide hydraulic containment and route the extracted water to site industrial uses.

Groundwater impacts are present at several distinct areas of the Wilmington Site, as described below. These areas are shown in Figure 3-10. The Northwest Site Area is located in the Northwest Site Sector, adjacent to the northwestern edge of the current proposed GLE site. It was a lubricant disposal area, and its groundwater contains TCE and its breakdown products, cis-1,2 dichloroethylene (cDCE), and VC. Calcium fluoride, which typically contains traces of uranium, was stored here. Excavation of contaminated soil took place in 1996 (RTI, 2008a). A corrective action plan for the groundwater proposed monitored natural attenuation (MNA) on the basis of a lack of downgradient receptors, sampling results, and model calculations (RTI, 1999a). Fluoride and uranium are included in the MNA assessment. Concentrations were stable or decreasing for TCE, cDCE, VC, uranium, and fluoride as of 2007 (RTI, 2008a).

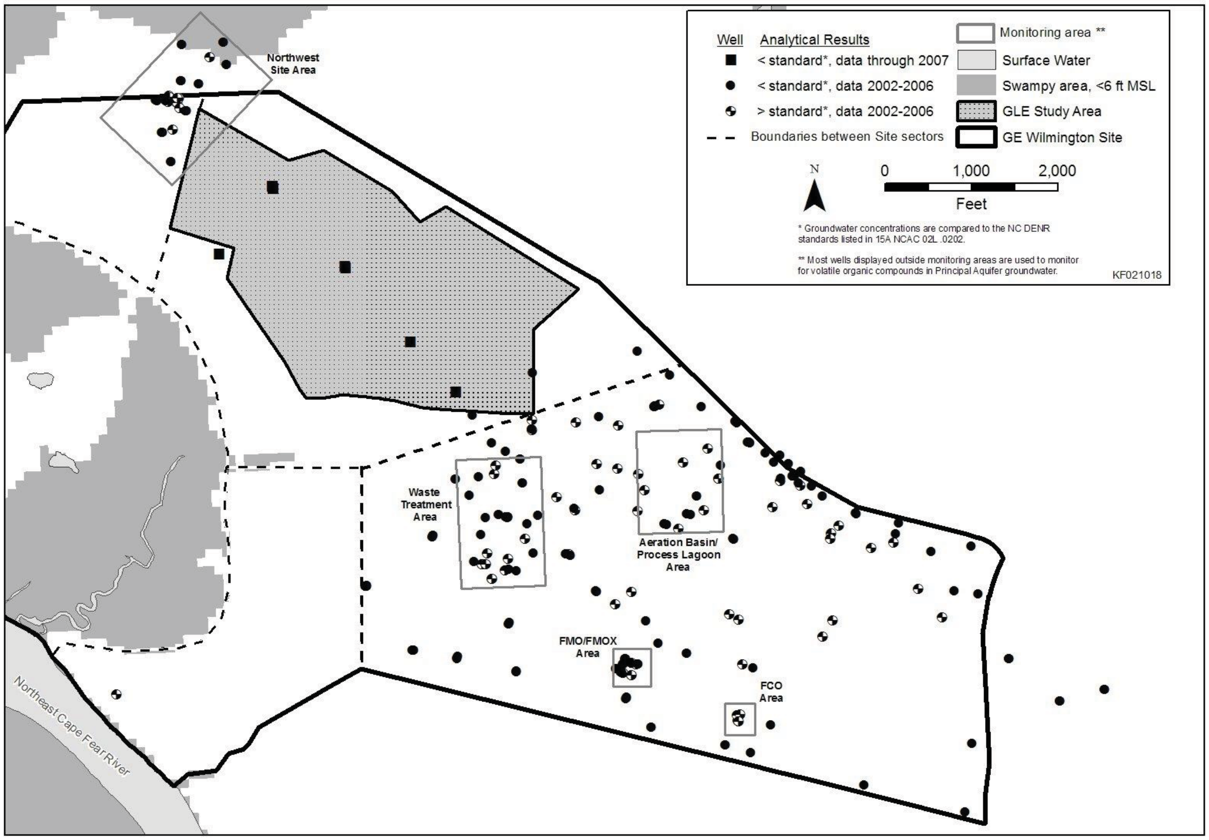

Figure 3-10 Summary of Groundwater Monitoring Results Relative to State Standards (Modified from GLE, 2008)

The other monitored locations are in the Eastern Site Sector (Figure 2-1). The Waste Treatment Area has nitrate impacts in the surficial and Peedee aquifers (RTI, 1999b). The facility is no longer used for storing nitrate-containing liquids. Monitoring has not indicated impact from fluoride or uranium. MNA is taking place, and the nitrate plume is stable in extent.

The FCO Cleanroom Area is monitored to address a release of acid process solutions. A breach in an acid tank containment was identified and repaired in September 1996 (RTI, 1998b). Shallow wells were installed and monitored from January to May 1997, and, following a dry period, monitoring continued in January 1998. Excavation and offsite disposal of 72 cubic feet of soil took place in 1999 (GLE, 2009b). The affected area is beneath the active FCO building, and monitoring is focused on pH, fluoride, nitrate, and five indicator metals (chromium, zirconium, tin, nickel, and copper).

The Aeration Basin/Process Lagoon Area is an active treatment facility for process wastewater. Shallow groundwater in this area has occasionally shown shallow inorganic and radiological impacts. GNF-A performs groundwater monitoring in this area as a condition of NRC Materials License SNM-1097 (GLE, 2008).

The FMO/FMOX Facility Area has been affected by a 1991 release of process liquid. Well installation and groundwater sampling took place immediately, and the fluoride and nitrate values were above the standard in all wells (NCDEHNR, 1991b). Uranium was also detected,

with a maximum of 387 parts per million. Soil excavation took place, and a sump system (the Horizontal Collection System) was installed to remove groundwater from the shallow surficial aquifer. Another sump (SD-1SW) was installed in a former storm drain to collect shallow groundwater. Groundwater monitoring has taken place since 1992 in the shallow surficial aquifer, deep surficial aquifer, and Peedee sand aquifer. Exceedances have included fluoride, nitrate, and uranium in the upper surficial aquifer beyond the perimeter of the FMOX building (RTI, 1998a).

In 1991, the State issued an NOV regarding TCE and other organic compounds present in site water wells at levels above the standard (NCDEHNR, 1991a). The wells included five process-water extraction wells and nine monitoring wells. In the NOV, the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) required determination and elimination of the source of contamination, assessment of the extent of contamination, and submission of a remedial action plan. In 2009, the State transferred the GE site to its Inactive Hazardous Waste Sites Priority List, a list of sites where uncontrolled disposal, spills, or releases of hazardous substances have been identified (NCDENR, 2009c). Listed sites are required to take action to control the contaminated discharge and mitigate hazards. Many other monitoring wells are located in or near the eastern site sector and are used to monitor VOC concentrations from various historic releases of solvents (RTI, 1992; RTI, 1994; RTI, 1996). VOCs across the entire Wilmington Site are addressed in comprehensive annual reports updating the ongoing site investigation (e.g., RTI, 2008b). In general, the concentrations of VOCs have been stable or decreasing; this is attributed to natural attenuation (RTI, 2008b).

3.8 Ecological Resources

This section describes the terrestrial, wetland, and aquatic ecological resources in the area of the proposed GLE Facility, with emphasis on the components that could be affected by the construction and operation of the facility, ancillary facilities, and the onsite access road to the facility. Particular attention is given to species protected by the Federal government under the *Endangered Species Act* (ESA), as well as species and habitats of special concern listed by the State of North Carolina. Unless otherwise cited, the information presented in this section has been adapted from the GLE Environmental Report (GLE, 2008), with additional information supplied by GLE (GLE, 2009b; GLE, 2009c). To the extent practicable, the information was verified independently by the NRC through a review of references provided by GLE; a site visit to observe habitats at the Wilmington Site; discussions with GLE and their consultants; and use of geographic information tools. Ecological field surveys were conducted during 6 days in July 2007, 4 days in September 2007, and from September 1 through September 30, 2009, to identify biotic communities and characterize the natural and anthropogenic communities on the Wilmington Site. The emphasis of the field surveys was on the area that encompasses the proposed GLE Facility and the area for the revised entrance and roadway (GLE, 2008, 2009c).

3.8.1 Vegetation

Ecoregions are designed to provide a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components (EPA, 2007a). An ecoregion is an area having a general similarity in ecosystems and is characterized by the spatial patterning and composition of biotic and abiotic features, including vegetation, wildlife, geology, physiography (patterns of terrain or land forms), climate, soils, land use, and hydrology, such that within an ecoregion, there is a similarity in the type, quality, and quantity of

environmental resources present (EPA, 2007b). The Wilmington Site is located within the Middle Atlantic Coastal Plain Level III Ecoregion. This ecoregion is characterized by low-level flat plains with many swamps, marshes, and estuaries. The ecoregion's forest cover was once dominated by longleaf pine (*Pinus palustris*), but is now dominated by loblolly pine (*P. taeda*) and some shortleaf pine (*P. echinata*), with patches of oaks (*Quercus* spp.), sweetgum (*Liquidamber styraciflora*), and cypress (*Taxodium* spp.) near major streams. Pine plantations are common, and there are some areas of cropland.

The Wilmington Site is located within the border of two Level IV ecoregions.[8] The eastern portion of the Wilmington Site, including most of the existing facilities, is located within the Carolina Flatwoods Level IV Ecoregion; while the western portion of the site, including the proposed GLE Facility, is located within the Mid-Atlantic Floodplains and Low Terraces Level IV Ecoregion (Figure 3-11). Table 3-11 summarizes the vegetation and the land use and land cover within these Level IV ecoregions.

Three general vegetation cover types dominate the Wilmington Site: (1) upland forested vegetation (mostly in sandy, well-drained to excessively well-drained soils that are never or rarely flooded for any significant period of time); (2) wetland vegetation (mostly in soils saturated at all times or for a significantly long period of time throughout the year); and (3) anthropogenic vegetation (occurring under various hydrologic regimes and soils with the type of vegetation cover primarily resulting from human occupation or intervention) (DuMond, 1984). The anthropogenic vegetation cover type occurs within the operations area, utility corridors, along roadsides, and also includes pine plantations.

Plant community mapping of the Wilmington Site was conducted on the basis of true-color orthophotography and field surveys conducted in July and September 2007 (GLE, 2008). Thirteen plant communities, including eight natural and five anthropogenically influenced communities, were identified on the Wilmington Site (Figure 3-12). Table 3-12 summarizes information on these communities. The proposed GLE Facility would be located within areas now occupied by pine forest, pine-hardwood forest, and pine plantation communities. These communities are described in more detail below. The ages of these pine-dominated plant communities are shown in Figure 3-13.

3.8.1.1 Pine Forest

Pine forest communities primarily occur within the north-central portion of the Wilmington Site, and within the upland area surrounded by the old oxbow of the Northeast Cape Fear River in the western portion of the site. Several small stands of pine forest are also scattered throughout the rest of the Wilmington Site. Most pine forest stands on the Wilmington Site, including those within and immediately adjacent to the proposed GLE Facility site, vary from less than 20 years old to 20 to 29 years old (Figure 3-13). A total of 123 hectares (304 acres) of pine forest occur on the Wilmington Site. Canopy species include loblolly, longleaf, and/or pond pines (*Pinus serotina*). Subcanopy species can include sweetgum, white oak (*Quercus alba*), southern red oak (*Q. falcata*), water oak (*Q. nigra*), red maple (*Acer rubrum*), loblolly bay (*Gordonia*

8 Level IV ecoregions are further subdivisions of a Level III ecoregion. Level IV ecoregions are based on physiography, geology, soils, climate, potential natural vegetation, land use, and land cover differences within a Level III ecoregion (Omernik et al., 2000).

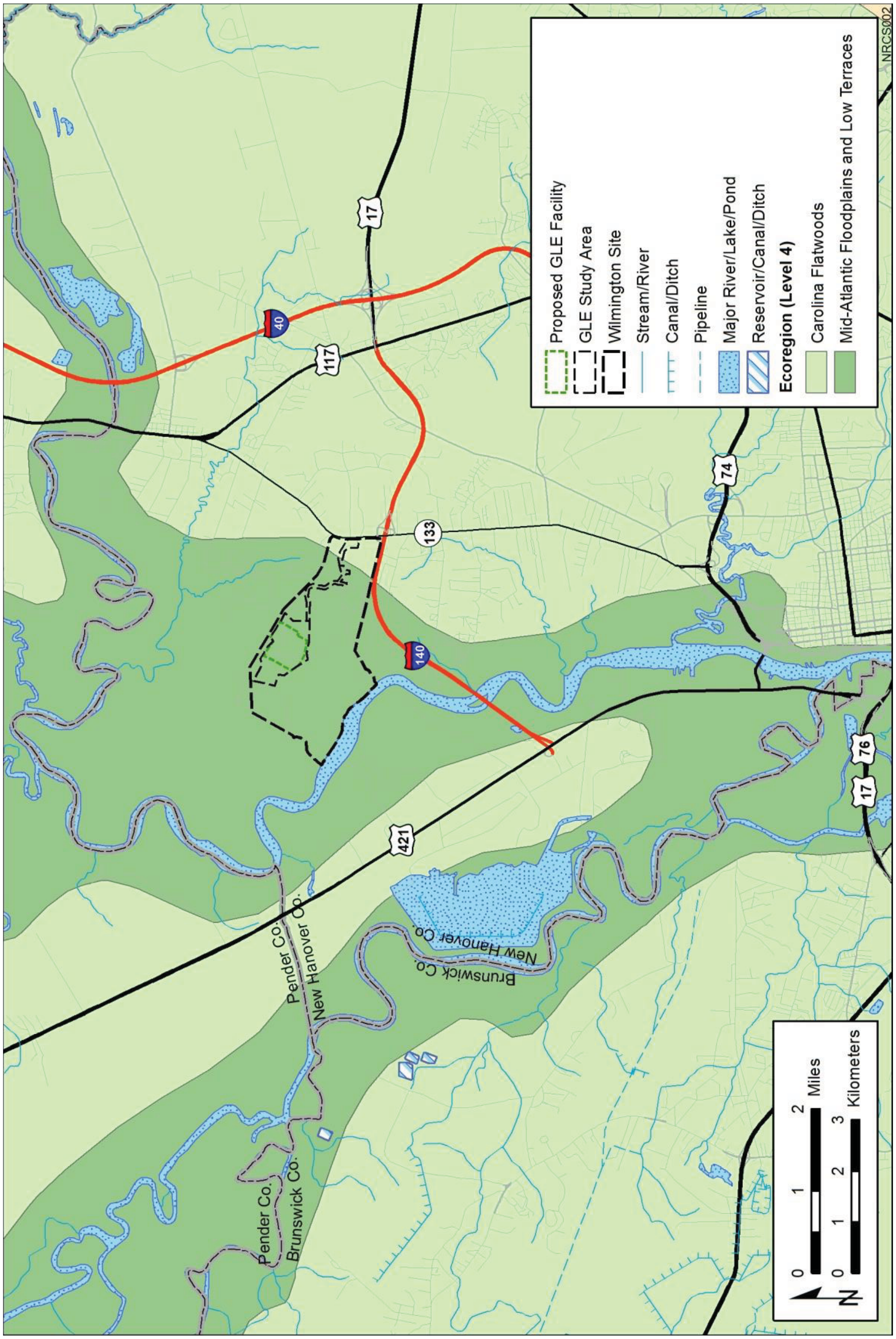

Figure 3-11 Level IV Ecoregions Located within the Wilmington Site Area (Griffith et al., 2002)

Table 3-11 Level IV Ecoregions within the Wilmington Site

Level IV Ecoregion	Potential Natural Vegetation	Land Use and Land Cover
Carolina Flatwoods	Longleaf pine (*Pinus palustris*) and Carolina wiregrass (*Aristida stricta*); xeric sandhill scrub (longleaf pine, turkey oak [*Quercus laevis*], and Carolina wiregrass); pond pine (*P. serotina*) forest and woodland; some oak-hickory and mixed forest.	Pine plantations, mixed forest; forested wetlands; cropland (cotton, corn, soybeans, wheat, peanuts, tobacco, and blueberries); production of hogs, broiler chickens, and turkeys; some public lands; and wildlife habitat.
Mid-Atlantic Floodplains and Low Terraces	Southern floodplain forests, including cypress-gum swamps (water-tupelo [*Nyssa aquatica*], swamp tupelo [*N. biflora*], bald cypress [*Taxodium distichum*], and pond cypress [*T. ascendens*]) and bottomland hardwood forests (bottomland oaks, red maple [*Acer rubrum*], sweetgum [*Liquidambar styraciflua*], green ash [*Fraxinus pensylvanica*], and bitternut hickory [*Carya cordiformis*]).	Forested wetlands, deciduous forests, and some croplands on larger terraces.

Source: Griffith et al., 2002.

lasianthus), flowering dogwood (*Cornus florida*), and tulip tree (*Liriodendron tulipifera*). Shrub species include coast pepper-bush (*Clethra alnifolia*), red bay (*Persea borbonia*), sweetbay magnolia (*Magnolia virginiana*), southern bayberry (*Morella cerifera*), sassafras (*Sassafras albidum*), horsesugar (*Symplocos tinctoria*), farkleberry (*Vaccinium arboreum*), and southern highbush blueberry (*V. formosum*). A number of vines also occur within the pine forest. These include Virginia creeper (*Parthenocissus quinquefolia*) and eastern poison-ivy (*Toxicodendron radicans*). The herbaceous layer includes slender spikegrass (*Chasmanthium laxum*), ebony spleenwort (*Asplenium platyneuron*), cinnamon fern (*Osmunda cinnamomea*), bracken fern (*Pteridium aquilinum*), and narrowleaf silk grass (*Pityopsis graminifolia* var. *graminifolia*).

3.8.1.2 Pine-Hardwood Forest

The pine-hardwood forest community is similar to the pine forest community except that hardwood trees tend to co-dominate. Pine-hardwood forests occur in the north-central and south-central portions of the Wilmington Site. Scattered stands also occur in the eastern portion of the site. The pine-hardwood forest stands located within and immediately adjacent to the proposed GLE Facility site are approximately 20 to 29 years of age (Figure 3-13). The age of the other pine-hardwood forest stands on the Wilmington Site (e.g., in the south-central portion of the site) are not known (GLE, 2009b). A total of 93 hectares (231 acres) of pine-hardwood forests occur on the Wilmington Site. Sweet-gum, tulip tree, water oak, post oak (*Quercus stellata*), white oak, red maple, blackgum (*Nyssa sylvatica*), and southern red oak are gradually replacing many of the pines within the forest canopy. Vine and herbaceous species are similar to those found in the pine forest communities.

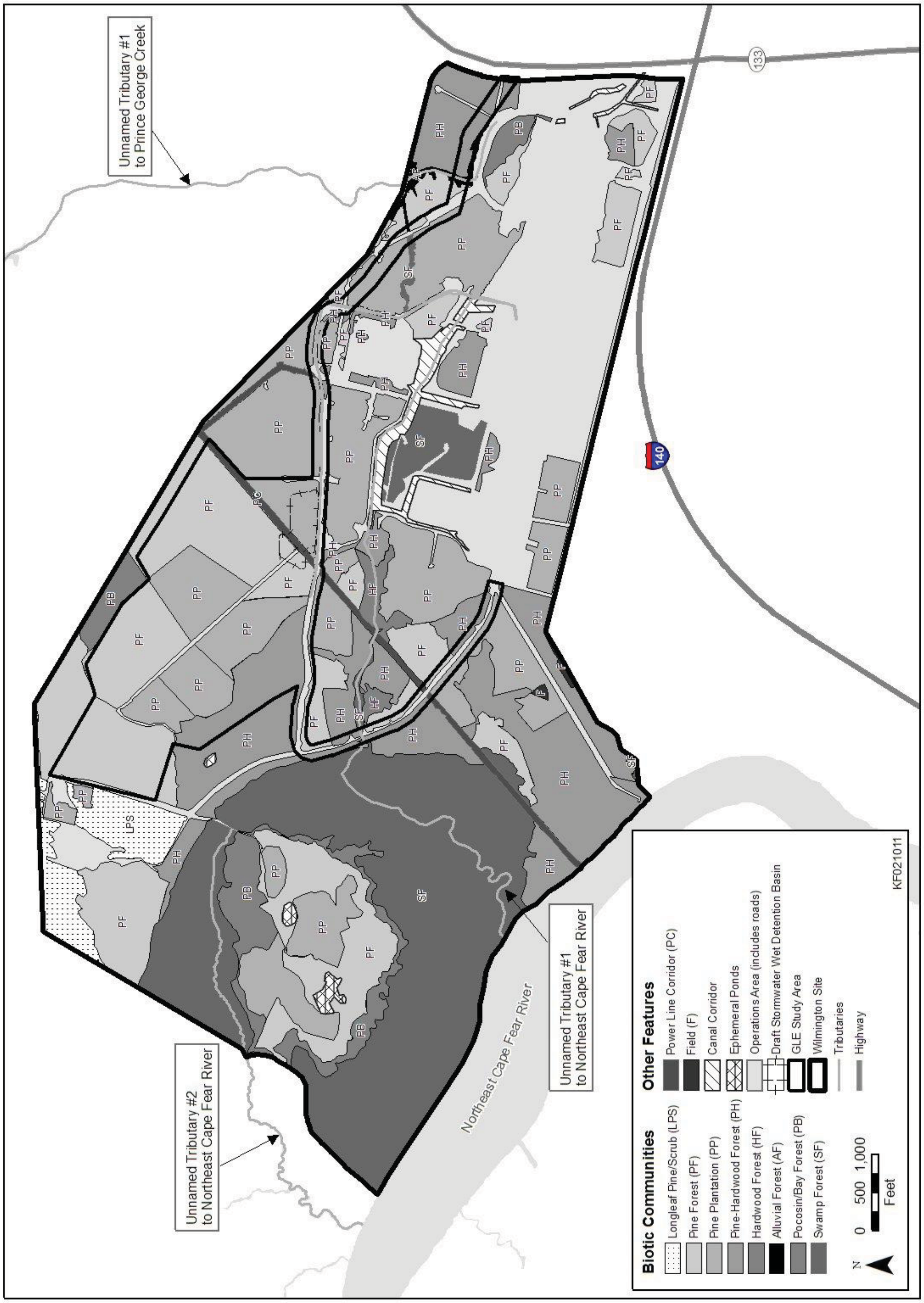

Figure 3-12 Plant Communities Located within the Wilmington Site (GLE, 2008)

Table 3-12 Plant Communities That Occur on the Wilmington Site

Plant Community	Acres[a] (% of Site)	Characteristic Plant Species
Natural Communities		
Longleaf pine/scrub forest	39 (2.4)	Longleaf pine (*Pinus palustris*)
Pine forest	304 (18.7)	Loblolly pine (*P. taeda*), longleaf pine, and pond pine (*P. serotina*)
Pine-hardwood forest	231 (14.3)	Pines: loblolly pine, longleaf pine, and pond pine Hardwoods: sweetgum (*Liquidambar styraciflua*), tulip tree (*Liriodendron tulipifera*), water oak (*Quercus nigra*), post oak (*Q. stellata*), white oak (*Q. alba*), red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), and southern red oak (*Q. falcata*)
Hardwood forest	10 (0.6)	Sweetgum, water oak (*Q. nigra*), and southern red oak
Alluvial forest	4 (0.2)	Red maple and sweetgum
Pocosin/bay forest	52 (3.2)	Loblolly pine and scattered pond pine intermixed with red bay (*Persea borbonia*), loblolly bay (*Gordonia lasianthus*), blackgum sand, pond cypress (*Taxodium ascendens*), and laurel oak (*Q. hemisphaerica*), with an isolated stand of Atlantic white cedar (*Chamaecyparis thyoides*)
Swamp forest	325 (20.0)	Loblolly pine, tulip tree, blackgum, pumpkin ash (*Fraxinus profunda*), red maple, sweetgum, and pond cypress
Ephemeral pond	4 (0.3)	New Jersey blueberry (*Vaccinium caesariense*), swamp titi (*Cyrilla racemiflora*), red bay, red maple, and blackgum among other species
Anthropogenically Influenced Communities		
Pine plantation	312 (19.2)	Loblolly pine and longleaf pine
Field	2 (0.1)	Bahia grass (*Paspalum notatum*)
Canal corridor	19 (1.2)	Various woody and herbaceous species, including Bahia grass, prickly Florida blackberry (*Rubus argutus*), Chinese bushclover (*Lespedeza cuneata*), northern dewberry (*R. flagellaris*), winged sumac (*Rhus copallinum*), broom-sedge (*Andropogon virginicus*), small dog-fennel thoroughwort (*Eupatorium capillifolium*), black willow (*Salix nigra*), Carolina willow (*S. caroliniana*), broadleaf cattail (*Typha latifolia*), common reed (*Phragmites australis*), and loblolly pine
Power line corridor	16 (1.0)	Primarily shrub and herbaceous species that occur in adjacent plant communities

Table 3-12 Plant Communities That Occur on the Wilmington Site (Cont.)

Plant Community	Acres[a] (% of Site)	Characteristic Plant Species
Operations area	303 (18.6)	Mowed areas of Bahia grass and centipede grass (*Eremochloa ophiuroides*) with ornamental and planted trees and shrubs
Total:	1621 (100.0)	

[a] To convert acres to hectares, multiply by 0.4047.
Source: GLE, 2008.

3.8.1.3 Pine Plantation

Pine plantations on the Wilmington Site consist of loblolly or longleaf pines that are planted in rows. These plant communities are maintained by manual thinning and prescribed burns to clear understory plants. The 126 hectares (312 acres) of pine plantations occur in large stands throughout the Wilmington Site. Most pine plantation stands on the Wilmington Site, including those within and immediately adjacent to the proposed GLE Facility site, vary from less than 20 years old to 20 to 29 years old (Figure 3-13). Sweetgum, red maple, water oak, red bay, loblolly bay, and sweetbay magnolia can also be present in the early stages of development of the pine plantation stands. These species become components of the understory as the plantation ages. Common shrub species include inkberry (*Ilex glabra*), American French mulberry (*Callicarpa americana*), fetterbush (*Leucothoe racemosa*), southern bayberry, and switch cane (*Arundinaria gigantea* ssp. *tecta*). Herbaceous species include broomsedge (*Andropogon virginicus*), American burnweed (*Erechtites hieracifolia* var. *hieracifolia*), small dog-fennel thoroughwort (*Eupatorium capillifolium*), flat-top fragrant goldenrod (*Euthamia graminifolia* var. *graminifolia*), and eastern milkpea (*Galactia regularis*).

3.8.2 Wetlands

Wetlands on the Wilmington Site are extremely varied and include a number of wetland types such as marshes, pocosins, and forested wetlands (swamps). Wetland areas are typically inundated or have saturated soils for a portion of the growing season and support plant communities that are adapted to saturated soil conditions. Streambeds and mudflats are among the wetland areas that may not be vegetated (Cowardin et al., 1979). While surface flows provide the water source for some wetlands, others, such as springs and seeps, are supported by groundwater discharge. Wetlands are often associated with perennial water sources, such as springs, perennial segments of streams, or lakes and ponds. However, some wetlands have seasonal or intermittent sources of water.

> ***Wetlands***
>
> *Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions (EPA, 2009f).*

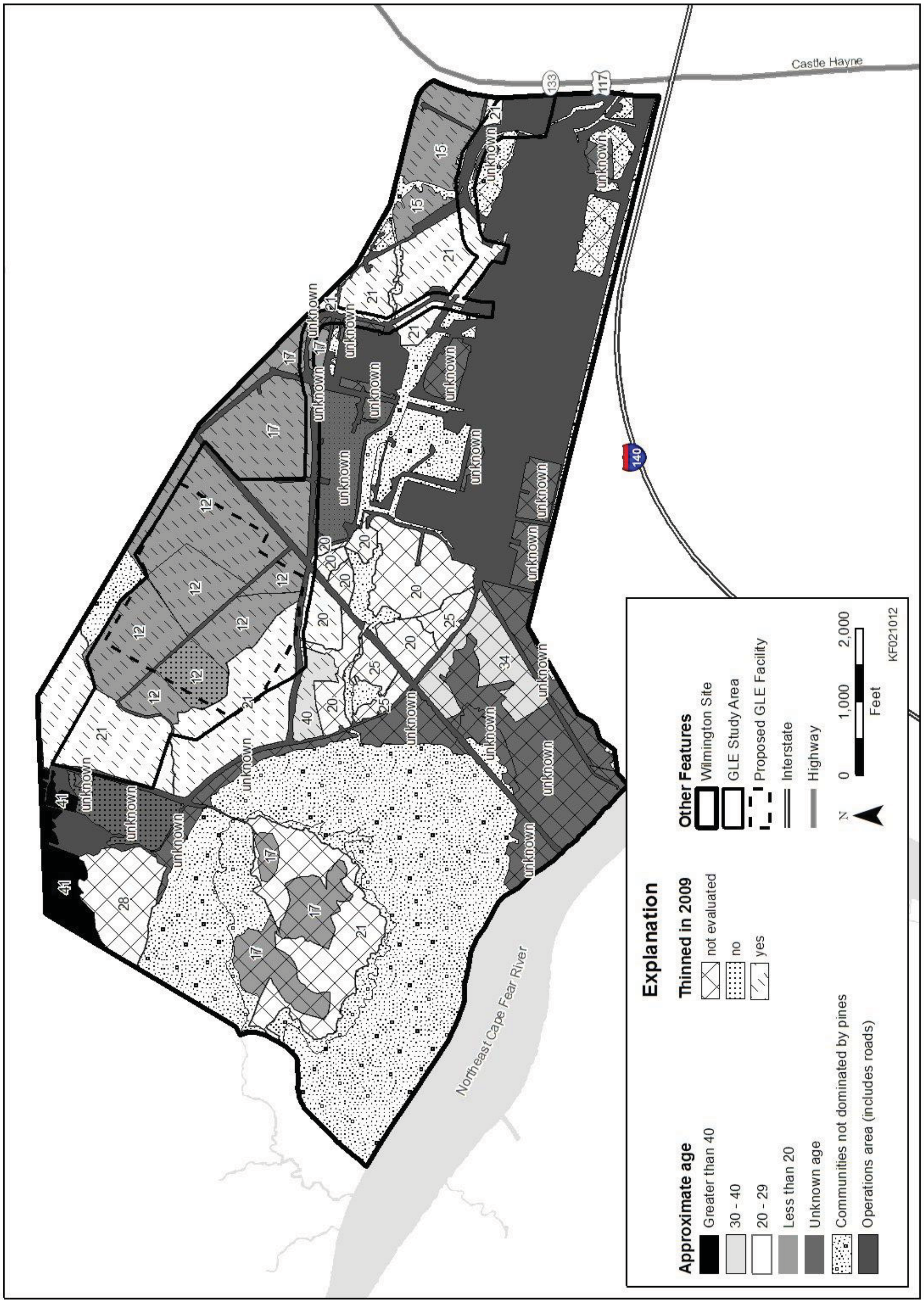

Figure 3-13 Age and Management of Pine-Dominated Plant Communities on the Wilmington Site (GLE, 2009b)

Wetlands can perform one or more of the following functions: groundwater recharge and discharge, flood storage and desynchronization, shoreline anchoring and dissipation of erosive forces, sediment trapping, nutrient retention and removal, food chain support, and fish and wildlife habitat (Whigham and Brinson, 1990).

Figure 3-14 shows the wetlands that occur on the Wilmington Site; Table 3-13 provides the acreages and descriptions of these wetlands. Nearly 308 hectares (760 acres) of wetlands occur within the Wilmington Site. More than 121 hectares (298 acres) of the forested wetlands within the North-Central and Eastern Site Sectors (where the proposed GLE Facility, ancillary facilities, and north access road would be located) were drained prior to 1963 (GLE, 2008). This area (shown as "PFO4Bd" in Figure 3-14) no longer meets the conditions necessary to be classified for regulatory purposes as a wetland (i.e., hydric soils, hydrophytic vegetation, and hydrological conditions that provide a temporary to permanent source of water to cause soil saturation) (EPA, 2009d).

Several jurisdictional and isolated wetlands (wetlands with and without connections to surface waters, respectively) occur within the corridor for the proposed access road to the proposed GLE Facility (Figure 3-15). These would include jurisdictional wetlands WD, WF, and WG and isolated wetland WA. Wetland WD is a forested wetland that abuts Unnamed Tributary #1 to Prince George Creek. Only 0.0008 hectare (0.002 acre) of wetland WD occurs within the proposed access road corridor (GLE, 2009c). Wetland WF is an herbaceous wetland located in the upstream reach of Unnamed Tributary #1 to Prince George Creek. About 0.012 hectare (0.03 acre) of this wetland occurs within the access road corridor (GLE, 2009c). Wetland WG is a forested wetland that occurs along Jurisdictional Channel #2. About 0.08 hectare (0.02 acre) of this wetland occurs within the access road corridor (GLE, 2009c). Isolated wetland WA is a forested wetland that is contained entirely within the proposed access road corridor. The area of the wetland is 0.02 hectare (0.06 acre) (GLE, 2008).

3.8.3 Environmentally Sensitive Areas

Environmentally sensitive areas[9] include conservation areas or other areas of ecological importance. Areas of outstanding natural significance in New Hanover County have been inventoried by LeBlond and Grant (2003). These are areas within the county that contain the best examples of natural habitats and/or are locations where rare biota or rare natural communities occur.

The southwestern portion of the Wilmington Site, which does not include the proposed GLE Facility site, occurs within the Northeast Cape Fear River Floodplain. The Northeast Cape Fear River Floodplain is considered to be a natural area of national significance. This means that the area is considered to contain examples of natural communities, rare plant or animal populations, or other significant ecological features that are among the highest quality or best

[9] While environmentally sensitive areas do not have an official definition, they can be defined basically as natural features such as habitats or rare species that may be protected by government regulation. Jennings and Reganold (1989) defined environmentally sensitive areas as landscape elements or places that are crucial to the long-term maintenance of biological diversity, soil, water, and other natural resources, especially as they relate to human health, safety, and welfare, both at a local and regional context.

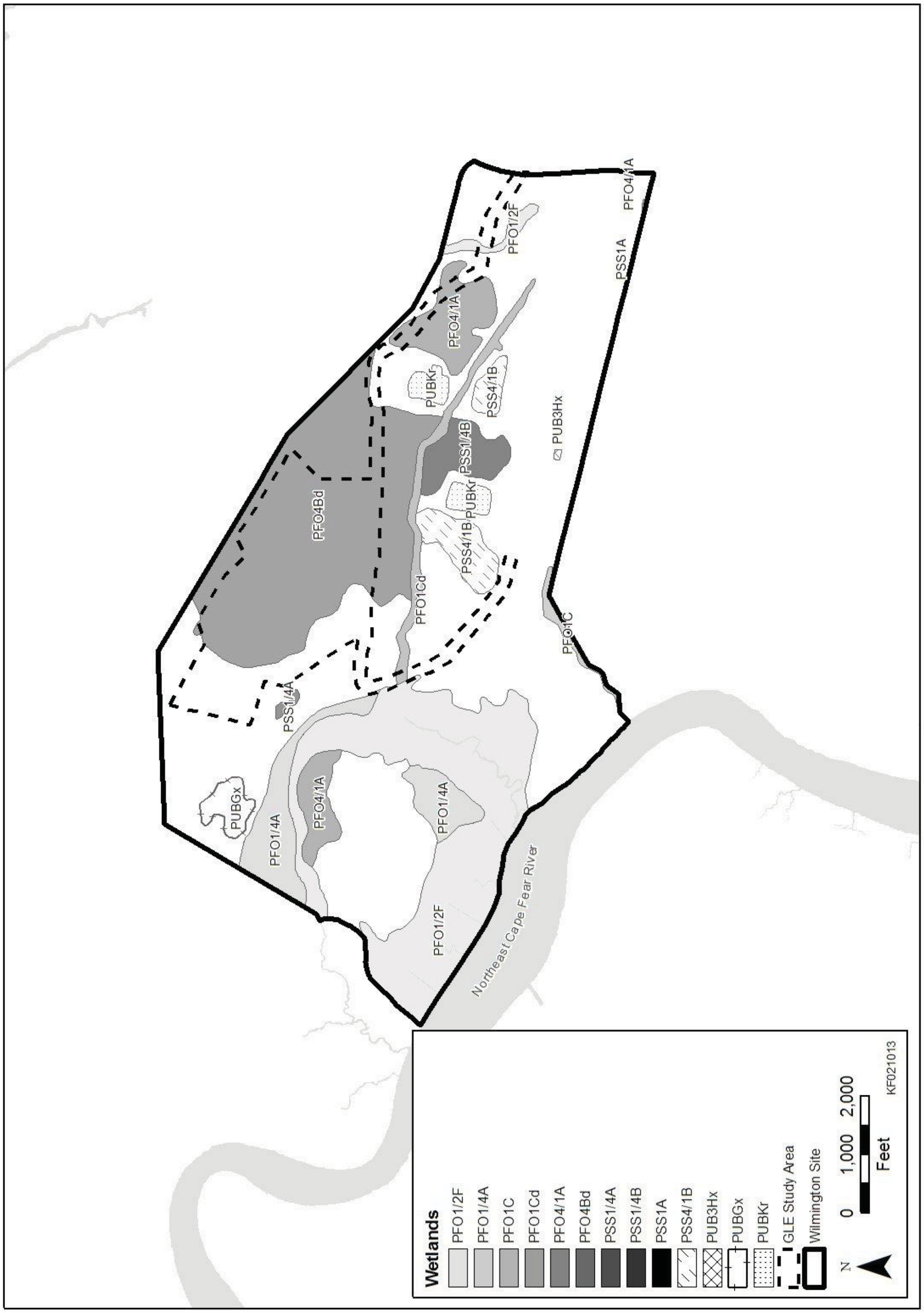

Figure 3-14 Wetlands Located within the Wilmington Site (GLE, 2008)

Table 3-13 Wetlands That Occur on the Wilmington Site

Wetland Type[a]	Area (acres)[b]	Wetland Characteristics
PFO1/2F	235.3	Palustrine, forested, broad-leaved deciduous/needle-leaved deciduous, semipermanently flooded
PFO1/4A	64.8	Palustrine, forested, broad-leaved deciduous/needle-leaved evergreen, temporarily flooded
PFO1C	7.4	Palustrine, forested, broad-leaved deciduous, seasonally flooded
PFO1Cd[c]	24.0	Palustrine, forested, broad-leaved deciduous, seasonally flooded, partially drained/ditched
PFO4/1A	61.4	Palustrine, forested, needle-leaved evergreen/broad-leaved deciduous, temporarily flooded
PFO4Bd[c]	274.4	Palustrine, forested, needle-leaved evergreen, saturated, partially drained/ditched
PSS1/4A	1.9	Palustrine, scrub-shrub, broad-leaved deciduous/needle-leaved evergreen, temporarily flooded
PSS1/4B	26.9	Palustrine, scrub-shrub, broad-leaved deciduous/needle-leaved evergreen, saturated
PSS1A	0.1	Palustrine, scrub-shrub, broad-leaved deciduous, temporarily flooded
PSS4/1B	32.9	Palustrine, scrub-shrub, needle-leaved evergreen/broad-leaved deciduous, saturated
PUB3Hx	0.5	Palustrine, unconsolidated bottom, mixohaline, permanently flooded, excavated
PUBGx[c]	13.3	Palustrine, unconsolidated bottom, intermittently flooded, excavated
PUBKr	15.4	Palustrine, unconsolidated bottom, artificially flooded, artificial substrate
Total:	758.3	

[a] Refer to Figure 3-14 for wetland locations.
[b] To convert ac to ha, multiply by 0.4047.
[c] Limited wetland hydrology remains in the area.
Sources: GLE, 2008; FWS, 1990.

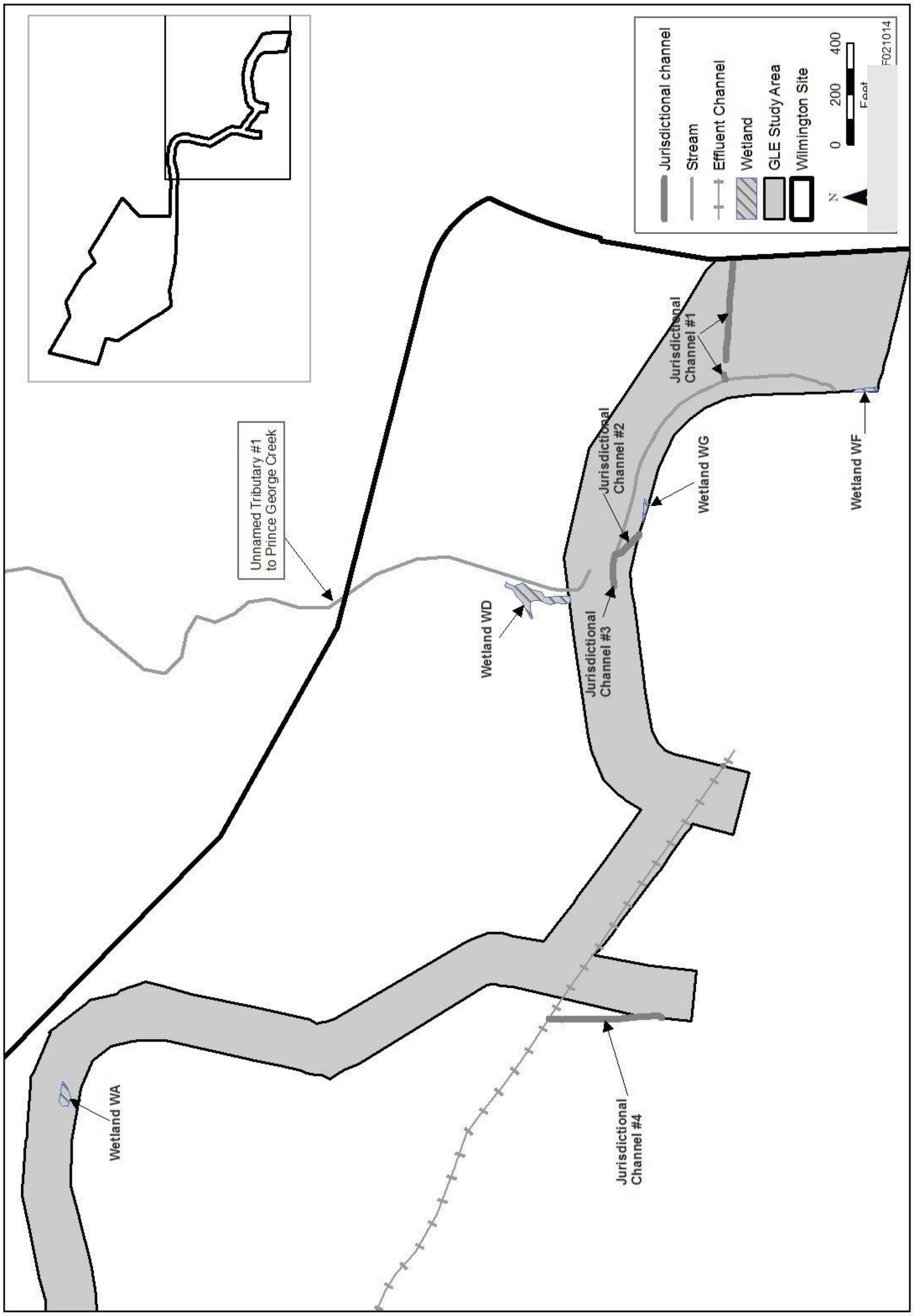

Figure 3-15 Wetlands Located within the Corridor for the Proposed Access Road to the Proposed GLE Facility (GLE, 2009c)

examples of their kind in the nation (LeBlond and Grant, 2003). The Northeast Cape Fear River Floodplain natural area is located along the Northeast Cape Fear River from its confluence with Smith Creek in New Hanover County to its confluence with Holly Shelter Creek in Pender County. It encompasses 10,392 hectares (25,679 acres), 3572 hectares (8827 acres) of which are within New Hanover County. It is one of the nation's best examples of a tidal cypress-gum swamp community (LeBlond and Grant, 2003).

Most of the Northeast Cape Fear River, including the reach along the southwestern portion of the Wilmington Site, is considered a primary nursery area for shellfish and fish (NCDMF, 2006). Primary nursery areas are located in the upper portions of creeks and bays and are usually shallow with soft muddy substrates and are surrounded by marshes and other wetlands. The low salinity and abundance of food items make these areas ideal for young fish and shellfish. Many commercial fishing activities (e.g., use of trawl nets, seine nets, dredges, or any mechanical means used to collect clams and oyster) are prohibited in primary nursery areas (NCDMF, 2009). Areas designated as primary nursery areas by the North Carolina Division of Marine Fisheries would also be considered to be essential fish habitat. Essential fish habitat are defined as those waters and substrate necessary for Federally managed marine and anadromous fish species and Federally managed shellfish species for spawning, breeding, feeding, or growth to maturity (*Magnuson-Stevens Fishery Conservation and Management Act*, 16 U.S.C. 1801 Section 3).

On a more localized scale, environmentally sensitive area features can include floodplains, wetlands, unstable soils, and steep slopes. The 100-year floodplain within the Wilmington Site occurs along the Northeast Cape Fear River, while the 500-year floodplain occurs within the forested wetland areas in the western portion of the Wilmington Site (GLE, 2008). Wetlands on the Wilmington Site are discussed in Section 3.8.2. About 30 hectares (74 acres) of unstable soils occur on the Wilmington Site, all at or within the vicinity of four former borrow pits. One of the areas of unstable soils occurs in the northwestern portion of the Wilmington Site, while the other three areas are located within the south–central and southern portion of the site (GLE, 2008). Gradients greater than 10 percent are considered steep slopes. Most areas of steep slopes on the Wilmington Site are contained along the remnant oxbow of the Northeast Cape Fear River and along the banks of existing stream banks and the effluent channel. Some steep slopes also occur in the area of the former borrow pits.

Except for drained forested wetlands, none of these sensitive area features occur within the proposed GLE Facility area. Small wetland areas that occur within the corridor for the access road were discussed in Section 3.8.2.

3.8.4 Wildlife

Although the Wilmington Site has been subjected to varying degrees of environmental disturbances from silviculture, agriculture, industrial operations, residential developments, and roads, the habitats within the Wilmington Site and surrounding areas support a relatively high diversity of wildlife species. Nearly 370 species of mammals, birds, reptiles, and amphibians potentially occur on the Wilmington Site. Wildlife species that could occur within the proposed GLE Facility area are primarily those that inhabit forested habitats.

About 40 mammal species could occur in the area. These include white-tailed deer (*Odocoileus virginianus*), American black bear (*Ursus americanus*), bobcat (*Lynx rufus*), gray fox (*Urocyon*

cinereoargenteus), raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), marsh rabbit (*S. palustris*), eastern gray squirrel (*Sciurus carolinensis*), and striped skunk (*Mephitis mephitis*). In addition, a number of bat, shrew, and small rodent (e.g., mice and voles) species are likely to occur in the proposed GLE Facility area. These would include the short-tailed shrew (*Blarina brevicauda*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), golden mouse (*Ochrotomys nuttallii*), and woodland vole (*Microtus pinetorum*).

More than 100 bird species could occur within the proposed GLE Facility area. Widespread and common species include wild turkey (*Meleagris gallopavo*), northern bobwhite (*Colinus virginianus*), mourning dove (*Zenaida macroura*), red-eyed vireo (Vireo olivaceus), northern cardinal (*Cardinalis cardinalis*), tufted titmouse (*Baeolophus bicolor*), eastern towhee (*Pipilo erythrophthalmus*), wood thrush (*Hylocichla mustelina*), summer tanager (*Piranga rubra*), blue-gray gnatcatcher (*Polioptila caerulea*), hooded warbler (*Wilsonia citrina*), and Carolina wren (*Thryothorus ludovicianus*). No sites on or near the Wilmington Site are recognized as Important Bird Areas (National Audubon Society, 2009a).[10]

Nearly 40 reptile species could occur within the habitat types found in the proposed GLE Facility area. Included among these would be the eastern box turtle (*Terrapene carolina*), green anole (*Anolis carolinensis*), ground skink (*Scincella lateralis*), six-lined racerunner (*Aspidoscelis sexlineata*), eastern kingsnake (*Lampropeltis getula getula*), racer (*Coluber constrictor*), and red-bellied snake (*Storeria occipitomaculata*). Several species of rattlesnakes (*Crotalus* spp.) and the copperhead (*Agkistrodon contortrix*) could also occur within the upland forested habitats of the proposed GLE Facility area. Fewer than 10 amphibian species would be expected to occur within the proposed GLE Facility area. These could include the redback salamander (*Plethodon cinereus*), Fowler's toad (*Bufo fowleri*), southern toad (*B. terrestris*), and several species of treefrogs (*Hyla* spp.). These reptile and amphibian species could occur within suitable habitat types throughout the Wilmington Site.

The developed portions (operations area) of the Wilmington Site include buildings, parking lots, infrastructure, and landscaped areas. Nevertheless, a number of wildlife species occur in these areas. However, the densities of most wildlife species are higher in undeveloped areas than in developed areas. Exceptions include species such as house sparrow (*Passer domesticus*), house finch (*Carpodacus mexicanus*), rock pigeon (*Columba livia*), house mouse (*Mus musculus*), and Norway rat (*Rattus norvegicus*). Other common bird species within the operations area include the killdeer (*Charadrius vociferus*), American crow (*Corvus brachyrhynchos*), northern mockingbird (*Mimus polyglottos*), American robin (*Turdus migratorius*), and European starling (*Sturnus vulgaris*). Other mammal species include Virginia opossum (*Didelphis virginiana*), eastern cottontail, striped skunk, and raccoon. Generally, it would be expected that wildlife use of the operational areas would primarily be for foraging, while the least frequent type of use would be for reproductive activities.

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10 Important Bird Areas are sites that provide essential habitat for one or more species of birds that are species of conservation concern, species with restricted ranges, species that are vulnerable because their populations are concentrated in one general habitat type or biome, or species (or groups of similar species) that are vulnerable because they occur at high densities because of congregatory behavior (National Audubon Society, 2009b).

3.8.5 Aquatic Biota

The Northeast Cape Fear River (at River Mile 6.1 to 6.7 [river kilometer 9.8 to 10.7]) borders the southwestern portion of the Wilmington Site. Aquatic habitats within the Wilmington Site include Unnamed Tributary #1 to the Northeast Cape Fear River, an industrial effluent channel that flows into Unnamed Tributary #1, Unnamed Tributary #2 to the Northeast Cape Fear River, several other smaller tributaries to the Northeast Cape Fear River, and an Unnamed Tributary #1 to Prince George Creek. An Unnamed Tributary #2 to Prince George Creek occurs just north of the Wilmington Site and receives drainage from the northern portion of the site. The lower portions of the tributaries to the Northeast Cape Fear River, as well as the Northeast Cape Fear River in the area of the Wilmington Site, are tidally influenced. Water quality characteristics of these water bodies are discussed in Section 3.7.1.

In addition to the onsite streams, several impoundments and ponds on the Wilmington Site provide aquatic habitat. These include two active final process lagoons and their associated aeration basin (which are part of the Wilmington Site's treatment system for process wastewater), four inactive wastewater treatment facility lagoons, one firefighting water supply pond, two stormwater wet detention basins, and three ephemeral woodland ponds. These impoundments and ponds would provide habitat for aquatic invertebrates, waterfowl and shorebirds, and amphibians. No aquatic habitats occur within the area proposed for the GLE Facility. More detailed information on the surface waters of the Wilmington Site were presented in Section 3.7.

Nearly 110 species of freshwater, marine, and migratory fish are reported from the Northeast Cape Fear River. About 40 fish species plus sunfish hybrids have been collected from the Northeast Cape Fear River near the Wilmington Site (NCWRC, 2007). About 50 of the species from the Northeast Cape Fear River are considered freshwater species. These include gars, suckers, minnows, catfish, sunfish, bass, crappie, perch, and darters. The anadromous species (species that migrate to freshwaters to spawn) include the blueback herring (*Alosa aestivalis*), hickory shad (*A. mediocris*), alewife (*A. pseudoharengus*), American shad (*A. sapidissima*), striped bass (*Morone saxatilis*), and shortnose sturgeon (*Acipenser brevirostrum*); the American eel (*Anguilla rostrata*) is the only catadromous species (species that migrate to marine waters to spawn). The Federally endangered shortnose sturgeon is discussed in more detail in Section 3.8.6.1. The blueback herring spawns in Prince George Creek, while the American shad and striped bass use the creek as nursery grounds. Atlantic sturgeon (*Acipenser oxyrhynchus*) and American eel are also present in the area of Prince George Creek (NOAA, 2002).

During periods of drought and elevated salinities, the fish community in the Northeast Cape Fear River near the Wilmington Site could shift to more estuarine species (NCWRC, 2007). About 50 marine and estuarine fish species ascend into the Northeast Cape Fear River. These include the bay anchovy (*Anchoa mitchilli*), gobies, striped mullet (*Mugil cephalus*), and pipefish. Marine and estuarine gamefish include the tarpon (*Megalops atlanticus*), crevalle jack (*Caranx hippos*), common snook (*Centropomus undecimalis*), spotted seatrout (*Cynoscion nebulosus*), black drum (*Pogonias cromis*), and red drum (*Sciaenops ocellatus*).

Commercial and recreational fishing occur in the Northeast Cape Fear River, although most commercial fishing occurs downstream of the Wilmington Site (e.g., in the Cape Fear River Estuary). Commercial fishing for American shad and striped bass occurs in the Northeast Cape Fear River near the Wilmington Site, while recreational fishing occurs for these species plus

blueback herring, hickory shad, alewife, largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*L. microlophus*), redbreast sunfish (*L. auritus*), pumpkinseed (*L. gibbosus*), warmouth (*L. gulosus*), black crappie (*Pomoxis nigromaculatus*), channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), chain pickerel (*Esox niger*), redfin pickerel (*E. americanus*), and yellow perch (*Perca flavescens*) (Ashley and Rachels, 2005). Sport fishing within the Cape Fear River Basin also occurs for the introduced spotted bass (*M. punctulatus*) and flathead catfish (*Pylodictis olivaris*) (Ashley and Rachels, 2005).

No major studies of fish species within the Wilmington Site have been conducted. During the onsite biological surveys for the Environmental Report, the eastern mosquitofish (*Gambusia halbrooki*) and a blue crab (*Callinectes sapidus*) were observed in the Unnamed Tributary #1 to the Northeast Cape Fear River (GLE, 2008). In addition to being an important nursery area for a number of fish species, the Northeast Cape Fear River is also used as a nursery area by shrimp, blue crabs, and other shellfish.

The Federally endangered West Indian manatee (*Trichechus manatus*), a marine mammal, may also occur within the Northeast Cape Fear River and the lower portions of its tributaries near the Wilmington Site. Information on the West Indian manatee is presented in Section 3.8.6.1.

The major factor limiting fisheries resources within the Cape Fear River Basin is the impedance to fish migrations by locks and dams. Additional factors include degraded water quality, sedimentation and turbidity, and loss of wetlands and riparian areas resulting from agricultural and forestry operations, increased development, unstable shorelines, and road construction (Ashley and Rachels, 2005).

3.8.6 Threatened, Endangered, and Other Special Status Species

Because of the diversity of species, habitats, and other influences (e.g., convergence of inland sandhill habitat with coastal areas), a large number of rare plants and animals are native to New Hanover County (LeBlond and Grant, 2003). The National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (FWS) are responsible for listing aquatic and terrestrial species as threatened and endangered at the Federal level, as delegated by the *Endangered Species Act* (ESA), as amended (16 U.S.C. 573, et seq.). NRC consultations with the FWS and NMFS have been conducted and completed to comply with Section 7 of the ESA.[11] The State of North Carolina lists additional species that are regionally threatened, endangered, or rare. The North Carolina Wildlife Resource Commission within the Department of Environment and Natural Resources has regulatory authority over animals (except insects), while the Plant Conservation Program within the North Carolina Department of Agriculture has regulatory authority over plants and insects.

3.8.6.1 Federally Listed Species

Nine Federally threatened or endangered species known to occur in New Hanover County (FWS, 2009a). No critical habitat for any of the nine species occurs in the area of the Wilmington Site (FWS, 2009a). In addition to the threatened and endangered species, a number of Federal species of concern occur within New Hanover County. Table 3-14 lists the

[11] Letters of consultation can be found in Appendix B.

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina

Scientific Name	Common Name[a]	Status Federal/State[b]	Record Status[c]	Habitat	Potential Presence on or near WS/GLEF[d]
Plants					
Amaranthus pumilus	Seabeach amaranth	T/T	Current	Upper beaches, foredunes, overwash flats and sand/shell replenishments, and dredge spoils.	No/No
Amorpha georgiana var. *confusa*	Georgia indigobush	FSC/T	Historic	Dry savannas and riverbanks.	No/No
Astragalus michauxii	Sandhills milkvetch	FSC/T	Historic	Longleaf pine/scrub oak woodlands.	Yes/Yes
Dionaea muscipula	Venus' flytrap	FSC/SR-L	Current	Bogs and perennially wet areas.	Yes/No
Hypericum adpressum	Creeping St. John's-wort	FSC/NL	Historic	Shores, shallow waters of freshwater ponds.	No/No
Litsea aestivalis	Pondspice	FSC/SR-T	Current	Margins of swamps, cypress ponds, and sandhill depression ponds.	Yes/No
Ludwigia ravenii	Raven's seedbox	FSC/SR-T	Historic	Swamps, bogs, ponds.	Yes/Yes
Lysimachia asperulaefolia	Roughleaf loosestrife	E/E	Current	Edges between longleaf pine uplands and pond pine pocosins on moist seasonally saturated sands or shallow organic soils overlying sands.	Yes/No
Pteroglossaspis ecristata	Giant orchid	FSC/SR-T	Historic	Pine savannas, scrub oaks.	No/No
Ptilimnium ahlesii	Carolina bishopweed	FSC/SR-L	Current	Tidal freshwater marshes.	Yes/No
Rhynchospora pleiantha	Brown beakrush	FSC/T	Current	Sands and peat of pond shores and moist pine savannas.	No/No
Sagittaria graminea var. *weatherbiana*	Grassleaf arrowhead	FSC/SR-T	Current	Swamps.	Yes/Yes

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina (Cont.)

Scientific Name	Common Name[a]	Status Federal/State[b]	Record Status[c]	Habitat	Potential Presence on or near WS/GLEF[d]
Sideroxylon tenax	Tough bumelia	FSC/SR-P	Historic	Maritime forests and scrub.	No/No
Solidago verna	Spring-flowering goldenrod	FSC/T	Current	Pine savannas, pocosins, pine barrens, open woods, fields, dry bogs, and disturbed roadsides.	Yes/Yes
Solidago villosicarpa	Coastal goldenrod	FSC/E	Historic	Mesic, hardwood forests with dense canopies and sparse understories and areas of disturbance.	Yes/Yes
Stylisma pickeringii var. *pickeringii*	Pickering's morning-glory	FSC/E	Current	Scrub habitats with sandy soils, minimal litter accumulation, sparse ground cover, and little canopy cover of scattered scrubby oaks and pines.	Yes/Yes
Thalictrum cooleyi	Cooley's meadowrue	E/E	Historic	Wet savannas.	No/No
Thalictrum macrostylum	Small-leaf meadowrue	FSC/SR-L	Current	Bogs, wet woods, and cliffs.	Yes/No
Trichostema sp. 1	Dune blue curls	FSC/SR-L	Current	Maritime grasslands behind foredunes, maritime scrub.	No/No
Invertebrates					
Agrotis buchholzi	Buchholz's dart moth	FSC/NL	Current	Pine plains.	No/No
Atrytone arogos arogos	Eastern arogos skipper	FSC/SR	Obscure	Savannas, open pinewoods, and other relatively undisturbed grasslands.	Yes/No
Atrytonopsis loammi	Loammi skipper	FSC/SR	Obscure	Barrier islands.	No/No
Helisoma eucosmium	Greenfield ramshorn snail	FSC/E	Historic	Shallow creek beds, marshes, and swamps.	Yes/No

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina (Cont.)

Scientific Name	Common Name[a]	Status Federal/State[b]	Record Status[c]	Habitat	Potential Presence on or near WS/GLEF[d]
Planorbella magnifica	Magnificent rams-horn	FSC/E	Historic	Ponds.	No/No
Problema bulenta	Rare skipper	FSC/SR	Current	Brackish water marshes, abandoned rice paddies.	Yes/No
Triodopsis soelneri	Cape Fear threetooth	FSC/T	Current	Savannas, flatwoods, and swamps.	Yes/No
Fishes					
Acipenser brevirostrum	Shortnose sturgeon	E/E	Current	Downstream reaches of large rivers and Atlantic coastal waters. It prefers deep water with soft substrate and vegetated bottoms.	Yes/No
Anguilla rostrata	American eel	FSC/NL	Current	Matures in fresh or brackish waters, spawns in the Sargasso Sea.	Yes/No
Amphibians					
Rana capito capito	Carolina gopher frog	FSC/T	Current	Sandhills, pine and turkey oak woodlands; breeds in wetlands and temporary ponds.	Yes/Yes
Reptiles					
Alligator mississippiensis	American alligator	T(S/A)/T	Current	Freshwater swamps and marshes, but can also be found in rivers, lakes, and other bodies of water.	Yes/No
Caretta caretta	Loggerhead	T/T	Current	Open seas.	No/No
Chelonia mydas	Green turtle	T/T	Current	Open seas.	No/No
Heterodon simus	Southern hog-nosed snake	FSC/SC	Current	Mature pine forests and sandhills.	Yes/Yes

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina (Cont.)

Scientific Name	Common Name[a]	Status Federal/State[b]	Record Status[c]	Habitat	Potential Presence on or near WS/GLEF[d]
Ophisaurus mimicus	Mimic glass lizard	FSC/SC	Historic	Sandhills, pine and turkey oak woodlands.	Yes/No
Pituophis melanoleucus melanoleucus	Northern pinesnake	FSC/SC	Current	Woodlands.	Yes/Yes
Birds					
Charadrius melodus	Piping plover	T/T	Current	Nests in barrier island beaches; sandy beach shoals used during migration and winter.	No/No
Passerina ciris ciris	Eastern painted bunting	FSC/SR	Current	Woodlands.	Yes/Yes
Picoides borealis	Red-cockaded woodpecker	E/E	Current	Open stands of mature pine trees >60 years old for nesting and roosting; pine and pine/hardwood stands >30 years old for foraging.	Yes/No
Mammals					
Corynorhinus rafinesquii	Rafinesque's big-eared bat	FSC/T	Current	Riparian woodlands, hardwood forests.	Yes/No
Myotis austroriparius	Southeastern myotis	FSC/SC	Current	Nests in snags and hollow trees in conifer and hardwood forests. Forages in riparian areas and uplands.	Yes/Yes
Trichechus manatus	West Indian manatee	E/E	Current	Shallow coastal bays, lagoons, estuaries, and inland rivers.	Yes/No

Footnotes on following page.

Table 3-14 Federally Threatened, Endangered, and Special Concern Species Reported from New Hanover County, North Carolina (Cont.)

[a] Common names follow those used in NatureServe, 2009.
[b] E = endangered; FSC = Federal species of concern; SC = special concern; SR = significantly rare; SR-L = significantly rare – limited; SR-P = significantly rare – peripheral; SR-T = significantly rare – throughout; T = threatened; T(S/A) = threatened due to similarity in appearance; NL = not listed.
[c] Current: the species has been observed in the county within the last 50 years; Historic: the species was last observed in the county more than 50 years ago; Obscure: the date and/or location of observation is uncertain.
[d] WS = Wilmington Site, GLEF = proposed GLE Facility site.
Sources: Buchanan and Finnegan, 2008; FWS, 2009a; Jordan, 1998; LeGrand et al., 2008; NatureServe, 2009; NCDENR, 2001; Patrick et al., 1995; GLE, 2008; FWS, 2008a; 2003a,b.

Federally threatened or endangered species and species of special concern that are known to occur or likely to occur within New Hanover County, along with their State status (as applicable).While several listed species exist or may exist in the Wilmington Site area, no listed species have been reported from the area proposed for the GLE Facility.

The following definitions are applicable to the species categories for listing under the ESA (FWS, 2008d):

- *Endangered*: any species that is in danger of extinction throughout all or a significant portion of its range.
- *Threatened*: any species that is likely to become endangered within the foreseeable future throughout all or a significant part of its range.
- *Threatened due to similarity of appearance*: a taxon that is threatened due to similarity of appearance with another listed species and is listed for its protection. Taxa listed as "threatened due to similarity of appearance" are not biologically endangered or threatened and are not subject to Section 7 consultation.
- *Proposed for listing*: species that have been formally proposed for listing by the FWS or NMFS by notice in the *Federal Register*.[8]
- *Candidate*: species for which the FWS or NMFS has sufficient information on their biological status and threats to propose them as threatened or endangered under the ESA but for which development of a proposed listing regulation is precluded by other higher priority listing actions.
- *Federal species of concern*: species under consideration for listing, for which there is insufficient information to support listing at this time. These species may or may not be listed in the future, and many of these species were formally recognized as Category 2 (C2) candidate species.[9]
- *Critical habitat*: specific areas within the geographical area occupied by the species at the time it is listed, on which are found physical or biological features essential to the conservation of the species and which may require special management considerations or protection. Except when designated, critical habitat does not include the entire geographical area that can be occupied by the threatened, endangered, or other special status species.

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[8] Within one year of a listing proposal, the FWS or NMFS must take one of three possible courses of action: (1) finalize the listing rule (as proposed or revised); (2) withdraw the proposal if the biological information on hand does not support the listing; or (3) extend the proposal for up to an additional six months because, at the end of one year, there is substantial disagreement within the scientific community concerning the biological appropriateness of the listing. After the extension, the FWS or NMFS must decide whether to list the species on the basis of the best scientific information available.

[9] Category 2 (C2) species are species for which information in the possession of the FWS indicated that proposing to list the species as endangered or threatened was possibly appropriate, but for which persuasive evidence on biological vulnerability and threat was not available to support the listing. Thus, the FWS concluded that these species might be threatened or endangered, but more information was necessary before a final conclusion could be reached.

Among the Federally listed threatened or endangered species that occur within New Hanover County, the seabeach amaranth (*Amaranthus pumilus*), Cooley's meadowrue (*Thalictrum cooleyi*), green turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), and piping plover (*Charadrius melodus*) do not occur within the Wilmington Site area. The following paragraphs describe the Federally listed threatened or endangered species and Federal species of concern that exist or may exist in the Wilmington Site area. Unless otherwise referenced, the information on each species is adapted from NatureServe (2009), with species status provided by Buchanan and Finnegan (2008) for plants and LeGrand et al. (2008) for animals.

Plants

Carolina bishopweed (*Ptilimnium ahlesii*)

The Carolina bishopweed, an erect annual herb, is a Federal species of concern and is considered to be "significantly rare–limited" by the State[10]. The plant inhabits freshwater tidal marshes (Weakley, 2008). Threats to the Carolina bishopweed include invasion by common reed (*Phragmites australis*) and water pollution (NatureServe, 2009; Weakley, 2008). No occurrences of the Carolina bishopweed have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Coastal goldenrod (*Solidago villosicarpa*)

The coastal goldenrod, a perennial herb, is a Federal species of concern and is State listed as endangered. It occurs in a wide variety of wooded habitats, occurring in areas associated with natural or human-caused disturbance (CPC, 2008a). Canopy closure is a threat to the coastal goldenrod. Invasive species also present a minor threat to the species. An occurrence was recorded within 3.2 kilometers (2 miles) of the northern boundary of the Wilmington Site, but more than that distance from the proposed GLE Facility area (NCDENR, 2009e). Habitat potentially suitable for the coastal goldenrod occurs in the pine-hardwood forests in the north-central and south-central portions of the Wilmington Site (GLE, 2008).

Grassleaf arrowhead (*Sagittaria graminea* var. *weatherbiana*)

The grassleaf arrowhead is a Federal species of concern and is considered "significantly rare–throughout" by the State. It is a perennial herb that inhabits shallow water and wet shores of ponds, marshes, and ditches. Threats to the species include drainage and other habitat modification that causes excessive drying of wetland habitat (Burns and Cusick, 1983). No occurrences of the grassleaf arrowhead have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Pickering's morning-glory (*Stylisma pickeringii* var. *pickeringii*)

The Pickering's morning-glory (also known as Pickering's dawnflower) is a Federal species of concern and is State-listed as endangered. The species is a perennial, creeping vine that occurs in dry to extremely dry, nutrient-poor, well-drained, coarse sandy soils. Tree cover, ground cover, and litter accumulation are generally sparse (Patrick et al., 1995). It generally forms large mats or clumps in dry, barren, deep sand areas such as the edge of Carolina bays

[10] The North Carolina status definitions are provided at the end of Section 3.8.6.2.

and relic riverine dunes (CPC, 2008b; Weakley, 2008). Preferred locations include frequently burned or clear-cut areas with little or no competing vegetation (CPC, 2008b). Threats to the Pickering's morning-glory include habitat loss and modification and disruption of natural fire regimes. There is a 1958 occurrence record for the Pickering's morning-glory within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009e). The Operations Area in the northwestern portion of the Wilmington Site contains deep sands that are periodically disturbed and may provide suitable habitat for the Pickering's morning-glory (GLE, 2008).

<u>Pondspice (*Litsea aestivalis*)</u>

Pondspice is a Federal species of concern and is considered "significantly rare–throughout" by the State. It is a deciduous shrub that inhabits the margins of swamps; cypress ponds; low wet woodlands; and sandhill depressions on wet, sandy or peaty, acidic soils. It may form thickets and be locally abundant. Pondspice is threatened by hydrological alterations (e.g., ditching and draining of wetland habitat and lowering of the water table) and suppression of natural fire regimes. It may be potentially threatened by red bay (or laurel wilt) disease, an emerging fungal disease for which the pondspice is a documented host. There is a 1977 occurrence record for the pondspice within 3.2 kilometers (2 miles) of the proposed GLE Facility area around the perimeter of an ephemeral pond within the north-central portion of the Wilmington Site (GLE, 2008; NCDENR, 2009e). However, hydrological conditions of this pond have been altered and do not appear to support recruitment of the species. During field surveys for the Environmental Report, the existing plants appeared stressed (GLE, 2008). The location of the proposed GLE Facility is more than 150 meters (500 feet) southeast of the ephemeral pond (GLE, 2008).

<u>Raven's seedbox (*Ludwigia ravenii*)</u>

Raven's seedbox, a perennial herb, is a Federal species of concern and is considered "significantly rare–throughout" by the State. It is an obligate wetland species that inhabits open, wet, peaty areas such as ditches and the margins of swamps, ponds, and bogs. Threats to the Raven's seedbox include excavation and deepening of ditches, road widening and paving, and herbicide use. The Raven's seedbox does not have any occurrence record within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

<u>Roughleaf loosestrife (*Lysimachia asperulaefolia*)</u>

The roughleaf loosestrife, an erect perennial herb, is both Federally and State-listed as endangered. It occurs in grass-shrub ecotones (transition areas between two habitats that can contain characteristic species from both) adjacent to longleaf pine/scrub oak, pine savanna, flatwoods, and pond pine pocosins (evergreen shrub bogs). It prefers full sunlight and is shade intolerant (CPC, 2008c; NCDENR, 2001). It grows on moist, seasonally saturated sands or shallow organic soils overlying sands. The roughleaf loosestrife has been found in roadside depressions, firebreaks, seeps, and power rights-of-way (ROWs) (NCDENR, 2001). The roughleaf loosestrife flowers from mid-May through June, with fruits present from July through October. Habitats within which the species occur are fire-maintained. Threats to the roughleaf loosestrife include drainage and development of habitat, land conversion, and suppression of natural fire regimes (CPC, 2008c). Suppression of naturally occurring fires within ecotones allows shrubs to increase in density and height, which eliminates the open edges required by

the species (FWS, 2009a). No occurrences for the roughleaf loosestrife have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e). Some areas of pocosin habitats that support the species have been drained from the Wilmington Site. Also, fire regimes necessary for maintaining the species habitat do not occur on the site (GLE, 2008).

Sandhills milkvetch (*Astragalus michauxii*)

The sandhills milkvetch, an erect perennial herb, is a Federal species of concern and is State-listed as threatened. It inhabits longleaf pine/scrub oak woodlands. It grows best in disturbed or fire-prone open understory areas (e.g., xeric to dry-mesic, nutrient poor soils, thickets, field edges, and road banks). Threats to the sandhills milkvetch include suppression of natural fire regimes, land conversion, and habitat fragmentation. There is a 1946 occurrence record for the sandhills milkvetch southwest of the Wilmington Site near the intersection of US 421 and I-140, which is within 3.2 kilometers (2 miles) of the proposed GLE Facility site (NCDENR, 2009e; GLE, 2008). The longleaf pine/scrub forest in the northwestern portion of the Wilmington Site and the pine plantation in the north-central portion of the site could provide suitable habitat for the species.

Small-leaf meadowrue (*Thalictrum macrostylum*)

The small-leaf meadowrue, an erect herb, is a Federal species of concern and is considered "significantly rare–limited" by the State. Habitat for the species includes swampy woodlands, slopes, and limestone cliffs. Threats to the small-leaf meadowrue include land use alteration, habitat fragmentation, silviculture practices, and changes in hydrology. No occurrences of the small-leaf meadowrue have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Spring-flowering goldenrod (*Solidago verna*)

The spring-flowering goldenrod, an erect perennial herb, is a Federal species of concern and is State listed as threatened. It inhabits a wide variety of habitats such as pine savannas, pocosins, pine barrens, open woods, fields, dry bogs, and disturbed roadsides (CPC, 2008d). Threats to the spring-flowering goldenrod include alteration and destruction of habitat for development, pine plantations, and agriculture. No occurrences of the spring-flowering goldenrod have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCNENR, 2009). Pocosin/bay and pine forests potentially provide limited habitat for the spring-flowering goldenrod on the Wilmington Site (GLE, 2008).

Venus' flytrap (*Dionaea muscipula*)

The Venus' flytrap, an insectivorous herb, is a Federal species of concern and is considered "significantly rare–limited" by the State. It inhabits bogs and perennially wet areas, often located between longleaf pine savannas and pocosins (shrub bogs) on the coastal plains of the Carolinas (Floridata, 2003). Threats to the Venus' flytrap include habitat conversion and suppression of natural fire regimes. Some collecting from natural populations can also affect the species. Two occurrences of the Venus' flytrap have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site, one of which is also within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009e). Suitable habitat for the Venus' flytrap occurs

within the western portion of the Wilmington Site, where pine forest and pocosin habitats are adjacent to each other.

Invertebrates

Cape Fear threetooth (*Triodopsis soelneri*)

The Cape Fear threetooth is a Federal species of concern and is listed as threatened by the State. It is a terrestrial snail that occurs on logs and under litter in swamps and under trash in pine woods (Hubricht, 1985). The main threat to the species is presumed to be habitat loss. No occurrences of the Cape Fear threetooth have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Eastern arogos skipper (*Atrytone arogos arogos*)

The eastern arogos skipper is a Federal species of concern, and the butterfly is considered "significantly rare" by the State. It inhabits native grasslands and savannas. Individuals are capable of dispersing several miles. The known North Carolina site for the species contains habitats that are mesic to boggy, sometimes ecotonal, pinebarrens reedgrass (*Calamovilfa brevipilis*) savanna. The pinebarrens reedgrass is a foodplant for eastern arogos skipper larvae. Adults obtain nectar from a variety of flowers. Threats to the eastern arogos skipper include habitat loss and fragmentation and fire (including prescribed burns). No occurrences of the eastern arogos skipper have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Greenfield ramshorn snail (*Helisoma eucosmium*)

The Greenfield ramshorn snail is a Federal species of concern and is listed as endangered by the State. Within New Hanover County, this freshwater snail is only known from Greenfield Lake in Wilmington. It is also known from Town Creek in Brunswick County and from the Wisconsin River in the northeastern portion of the State. Specimens from Town Creek inhabited densely vegetated areas in water less than 3 meters (10 feet) deep. Threats to the species include habitat degradation and, possibly, invasive plant species. No occurrences of the Greenfield ramshorn snail have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Rare skipper (*Problema bulenta*)

The rare skipper is a Federal species of concern and the butterfly is considered "significantly rare" by the State. Although nonmigratory, the rare skipper is a strong flier that can fly over forests or fly up to 0.5 kilometer (0.3 mile) to find nectar. They inhabit marshes along tidal rivers. Adults are usually viewed while feeding on the nectar of roadside flowers. Threats to the rare skipper include habitat loss and, probably, biocides used to control mosquitoes. No occurrences of the rare skipper have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Fishes

American eel (*Anguilla rostrata*)

The American eel is a Federal species of concern but has no State listing status. It spawns in the Sargasso Sea and matures in fresh or brackish waters (estuaries, rivers, streams, ponds, and lakes), spending 4 to 10 years in these habitats until they return to sea to spawn (FWS, 2009b). Upstream migration can occur from March through October, while downstream migration begins in summer or fall. Threats to the American eel include barriers to migration, habitat loss and alteration, turbine mortalities, overfishing, and pollution. No occurrences of the American eel have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENRP, 2009e). However, the American eel is expected to occur in the Northeast Cape Fear River near the Wilmington Site (NCDENR, 2008c). The river's tributaries on the site could also provide suitable habitat for the American eel.

Shortnose sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is both Federally and State-listed as endangered. Federal protection of the species is under the jurisdiction of the NMFS. The shortnose sturgeon inhabits the lower reaches of large rivers and Atlantic coastal waters. It primarily occurs in brackish and salt waters of lower coastal river reaches and river estuaries. Shortnose sturgeon seldom venture into the Atlantic Ocean (Ozier et al., 1999). The shortnose sturgeon ascends into the freshwaters of larger coastal rivers to spawn. Spawning occurs from April through June in swift waters over gravel or coarse substrates such as submerged logs (NCDENR, 2001; Ozier et al., 1999). Juveniles may remain in rivers for up to 5 years before migrating to estuarine waters (NCDENR, 2001). Larvae and juveniles may prefer deep river channels. The shortnose sturgeon feeds upon invertebrates and aquatic plants (FWS, 2003a). It is very rare in the Cape Fear River drainage. The absence of juvenile shortnose sturgeon within the Cape Fear River drainage indicates that the species may not be spawning because of blockage of upstream migration by adults at Lock and Dam 1 at River Mile 60 (river kilometer 96). In other river systems, spawning takes place 100 to 300 kilometers (62 to 186 miles) upstream of the mouth of the river (Moser and Ross, 1995). Threats to the shortnose sturgeon include habitat alteration, barriers to upstream movement, pollution, and overfishing (including poaching) (NCDENR, 2001). They are also susceptible to gill nets set for striped bass and American shad (Moser and Ross, 1995). There is a 1993 occurrence record for the shortnose sturgeon within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e). It may occur in the Northeast Cape Fear River and the lower portions of its unnamed tributaries that occur on the Wilmington Site. It does not ascend into smaller tributaries such as the Prince George Creek (NOAA, 2002).

Amphibians

Carolina gopher frog (*Rana capito capito*)

The Carolina gopher frog is a Federal species of concern and is listed as threatened by the State. Adults inhabit primarily xeric uplands, especially longleaf pine-turkey oak sandhill associations. They also occur in xeric to mesic longleaf pine flatwoods, sand pine scrub, and xeric oak hammocks. Burrows of gopher tortoises (*Gopherus polyphemus*) and rodents are used for shelter. They will also hide in sewers, under logs, and in or under stumps. Breeding

habitat includes ephemeral to semipermanent graminoid (grass or grass-like) dominated wetlands that lack large predatory fishes. Breeding generally occurs between mid-January and April. The larval period lasts about four months; individual adults spend less than four weeks in breeding ponds. Threats to Carolina gopher frogs include habitat loss and degradation caused by logging and fire suppression, introduction of predatory fishes into breeding ponds, and declines in gopher tortoises. No occurrences of the Carolina gopher frog have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Reptiles

American alligator (*Alligator mississippiensis*)

The American alligator is Federally listed as threatened because its appearance is similar to the American crocodile (*Crocodylus acutus*); it is State listed as threatened. From a Federal perspective, the American alligator is not biologically threatened and does not have protection under the ESA (FWS, 2009a). It inhabits slow-moving coastal rivers, canals, lakes, impoundments, marshes, cypress ponds, and estuaries. Its tolerance to salinity increases with age (NCDENR, 2001). The minimum home range averages 1255 hectares (3100 acres) for males and 8 hectares (21 acres) for females (NCDENR, 2001). Past threats to the American alligator included overharvest and habitat loss (FWS, 2008c). Current threats include loss and degradation of habitat due to recreational use and development. The American alligator has been recorded from various localities near the Wilmington Site, including the Prince George Creek at its confluence with its Unnamed Tributary #1; the Northeast Cape Fear River at its confluence with Prince George Creek upstream of the Wilmington Site in Turkey Creek, Morgan Creek, and Long Creek; and south of the Wilmington Site in Ness Creek (GLE, 2008). Occurrences of the American alligator have been reported within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009e). At the Wilmington Site, potential breeding habitat occurs along the Northeast Cape Fear River and its tributaries, and small alligators may occur within the streams and swamp forest habitats of the site.

Mimic glass lizard (*Ophisaurus mimicus*)

The mimic glass lizard, a legless lizard, is a Federal and a State species of concern. It inhabits longleaf pine savannas and conifer and mixed woodlands where it burrows in the soil or inhabits fallen logs and woody debris. Threats to the mimic glass lizard include habitat loss, conversion of preferred habitat to pine plantations, and road mortality. No occurrences of the mimic glass lizard have been reported within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Northern pinesnake (*Pituophis melanoleucus melanoleucus*)

The northern pinesnake is a Federal and a State species of concern. It inhabits xeric pine forest uplands. Threats to the northern pinesnake include logging, habitat modification and fragmentation, and direct mortality by humans (e.g., deliberate killing and road mortality). A pre-1927 occurrence record exists for the northern pine snake within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009e).

Southern hog-nosed snake (*Heterodon simus*)

The southern hog-nosed snake is a Federal and a State species of concern. It inhabits mature pine forests and sandhill habitats (Jordan, 1998) and spends most of its time buried in soil. It primarily eats toads, but also preys on frogs, lizards, and small mammals. Habitat loss is the primary threat to the southern hog-nosed snake (Jordan, 1998). Sightings of the southern hog-nosed snake have been made southwest of the Wilmington Site between the Northeast Cape Fear River and the Cape Fear River (GLE, 2008). No occurrences of the southern hog-nosed snake have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e). Within the Wilmington Site, the snake could occur within the pine forests, longleaf pine/scrub forests, hardwood forests, and fields. The xeric, sandy soils in the northwestern portion of the site may also be suitable habitat.

Birds

Eastern painted bunting (*Passerina ciris ciris*)

The eastern painted bunting is a Federal species of concern and is considered "significantly rare" by the State. Habitat includes partly opened areas with scattered trees and brush, riparian thickets and brush, weedy and shrubby areas, woodland edges, yards, and gardens. Salt marsh/forest edges are preferred over interior forests. Eggs are laid in March through July (mostly May through June) in bushes or vine tangles at heights of 1 to 2 meters (3 to 6 feet) or at greater heights in thick Spanish moss (*Tillandsia usneoides*) in trees. It winters in Mexico. The major threat to the eastern painted bunting is loss of breeding habitat. No occurrences of the eastern painted bunting have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e).

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker is both Federally and State-listed as endangered. No critical habitat has been designated for the species (FWS, 2008b). Coastal Plain longleaf pine forests maintained by frequent fires probably supported the highest population levels (Ozier et al., 1999). It requires open stands of mature pine (more than 60 years old) for nesting and roosting habitat. Nesting and roosting occur in cavities of live trees that range in age from 63 to more than 300 years old for longleaf pine, or 62 to more than 200 years old for loblolly and other pines. An aggregate (cluster) of 1 to 20 cavity trees is used on an area of 1 to 24 hectares (3 to 60 acres) (FWS, 2003b; NatureServe, 2009). The red-cockaded woodpecker generally chooses trees that are infected with red heart disease, which is caused by a fungus (*Phellinus pini*) that attacks the heartwood (the older, nonliving central wood of a tree), thereby making it softer and pithy, which aids in the bird being able to excavate the cavity. Suitable habitat surrounding a cluster of cavity trees contains open, park-like conditions. Often, the breeding pair and up to nine "helpers" (usually four or less) form a family unit called a group. The helpers assist in incubating the eggs, feeding nestlings and fledglings, and defending territories. Each member of a group usually has an exclusive roost cavity. Egg-laying generally occurs between April and early May. A group may not nest every year. Incubation lasts 10 to 12 days, and nestlings remain in the nest for nearly a month.

The diet of red-cockaded woodpeckers primarily consists of invertebrates found on and within pine bark (Ozier et al., 1999). Stands of pine or mixed pines and hardwoods that are more than 30 years old are used for foraging. A group requires at least 32 to 51 hectares (80 to 125 acres) of foraging habitat. The territory for a group averages about 81 hectares (200 acres) but can range from 24 to 243 hectares (60 to more than 600 acres) (FWS, 2003b). Most suitable nesting habitat in the southeastern United States occurs on public lands. Threats to the red-cockaded woodpecker include habitat loss and fragmentation, short-term timber rotation (e.g., <45 years), fire suppression (and subsequent encroachment of hardwood midstory trees that reach the heights of the cavity entrance), and competition for cavity space. When foraging habitat is cleared, groups may have difficulty raising young. Juveniles dispersing from isolated clusters of cavity trees seldom encounter suitable habitat, and much less other individuals. Once a breeding female dies, it is highly unlikely that a replacement will immigrate to the group (Ozier et al., 1999).

An active red-cockaded woodpecker group occurs within 8 kilometers (5 miles) northeast of the Wilmington Site. It is located just north of the Northeast Cape Fear River along NC 117 in Pender County (GLE, 2008). Several occurrences of the red-cockaded woodpecker have been recorded within 3.2 kilometers (2 miles) of the western border of the Wilmington Site (NCDENR, 2009e). No cavity trees were observed on the Wilmington Site during field surveys conducted in support of the Environmental Report (GLE, 2008). The forested habitats on the Wilmington Site meet the minimum area requirements needed for foraging habitat. However, the lack of mature forests would limit the value of the Wilmington Site as foraging habitat. Only the longleaf pine/scrub plant community located in the northwest corner of the Wilmington Site is estimated to be over 40 years of age (Figures 3-12 and 3-13). Thinning of forested areas has increased habitat potentially suitable for the red-cockaded woodpecker on the Wilmington Site (GLE, 2009c). The Sledge Forest, a property containing more than 1619 hectares (4000 acres) of high-quality forest directly adjacent to and north of the Wilmington Site, does contain loblolly and longleaf pine trees that are more than 300 years old. This area would be suitable as nesting and roosting habitat for the red-cockaded woodpecker. It is possible that woodpeckers that forage in the Sledge Forest could occasionally forage within the western forested portion of the Wilmington Site.

Mammals

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)

The Rafinesque's big-eared bat is a Federal and a State species of concern. The species occurs in forested areas. Summer roosts include hollow trees, loose bark, or abandoned buildings in or near wooded areas. Bridges are also used as day roosts and as maternity roosts. Foraging habitat is primarily among the canopies of mature upland and lowland forests (Ozier et al., 1999). While most bats become active before dark, the Rafinesque's big-eared bat does not emerge from its roost until it is completely dark (Ozier et al., 1999). In the Coastal Plain, they are assumed to use hollow trees during cold weather and possibly as winter roosts. It roosts singly, in small clusters, or in groups of more than 100 individuals. During the nursing season, males are generally solitary. The species is considered nonmigratory, having only short-distance movements between summer and winter roosting sites. Threats to the species include habitat loss (e.g., forest destruction, removal of hollow trees, removal of abandoned buildings, and vandalism or destruction of mines and caves), insecticide applications, and

disturbance at roost sites. There is a pre-2006 occurrence record for the Rafinesque's big-eared bat within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009e).

Southeastern myotis (*Myotis austroriparius*)

The southeastern myotis bat is a Federal and a State species of concern. It nests in caves, buildings, and snags and hollow trees of pine and hardwood forests; and it primarily forages in riparian areas, but also in various upland habitats. Threats to the southeastern myotis include human disturbance and physical alteration of caves used for hibernacula and maternity sites. Clearing and draining of bottomland hardwood forest wetlands also have reduced summer roosting and foraging habitat. There is a 1986 occurrence record for the southeastern myotis within 3.2 kilometers (2 miles) of the proposed GLE Facility area from floodplains north of the Wilmington Site near the confluence of the Northeast Cape Fear River and Prince George Creek (NCDENR, 2009e; GLE, 2008). The riparian habitats and pine and hardwood forests on the Wilmington Site provide suitable foraging and breeding habitat for the southeastern myotis. It may also forage in the Operations Area and transmission line ROWs.

West Indian manatee (*Trichechus manatus*)

The West Indian manatee is both Federally and State-listed as endangered. It inhabits shallow coastal bays, lagoons, estuaries, and rivers. The manatee usually inhabits waters with a depth of 1 to 6 meters (3.3 to 20 feet) (FWS, 2009a; NatureServe, 2009). Much of their time is spent submerged or partly submerged. Manatees feed on aquatic vegetation. It is a seasonal inhabitant of North Carolina, being present mainly from June through October. They migrate south (e.g., to Florida) when water temperatures fall below about 21° Celsius (70° Fahrenheit). Manatees often return to the same winter and summer habitats every year (Ozier et al., 1999). Threats to the West Indian manatee include collisions with boats, habitat loss and degradation, entrapment and/or crushing in water control structures, entanglement in fishing gear, hunting and fishing, red tide poisoning, and exposure to cold temperatures. No occurrences of the West Indian manatee have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009e). However, the Northeast Cape Fear River and some of its tributaries in the area of the Wilmington Site may provide suitable habitat for the manatee (FWS, 2009a).

3.8.6.2 State-Listed Species

In addition to the Federally threatened or endangered species and Federal species of concern identified in Table 3-14, there are additional State-rare species that are known to occur within New Hanover County (Buchanan and Finnegan, 2008; LeGrand et al., 2008). These are identified in Table 3-15.[11] Some of these species may occur on or near the Wilmington Site. Continued declines in some of these species could be expected in the future, which may lead to their becoming upgraded to State threatened or endangered or possibly as Federally listed species.

[11] County distributions for "watch list" animal species were not provided by LeGrand et al., 2008; therefore, these species are not included in Table 3-15. The State status of the Federally threatened or endangered species and Federal species of concern is provided in Table 3-15. These species are also discussed in Section 3.8.6.1.

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a]

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Lichens				
Cladonia evansii	Powder-puff lichen	W	Sandhills (primarily near the coast), usually associated with sand live oak.	No/No
Liverworts				
Cephalozia connivens var. *bifida*	A liverwort	SR-T*	Moist riverbanks.	Yes[†]/No
Metzgeria uncigera	A liverwort	W*	On bark in maritime forests or on rhododendron in mountain forests.	No/No
Mosses				
Fissidens elegans	A plume moss	W*	Sandy and clayey soils along roadsides and streams, on trees or stumps.	Yes/Yes
Weissia muehlenbergiana	A moss	W*	Soil among grasses, roadsides.	Yes/Yes
Vascular Plants				
Adiatium capillus-veneris	Venus hair fern	E	Coquina limestone (marl) outcrops, adventitious on mortar of old stone walls.	No/No
Agalinis aphylla	Scale-leaf gerardia	W*	Wet savannas and sandhills streambed pocosin ecotones.	No/No
Agalinis linifolia	Flaxleaf gerardia	W	Savannas, clay-based carolina bays, depression ponds, and other open habitats.	No/No
Agalinis virgata	Branched gerardia	SR-P	Savannas and depression pond shores.	No/No
Anthaenantia rufa	Purple silkyscale	W*	Savannas.	No/No
Aristida condensata	Big three-awn grass	SR-P	Bay rims with xeric pine-oak scrub.	Yes[†]/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Asclepias pedicellata	Savanna milkweed	SR-P	Dry savannas and moist flatwoods.	Yes[†]/No
Baccharis angustifolia	Saltwater false-willow	W	Brackish marshes, sandhill seeps, and other open wet areas.	No/No
Bacopa caroliniana	Blue water-hyssop	SR-P*	Shallow ponds, marshes, natural lakes, and tidal creeks.	No/No
Bacopa innominata	Tropical water-hyssop	SR-P*	Tidal freshwater marshes.	No/No
Bartonia paniculata ssp. *paniculata*	Twining screwstem	W	Wet savannas, sandhill seeps, and other open wet areas.	No/No
Boltonia asteroides	White doll's-daisy	SR-O	Clay-based Carolina bays, marshes, and savannas.	Yes[†]/No
Burmannia biflora	Northern bluethreads	W	Limesinks, cypress savannas, and sandhill seeps.	No/No
Calamovifa brevipilis	Pinebarren sandreed	W	Savannas and sandhill seeps.	No/No
Cardamine longi	Long's bittercress	SR-T	Tidal marshes and tidal cypress-gum forests.	Yes/No
Carex chapmanii	Chapman's sedge	W*	Moist bottomlands and slopes, perhaps associated with marl.	No/No
Carex mitchelliana	Mitchell's sedge	W	Swampy woodlands and forests.	Yes/No
Carex decomposita	Cypress knee sedge	SR-T*	Beaver ponds and old millponds.	No/No
Carex vericosa	Warty sedge	SR-P*	Savannas and pinelands.	Yes/Yes
Cirsium lecontei	Le Conte's thistle	SR-P*	Savannas.	No/No
Cladium mariscoides	Twig-rush	SR-O	Bogs, fens, brackish marshes, and sandhill seepage bogs.	No/No
Chrysopogon pauciflorus	Goldenbeard	W*	Sandhills.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Chrysopsis trichophylla	Naked golden-aster	W	Xeric sandhills and sandhill scrub.	No/No
Cleistes bifaria	Small spreading pogonia	W	Savannas, dry meadows.	No/No
Coelorachis rugosa	Wrinkled jointgrass	W	Limesink ponds, clay-based Carolina bays, and wet savannas.	No/No
Corallorhiza odontorhiza	Autumn coral-root	W*	Harwood forests.	No/No
Corallorhiza visteriana	Spring coral-root	SR-O	Nutrient-rich forests, especially over limestone, mafic rocks, or shell-rich sands.	No/No
Crinum americanum	Swamp-lily	SR-P*	Tidal swamp forests and tidal marshes.	Yes/No
Crocanthemum carolinianum	Carolina sunrose	SR-P	Sandhills, pinelands, and dry savannas.	Yes[†]/No
Crocanthemum georgianum	Georgia sunrose	SR-P	Maritime forests.	No/No
Crocanthemum nashii	Florida scrub frostweed	E	Coastal fringe sandhill.	No/No
Cyperus distans	A flatsedge	W*	Marshes.	No/No
Cyperus lecontei	Leconte's flatsedge	SR-P*	Limesink ponds.	No/No
Cyperus tetragonus	Four-angled flatsedge	SR-P+	Maritime forests and barrier island grasslands.	No/No
Dicanthelium aciculare spp. *neuranthum*	Nerved witch grass	SR-D	Maritime wet grasslands.	No/No
Dicanthelium sp. 9	A witch grass	SR-L*	Wet streamhead pocosin openings, including utility clearings.	Yes/No
Dichanthelium erectifolium	Erectleaf witch grass	W	Pond shores.	Yes/No
Dryopteris ludoviciana	Southern woodfern	W*	Acid swamps.	Yes/No
Eleocharis equisetoides	Horsetail spikerush	W*	Limesink ponds.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Eleocharis melanocarpa	Blackfruit spikerush	W	Clay-based Carolina ponds.	No/No
Eleocharis robbinsii	Robbins' spikerush	SR-P	Limesink ponds, clay-based Carolina bays, peat-burn lakes, millponds, beaver ponds, and artificial lakes.	Yes[†]/No
Eleocharis tricostata	Three-angle spikerush	W	Bogs and savannas.	No/No
Epidendrum magnoliae	Green fly orchid	SR-P	Epiphytic on trees in blackwater river swamps.	Yes[†]/No
Erythrina herbacea	Coralbean	SR-P	Maritime forests.	No/No
Eupatorium leptophyllum	Limesink dog-fennel	SR-P	Limesink ponds and clay-based Carolina bays.	No/No
Gaylussacia nana	Confederate huckleberry	E	Coastal fringe sandhill.	No/No
Gelsemium rankinii	Swamp jessamine	SR-P	Floodplains of blackwater rivers and streams.	Yes/No
Habenaria repens	Water-spider orchid	W*	Stagnant blackwater pools and impoundments.	No/No
Helenium pinnatifidum	Dissected sneezeweed	SR-P*	Savannas and open, wet, and mucky sites.	No/No
Hibiscus aculeatus	Comfortroot	SR-P	Bay forests, sand ridges, and roadsides.	Yes/No
Hypericum fasciculatum	Peelbark St. John's-wort	SR-L*	Beaver ponds, low pinelands, and pools.	Yes/No
Ilex cassine var. *cassine*	Dahoon	W	Blackwater swamps and pocosins.	Yes/Yes
Iresine rhizomatosa	Rootstock bloodleaf	W	Low, wet places, interdune swales, damp woods, edges of brackish marshes.	Yes/No
Lachnocaulon minus	Brown bogbutton	SR-P	Depression ponds and ditches.	Yes/No
Liatris secunda	Sandhill blazing-star	W	Sandhills.	No/No
Lilaeopsis carolinensis	Carolina grasswort	T	Freshwater marshes, pools, and tidal marshes.	No/No
Lophiola aurea	Golden-crest	E	Very wet, mucky habitats in pine savannas.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Ludwigia alata	Winged seedbox	SR-P*	Interdune ponds and marshes.	No/No
Ludwigia lanceolata	Lanceleaf seedbox	SR-P	Interdune ponds and open wet areas.	No/No
Ludwigia linifolia	Flaxleaf seedbox	SR-P	Limestone ponds.	No/No
Ludwigia sphaerocarpa	Globe-fruit seedbox	SR-P	Bogs, pools, and lake shores.	No/No
Ludwigia suffruticosa	Shrubby seedbox	SR-P	Limesink ponds and clay-based Carolina bays.	No/No
Magnolia grandiflora	Southern magnolia	W*	Mainland forests with maritime influence.	Yes/No
Nuphar sagittifolia	Narrowleaf cowlily	W	Blackwater streams, rivers, and lakes.	Yes/No
Oenothera riparia	Riverbank evening-primrose	SR-L	Tidal marshes.	Yes†/No
Panicum tenerum	Southeastern panic grass	W	Wet savannas, sandhill seeps, and limesink ponds.	No/No
Parietaria floridana	Florida pellitory	W*	Shell middens, disturbed sites, and maritime forests.	No/No
Paspalum praecox	Early crown grass	W	Limesink ponds and savannas.	No/No
Parietaria praetermissa	Large-seed pellitory	SR-P*	Shell middens, disturbed sites, and maritime forests.	No/No
Peltandra sagittifolia	Spoonflower	SR-P	Pocosins and other wet, peaty sites.	Yes†/Yes
Persea borbonia	Red bay	W	Sandy upland soils in maritime forests.	Yes/No
Physalis lanceolata	Sandhill ground cherry	W*	Sandhills.	No/No
Phytolacca rigida	Maritime pokeweed	W	Dunes, edges of brackish or salt marshes.	No/No
Platanthera nivea	Snowy orchid	E	Wet savannas.	Yes†/No
Polygala hookeri	Hooker's milkwort	SR-D	Savannas.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Polygonum glaucum	Seabeach knotwood	SR-T*	Ocean and sound beaches.	No/No
Ptelea trifoliata	Wafer-ash	W*	Rich woods, cliffs, and rock exposures mainly over mafic or calcareous rocks.	No/No
Ptilimnium costatum	Ribbed bishop-weed	SR-P	Tidal swamps or marshes.	Yes/No
Rhexia cubensis	West Indies meadow-beauty	W	Limesink ponds.	No/No
Rhynchospora careyana	Carey's beaksedge	W	Limesink ponds, and clay-based Carolina bays.	No/No
Rhynchospora inundata	Narrowfruit beaksedge	W	Limesink ponds, and clay-based Carolina bays.	No/No
Rhynchospora pallida	Pale beaksedge	W	Savannas, sandhill seeps, and pocosins.	Yes/No
Rhynchospora scirpoides	Long-beak baldsedge	W	Beaver ponds, limesink ponds, and wet savannas.	No/No
Rhynchospora tracyi	Tracy's beaksedge	SR-P	Clay-based carolina bays, and limesink ponds.	Yes[†]/No
Sabatia dodecandra	Large marsh pink	W*	Tidal, brackish, and freshwater marshes.	No/No
Sagittaria isoetiformis	Quillwort arrowhead	SR-P	Limesink ponds, clay-based Carolina bays, beaver ponds, and natural lakes.	No/No
Salvia azurea	Azure sage	SR-P*	Sandhills.	No/No
Schizachyrium littorale	Seaside little bluestem	W	Coastal dunes and maritime dry grasslands.	No/No
Schoenoplectus americanus	Olney threesquare	W	Tidal marshes.	No/No
Schoenoplectus californicus	California bulrush	W*	Tidal marshes.	No/No
Scleria georgiana	Georgia nutrush	W	Savannas.	No/No
Scleria reticularis	Netted nutrush	SR-O	Clay-based carolina bays and limesink ponds.	No/No
Sesuvium portulacastrum	Shoreline sea-purslane	SR-P	Ocean beaches.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Sideroxylon lycioides	Buckthorn bumelia	W	Maritime forests, bluffs, or forests over calcareous or mafic rocks.	No/No
Solidago tortifolia	Twisted-leaf goldenrod	SR-P*	Dry savannas and mesic flats.	Yes/No
Spiranthes laciniata	Lace-lip ladies'-tresses	SR-P	Moist wet habitats.	Yes[†]/No
Symphyotrichum elliottii	Elliot's aster	W*	Freshwater or brackish marshes.	No/No
Syngonanthus flavidulus	Yellow hatpins	W*	Ditches, pocosin ecotones, and savannas.	Yes/No
Trifolium carolinianum	Carolina clover	SR-O*	Savannas and sandy open areas.	No/No
Typha domingensis	Southern cattail	W*	Brackish marshes.	No/No
Utricularia cornuta	Horned bladderwort	SR-P*	Bogs and limestone ponds.	No/No
Utricularia olicacea	Dwarf bladderwort	T	Limesink ponds and beaver ponds.	No/No
Verbena scabra	Sandpaper vervain	W*	Marsh edges and shell middens.	No/No
Vigna luteola	Wild cowpea	W*	Marsh edges and wet open areas.	No/No
Viola villosa	Carolina violet	W*	Moist places, especially pocosin edges.	Yes/No
Xyris smalliana	Small's yellow-eyed-grass	W	Pineland pools, limesink ponds, and shores.	No/No
Yucca aloifolia	Aloe yucca	W	Dunes.	No/No
Yucca gloriosa	Moundlily yucca	SR-P	Dunes.	No/No
Zizania aquatica	Wild rice	W	Freshwater marshes.	No/No
Invertebrates				
Amblyscirtes alternata	Dusky roadside-skipper	SR+	Open pine woods and savannas.	Yes/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Anodonta couperiana	Barrel floater	E*	Ponds or slow-flowing streams in soft substrates.	Yes/No
Calephelis virginiensis	Little metalmark	SR	Savannas and pine flatwoods.	Yes/No
Catocala amestris	Three-staff underwing	SR	Sand ridges and flatwoods with leadplant.	Yes/No
Catocala jair	Jair underwing	SR	Xeric pine-oak sandhills.	No/No
Catocala marmorata	Marbled underwing	SR	Swamp forests with swamp cottonwood.	Yes/No
Catocala messalina	Messalina underwing	SR	Maritime forests and mesic sandhills.	No/No
Cerma cora	A bird-dropping moth	SR	Levee forests with hawthorn.	No/No
Chaetaglaea fergusoni	A noctuid moth	SR	Sandhills.	No/No
Cyclophora sp. 1 (*culicaria*)	Sand-myrtle geometer	SR	Flatwoods with sand-myrtle.	Yes/No
Datana ranaeceps	A hand-maid moth	SR	Recently burned flatwoods and sandhills.	Yes/No
Doryodes sp. 1	A noctuid moth	SR	Savannas, flatwoods, and sandhills.	Yes/No
Drasteria graphica	Graphic moth	SR	Maritime shrub thickets.	No/No
Elliptio marsupiobesa	Cape Fear spike	SC	Low-gradient creeks in variable substrates.	Yes/No
Eupithecia peckorum	An inchworm moth	SR	Sandhills and flatwoods.	Yes/No
Heterocampa varia	A prominent moth	SR	Xeric pine-oak sandhills.	No/No
Lithophane laceyi	A pinion moth	SR	Swamp forests.	Yes/No
Lynceus gracilicornis	Graceful clam shrimp	SC	Temporary ponds, pools, and ditches.	Yes/No
Metarranthis sp. 1	An new inchworm moth	SR	Pocosins.	Yes/Yes
Papilio cresphontes	Giant swallowtail	SR	Primarily coastal in maritime forests or thickets.	No/No
Procambarus plumimanus	Croatan crayfish	SR	Rivers, ponds, ditches, and borrow pits.	Yes/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Ptichodis bistrigata	Southern ptichodis	SR	Xeric sandhills.	No/No
Satyrium favonius favonius	Southern oak hairstreak	SR	Maritime forests along the southern coast.	No/No
Schizura apicalis	Plain schizura	SR	Dry woodlands or scrub.	Yes/Yes
Trichosilia manifesta	An owlet moth	SR	Xeric oak woodlands.	No/No
Zale declarans	An owlet moth	SR	Maritime forests with live oak.	No/No
Fishes				
Fundulus luciae	Spotfin killifish	SR	Ponds and pools along the coast.	Yes†/No
Heterandria formosa	Least killifish	SC	Streams and lakes near Wilmington.	No/No
Amphibians				
Ambystoma mabeei	Mabee's salamander	SR*	Savannas, wet woods, and swamps.	Yes†/No
Pseudacris ornata	Ornate chorus frog	SR*	Swamps, savannas, and wooded ponds and pools.	Yes/No
Reptiles				
Crotalus adamanteus	Eastern diamondback rattlesnake	E	Pine flatwoods, savannas, and pine-oak sandhills.	Yes/Yes
Deirochelys reticularia	Chicken turtle	SR	Quiet waters of ponds, ditches, and sluggish streams.	Yes/No
Malaclemys terrapin centrata	Carolina diamondback terrapin	SC	Salt or brackish marshes, estuaries.	No/No
Masticophis flagellum	Coachwhip	SR	Dry and sandy woods, mainly in pine/oak sandhills.	Yes†/Yes
Micrurus fulvius	Eastern coral snake	E	Pine-oak sandhills, sandy flatwoods, and maritime forests.	Yes/Yes

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Regina rigida	Glossy crayfish snake	SR*	Marshes, cypress ponds, and other wetlands.	No/No
Seminatrix pygaea	Black swamp snake	SR	Lush vegetation of ponds, ditches, or sluggish streams.	Yes/No
Sistrurus miliarius	Pigmy rattlesnake	SC	Pine flatwoods, pine/oak sandhills, other pine/oak forests.	Yes/Yes
Birds				
Charadrius wilsonia	Wilson's plover	SC	Beaches, island-end flats, and estuarine islands.	No/No
Columbina passerina	Common ground-dove	SR	Dunes, sandy fields, and margins of marine woods and thickets.	No/No
Egretta aerulea	Little blue heron	SC	Forests or thickets on maritime islands.	No/No
Egretta tricolor	Tricolored heron	SC	Forests or thickets on maritime islands.	No/No
Haematopus palliatus	American oystercatcher	SC	Estuaries, oyster beds, and mudflats.	No/No
Ixobrychus exilis	Least bittern	SC	Fresh or brackish marshes.	No/No
Lanius ludovicianus	Loggerhead shrike	SC	Fields and pastures.	Yes/No
Laterallus jamaicensis	Black rail	SC	Brackish marshes, rarely freshwater marshes.	No/No
Pelecanus occidentalis	Brown pelican	SR	Maritime islands.	No/No
Plegadis falcinellus	Glossy ibis	SC	Forests or thickets on maritime islands.	No/No
Rynchops niger	Black skimmer	SC	Sand flats on maritime islands.	No/No
Sterna hirundo	Common tern	SC	Sand flats on maritime islands.	No/No
Sternula antillarum	Least tern	SC	Beaches, sand flats, and open dunes.	No/No

Table 3-15 State Rare Species Reported from New Hanover County, North Carolina[a] (Cont.)

Scientific Name	Common Name	State Status[b]	Habitat	Potential Presence on or near WS/GLEF[c,d]
Mammals				
Condylura cristata pop. 1	Star-nosed mole – coastal plain population	SC*	Moist meadows, bogs, swamps, and bottomlands.	Yes/No
Lasiurus intermedius	Northern yellow bat	SC	Roosts in Spanish moss and other thick vegetation near water, often in longleaf pine habitats.	Yes/Yes
Neotoma floridana floridana	Eastern woodrat – coastal plain population	T	Forests, mainly in moist areas.	Yes/No
Sciurus niger	Eastern fox squirrel	SR-G	Open forests, mainly longleaf pine/scrub oak.	Yes†/Yes

[a] Excludes endangered, threatened, and special concern species previously listed in Table 3-14.
[b] E = endangered; G = game animal that by law cannot be listed for State protection as endangered, threatened, or special concern; SC = special concern; SR = significantly rare; SR-D = significantly rare – disjunct; SR-L = significantly rare – limited; SR-O = significantly rare – other; SR-P = significantly rare – peripheral; SR-T = significantly rare – throughout; T = threatened; W = watch list; * = recorded occurrence is either extirpated, have not been found in recent surveys, or have not been surveyed recently enough to be confident that it is still present, + = record is obscure or undatable.
[c] WS = Wilmington Site, GLEF = proposed GLE Facility site.
[d] † = there is an occurrence record for the species within 3.2 kilometers (2 miles) of the Wilmington Site.
Sources: Buchanan and Finnegan, 2008; LeGrand et al., 2008; NCDENR, 2009e.

The following definitions are applicable for the State listed species (Buchanan and Finnegan, 2008; LeGrand et al., 2008):

- *Endangered plant*: any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy. Endangered plants may not be removed from the wild except when a permit is obtained for research, propagation, or rescue that will enhance the survival of the species.

- *Endangered animal*: any native or once-native species of wild animal whose continued existence as a viable component of the State's fauna is determined by the North Carolina Wildlife Resource Commission to be in jeopardy or any species of wild animal determined to be an "endangered species" pursuant to the ESA.

- *Threatened plant*: any resident species of plant that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Threatened plants may not be removed from the wild except when a permit is obtained for research, propagation, or rescue that will enhance the survival of the species.

- *Threatened animal*: any native or once-native species of wild animal that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a threatened species pursuant to the ESA.

- *Special concern plant*: any species of plant that requires monitoring but which may be collected and sold under regulations adopted under the provisions of the *Plant Protection and Conservation Act*.

- *Special concern animal*: any native or once-native species of wild animal that is determined by the Wildlife Resources Commission to require monitoring but which may be taken under regulation.

- *Significantly rare plant*: any plant species not listed by the North Carolina Plant Conservation Program as endangered, threatened, or special concern species, which is rare in North Carolina, generally with 1 to 100 populations in the State, frequently substantially reduced in numbers by habitat destruction (and sometimes also by direct exploitation or disease).

- *Significantly rare animal*: any wild animal species not listed by the North Carolina Wildlife Resources Commission as an endangered, threatened, or special concern species, but which exists in the State in small numbers and has been determined by the North Carolina Natural Heritage Program to need monitoring.

- *Watch list*: any plant or animal species believed to be rare and of conservation concern in the State but not warranting active monitoring at this time.

Qualifying categories are also applied to some of the species that are considered significantly rare, as follows: *disjunct* – the species in North Carolina is separated from its main range in a different part of the country or world; *limited* – the range of the species is limited to North Carolina and adjacent states and the species may have only 20 to 50 populations in North Carolina, but fewer than 100 populations rangewide; *other* – the range is sporadic or cannot be

described by other significantly rare categories; *peripheral* – the species is at the periphery, or edge, of its range in North Carolina; and *throughout* – the species is rare throughout its entire range (i.e., fewer than 100 populations in total)

3.9 Noise

Any pressure variation that the human ear can detect is considered sound; noise is unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured on a logarithmic decibel (dB) scale. To account for human sensitivity to frequencies of sound (i.e., humans are less sensitive to lower and higher frequencies and most sensitive to sounds between 1 and 5 kilohertz), A-weighting (denoted by dBA), which is correlated with a human's subjective reaction to sound, is widely used (ASA, 1983; ASA, 1985). To account for variations of sound with time, the equivalent continuous sound level (L_{eq}) is employed. L_{eq} is the continuous sound level during a specific time period that would contain the same total energy as the actual time-varying sound. For example, $L_{eq\ (24)}$ is the 24-hour equivalent continuous sound level. In addition, human responses to noise differ depending on the time of the day (e.g., there is more annoyance over noise during nighttime hours due to low background levels). The day-night average sound level (L_{dn} or DNL) provides an average of the level over a 24-hour period after the addition of 10 dB to noise during nighttime hours (from 10 p.m. to 7 a.m.) to account for the greater sensitivity of most people to it. Day-night average sound level is widely used for community noise and airport noise assessments. Generally, a 3-dB change is considered a just noticeable difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response. See the text box (next page) for the definition of noise-related technical terms and some simple rules governing sound levels.

The *Noise Control Act of 1972*, along with its subsequent amendments (*Quiet Communities Act of 1978*, 42 USC 4901 et seq.), delegates to the States the authority to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Many local noise ordinances are qualitative and prohibit excessive noise or noise that results in a public nuisance. Because of the subjective nature of such ordinances, they are often difficult to enforce. However, several States and counties have established quantitative noise level regulations, which typically specify environmental noise limits based on the land use of the property receiving the noise.

New Hanover County has established quantitative community noise limits set forth in Chapter 23, Environment, Article II, Noise, in the County Code of Ordinances (New Hanover County, 2009a), although the State of North Carolina has not. For nonresidentially zoned districts, any noise source should not produce noise levels exceeding 75 A-weighted decibels (dBA), combined with the ambient noise, during daytime hours, and no more than 70 dBA during nighttime hours. Residentially zoned districts have lower criteria of 65 dBA during the daytime and 50 dBA at night. If the ambient noise level already exceeds the criteria, a violation shall occur only when such sound exceeds the ambient noise level by 3 dBA. Noise measurements shall be made at the nearest corner of the primary structure or at the boundary of the public ROW that adjoins the property of interest. The EPA identified noise levels requisite to protect public health and welfare against hearing loss, annoyance, and activity interference (EPA, 1974), as shown in Table 3-16. The EPA recommends a day-night average sound level of 55 dBA, which is sufficient to protect the public health and welfare in sensitive areas (e.g., residences, schools, and hospitals) from the effect of broadband environmental noise.

Definition of Noise-Related Technical Terms

Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure (typically 20 micropascals per square meter which is the lowest pressure level audible to humans), that is, $20 \bullet \log_{10}(P/P_{ref})$.
Frequency (Hz)	The number of complete pressure fluctuations per second above and below atmospheric pressure. The normal hearing of a young healthy person ranges from 20 to 20,000 Hz.
A-weighted sound level (dBA)	The most common frequency weighting on a sound level meter in a manner similar to the frequency response of the human ear, that is, low sensitivity to the very low and high frequencies and high sensitivity to middle frequencies; correlates well with subjective reactions to noise.
Equivalent continuous sound level (L_{eq})	The sound level (in dBA) that, had it been a steady level during the measurement period, would represent the amount of energy present in the measured, fluctuating sound pressure level.
Day-night average sound level (L_{dn} or DNL)	The sound level (in dBA) over a 24-hour period that accounts for human sensitivity to noise during nighttime hours (10 p.m. to 7 a.m.) due to relatively low background noise. The 10-dB penalty, which means 10 times more sound energy (e.g., noise from one car at night corresponds to a combined noise from 10 cars during the day), is added to the sound level measured during nighttime hours to estimate the DNL.
Loudness	Subjective magnitude of sound. As a rule of thumb, an increase of 10 dB is perceived to be approximately twice as loud. For example, 65 dB is perceived as being twice as loud as 55 dB.

Sound-Related Rules of Thumb

- Sound pressure level decreases at a rate of 6 dB and 3 dB per doubling of distance for point source (e.g., diesel generator at a fixed location) and line source (e.g., road traffic), respectively. For example, if the sound level of a point source is 60 dB at 15 meters (50 feet), then it is 54 dB at 30 meters (100 feet) and 48 dB at 60 meters (200 feet). If the sound level of a line source is 60 dB at 15 meters (50 feet), then it is 57 dB at 30 meters (100 feet) and 54 dB at 60 meters (200 feet).
- The doubling of sound energy increases the sound level by 3 dB. For example, if one source produces 80 dB, then the combined noise levels would be 83 dB for two identical sources and 86 dB for four identical sources.
- If the sound levels from two sources differ by 10 dB, the louder source will predominate. Accordingly, background noise level should be more than 10 dB below the sound level of a source being monitored to have confidence in the accuracy of the measurement.

Table 3-16 Summary of Noise Levels Identified as Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety

Effect	Level[a]	Area
Hearing	$L_{eq(24)} \leq 70$ dB	All areas (at the ear).
Outdoor activity interference and annoyance	$L_{dn} \leq 55$ dB	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	$L_{eq(24)} \leq 55$ dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	$L_{dn} \leq 45$ dB	Indoor residential areas.
	$L_{eq(24)} \leq 45$ dB	Other indoor areas with human activities such as schools, etc.

[a] L_{dn} = day-night average sound level; $L_{eq(24)}$ = 24-hour equivalent continuous sound level; dB = decibels.
Source: EPA, 1974.

These levels are not regulatory goals but are "intentionally conservative to protect the most sensitive portion of the American population" with "an additional margin of safety." To ensure adequate protection for indoor living, a day-night average sound level of 45 dBA is recommended. For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends a 24-hour equivalent sound level of 70 dBA or less over a 40-year period.

The Department of Housing and Urban Development (HUD) has developed regulations that are related to the overall community noise level. These regulations would only affect their own programs and are not binding on local communities; that is, HUD has no regulatory authority over noise sources. HUD considers day-night average sound levels from 65 to 75 dBA as "normally unacceptable [for housing]" and DNL levels above 75 dBA as "unacceptable" (24 CFR 51.103). Levels below 65 dBA are considered "acceptable."

The Wilmington Site, including the proposed GLE Facility, is surrounded by a mix of land uses. The nearest sensitive receptors, areas of human habitation or use where the intrusion of noise has the potential to adversely impact the occupancy, use, or enjoyment of the environment, are located just next to the northeast site boundary and about 1.2 kilometers (0.8 mile) directly to the east of the proposed facility (GLE, 2008). Other land uses adjacent to the site include a hunting/recreational area to the north, the Northeast Cape Fear River to the southwest, I-140 to the south, and NC 133 (Castle Hayne Road) to the east. Highway I-140, which is elevated relative to the site, acts as a natural sound barrier and blocks noises from current site operations to the residences to the south. Industrial land uses are dominant on the west side of the Cape Fear River. No other residences and sensitive receptors (e.g., schools, hospitals, and nursing homes) are located in the immediate vicinity (within about 1.6 kilometers [1 mile]) of the Wilmington Site.

Per New Hanover County zoning code, the entire Wilmington property (including industrial facilities, forest areas, and open-space areas) is currently zoned I-2 Industrial District (New Hanover County, 2009b). This zone is intended for heavy industrial uses, which allows the highest noise levels. Similar to those of any other industrial facilities, noise emission

sources within the Wilmington Site are associated with various activities, including heavy equipment, mechanical systems, vehicular traffic, and public address system (GLE, 2008).

Natural sounds were observed during the baseline sound survey, including birds and insect noise, and leaf-rustling noise by wind. In particular, insect noises peaked at 4 kilohertz; they are typically overwhelmed by other created noises during the daytime but are prominent at night. Medium-density wooded areas and soft grounds could provide some attenuation for noise from the Wilmington Site to propagate to the neighboring areas. Noise sources outside the site boundary include local vehicular traffic on NC 133 and I-140, distant vehicular traffic on I-40, aircraft overflights, yard maintenance activities in the residential community, and gunshots from the hunting/recreation area.

The baseline sound survey was conducted from October 30 to November 1, 2007, to characterize the existing acoustic conditions (GLE, 2008). As shown in Figure 3-16, measurements were made at four onsite locations: northeastern property line near the residences in the Eastern Site Sector (position A); proposed GLE Facility (currently a tree farm) in the North-Central Site Sector (position B); northern edge of the existing GNF-A facility in the Eastern Site Sector (position C); and existing northern entrance roadway in the Eastern Site Sector (position D). Noise levels at the northern property line near the residences representative of community noise level (position A) ranged from 41 dBA (night) to 46 dBA (day) with a day-night average sound level of 48 dBA. These levels are well below the New Hanover County noise ordinance of 50 and 65 dBA, respectively, for residentially zoned districts and the EPA day-night average sound level guideline of 55 dBA. The noise levels at the proposed GLE Facility, which is currently wooded (position B), ranged from 40 dBA (night) to 48 dBA (day) with a day-night average sound level of 48 dBA. At the northern edge of the existing facility (position C), noise levels of 47 dBA (night) and 51 dBA (day) with a day-night average sound level of 54 dBA were recorded, which is characteristic of the noise levels from existing operations. The measurements at the northern entrance roadway (position D) were the highest among those at four measurement locations, ranging from 56 dBA (night) to 61 dBA (day) with a day-night average sound level of 63 dBA,[12] which reflects existing traffic noise levels within the Wilmington Site. Comparisons of sound levels from field observations demonstrated that noise levels at the northeastern property line near the residences have little correlation with consistent noise levels from the existing facilities and the northern entrance roadways. This suggests that sound levels at the northern property line originate from activities in the surrounding community, rather than from activities at the existing Wilmington Site facilities. Noise measurements were conducted in mid-fall when some deciduous trees lose their leaves, which can otherwise attenuate sound propagation to some extent. Accordingly, noise levels during this survey are considered as median values over the year. To date, no noise complaints have been reported from neighboring communities due to noisier sources outside the Wilmington Site, for example, nearby roadways.

For the general area surrounding the proposed GLE Facility, the countywide day-night sound level based on population density for the New Hanover County was estimated to be 51 dBA, typical of “quiet suburban residential” areas (Miller, 2002; Eldred, 1982).

[12] This location is inside the Wilmington Site, thus noise levels at this location are not subject to any noise guidelines or regulations. These noise levels are presented for informational purposes only.

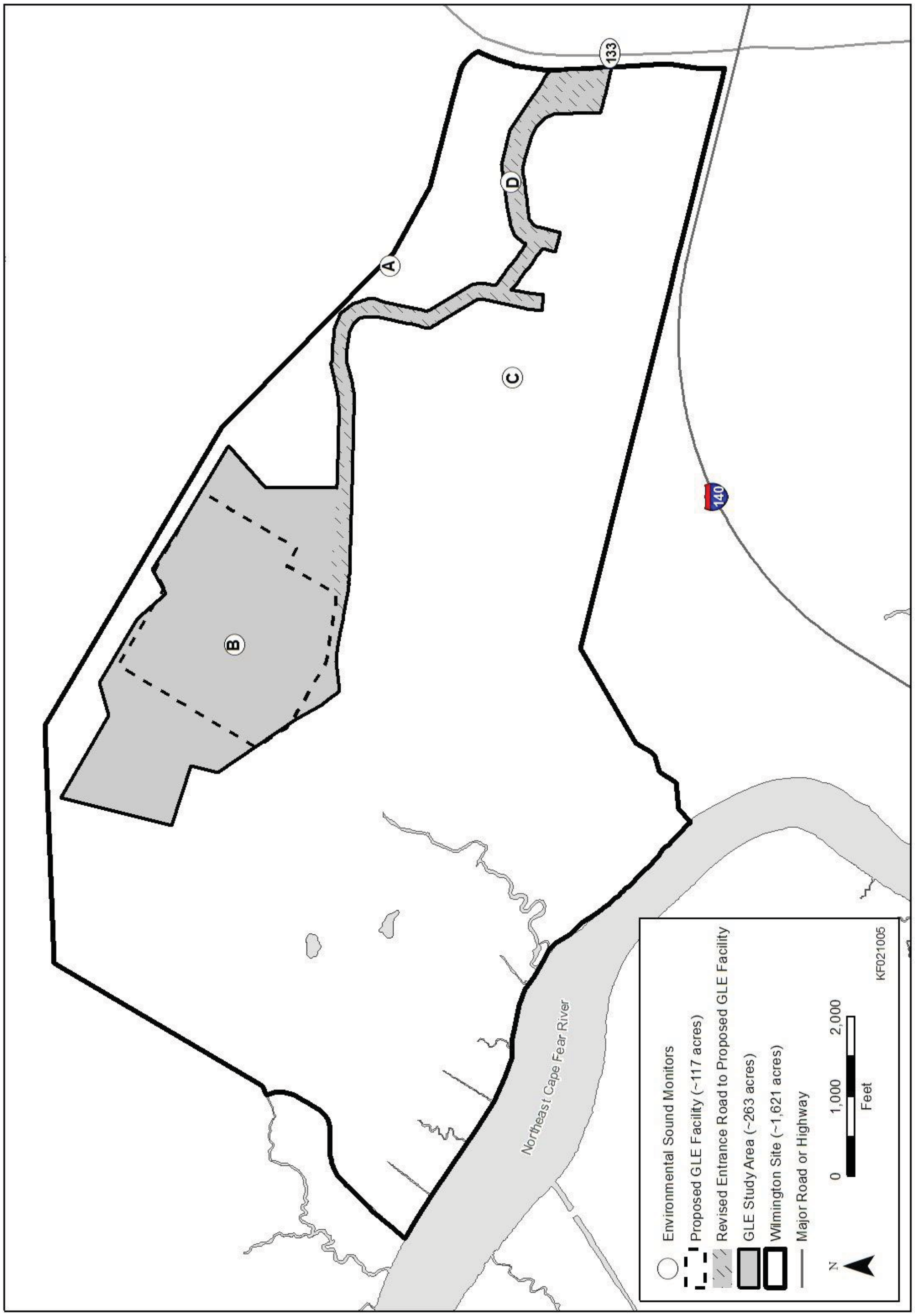

Figure 3-16 Locations of Sound Measurements Conducted from October 30 to November 1, 2007, at the Wilmington Site (Modified from GLE, 2008; GLE, 2009c)

3.10 Transportation

The Wilmington, North Carolina, area is readily accessible by road, rail, air, and water. The road network includes an interstate highway and several major U.S. highways. Public transportation in the area includes fixed bus and shuttle routes as well as a trolley in downtown Wilmington. The area is home to a major deepwater seaport that is served by a rail network that handles the incoming and outgoing cargo. Commercial airline service is provided by a regional airport.

3.10.1 Roads and Highways

Wilmington serves as the eastern terminus of I-40 as shown in Figure 3-17. I-40 briefly runs northward upon leaving Wilmington, intersecting I-95, the major east coast north-south interstate, at a distance of about 160 kilometers (100 miles). Shortly thereafter, I-40 passes through Raleigh, North Carolina, and begins its westward trek to its western terminus near Los Angeles, California. Another major north-south transportation corridor through the area is U.S. Route 17 that runs along the North Carolina coast, linking North Carolina with Virginia and South Carolina. Other major roads in the area include I-140, U.S. 74, U.S. 76, U.S. 421, and NC 132. All routes are available for the transport of goods and materials. The State of North Carolina has not limited the transport of hazardous materials to specifically designated routes within its boundaries (see *Transportation of Hazardous Materials; Designated, Preferred, and Restricted Routes*, 65 FR 75771, 75802 [December 4, 2000]).

I-140, a four-lane interstate highway (two lanes in each direction), considered to be the Wilmington Outer Loop, is under construction (GLE, 2008). The northern portion has been completed and connects U.S. 421 in the west with I-40 and U.S. 17 in the east. The western section of I-140, which links U.S. 421 with U.S. 74-76, has been funded and is scheduled for construction in 2011, while the southern portion, which is intended to link U.S. 74-76 with U.S. 17, has not yet been funded. As shown in Figure 3-18, the completed portion of I-140 passes directly south of the Wilmington Site and has an interchange with NC 133 (Castle Hayne Road).

Access to the Wilmington Site is gained from Castle Hayne Road immediately north of the I-140 interchange. Castle Hayne Road is a two-lane highway with an additional lane in each direction in the vicinity of the interchange with I-140 and the Wilmington Site. Table 3-17 provides the annual average daily traffic (AADT) flow on major roads near the Wilmington Site entrances. The AADT refers to the average number of vehicles in all lanes in both directions passing a point on a given road during an average day in the year. The current site entrance serves approximately 2800 workers employed at the Wilmington Site (GLE, 2008). Peak traffic periods related to site access occur during shift changes, such as at 3:00 p.m., as noted during a site visit on July 24, 2007 (GLE, 2008).

A second entrance, located 0.04 kilometer (0.25 mile) north of the entrance at the intersection of Castle Hayne Road and I-140, is used for truck deliveries and shipments. About 1000 radioactive material shipments a year are made to and from the Wilmington Site (GLE, 2009a). Outbound radioactive material truck shipments enter I-140 from NC 133 on their way to I-40 and their interstate destinations. Similarly, inbound interstate shipments would take the reverse course, coming in through I-40 to I-140 and exiting at NC 133 near the Wilmington Site entrance.

Figure 3-17 Map of the Wilmington Region

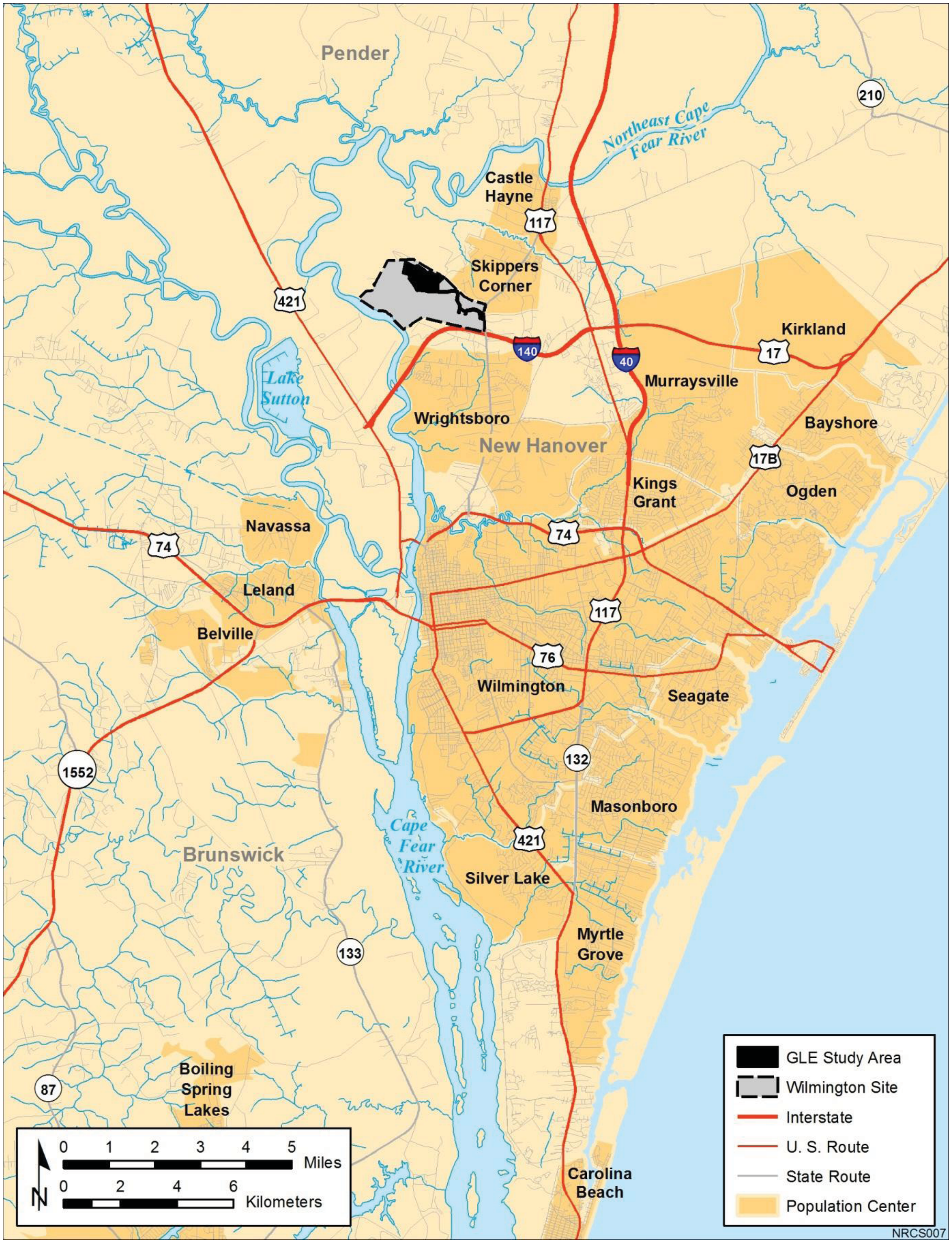

Figure 3-18 Local Map of the Wilmington Area

Table 3-17 Annual Average Daily Traffic (AADT) on Major Roads near the Wilmington Site

Road	General Direction	Location	AADT (Vehicles)
Castle Hayne Rd.	North-South	South of Sonday Rd.	13,000
		North of McDougald	10,000
		North of I-140 near site entrance	12,000
		South of I-140	12,000
		North of Old Mill Rd.	14,000
		North of Kerr Ave.	17,000
I-140	East-West	West of Castle Hayne Rd.	16,000
		East of Castle Hayne Rd., West of I-40	18,000
		East of I-40	14,000
I-40	North-South	North of I-140	30,000
		South of I-140	27,000

Source: NCDOT, 2008.

Wave Transit, the operating name for the Cape Fear Public Transportation Authority, which provides services for the City of Wilmington and New Hanover County (Wave Transit, 2009), operates bus routes in the area around the Wilmington Site. The Castle Hayne route passes by the Wilmington Site entrance on Castle Hayne Road. Wave Transit also operates a trolley that serves the downtown Wilmington area and shuttle buses that serve the University of North Carolina – Wilmington campus approximately 3 kilometers (2 miles) west of downtown.

3.10.2 Rail Network

The CSX Corporation provides freight service to the Wilmington area with primary terminals at the Port of Wilmington and the U.S. Army Military Ocean Terminal at Sunny Point. Nearly all rail freight traffic to these two terminals is routed through Hamlet, 179 kilometers (111 miles) to the west (NCDOT, 2005). Currently, there is no passenger train service to Wilmington, but studies have been conducted to assess interest and feasibility (NCDOT, 2005). The Wilmington Site has no current plans for shipping by rail and no direct rail access, but it is within several miles of the freight terminal in Wilmington.

3.10.3 Water

The Cape Fear River and the Intracoastal Waterway in and around Wilmington are maintained by the U.S. Army Corps of Engineers (USACE) to support commercial and recreational navigation. The southwestern portion of the Wilmington Site borders the Cape Fear River north of the city.

The Port of Wilmington is a major East Coast deepwater port near downtown. Direct rail access and easy access to I-40 are available for freight shipments. Approximately 3.6 million metric

tons (4 million tons) of goods pass through the port annually in the form of containerized, bulk, and breakbulk cargoes. The top five imports in fiscal year 2006, in terms of tonnage, passing through the port were forest products, chemicals, cement, general merchandise, and coal (GLE, 2008). Wood pulp, forest products, general merchandise, food, and chemicals were the top five exports, in terms of tonnage, during the same period (GLE, 2008).

3.10.4 Air

The Wilmington International Airport provides regional passenger service to Charlotte, New York, Atlanta, and Philadelphia. The airport is serviced by two major domestic commercial airlines. International service is only provided by either corporate or personal aircraft. The nearest major airports are Raleigh-Durham International Airport (122 kilometers [145 miles] to the north-northwest) and Charlotte-Douglas International Airport (322 kilometers [200 miles] to the west-northwest). Several smaller municipal and private airports and heliports also serve the Wilmington area in New Hanover County (3), Brunswick County (7) and Pender County (4) (FAA, 2009).

3.11 Public and Occupational Health

As described in Sections 3.5 through 3.7, several different media in and around the Wilmington Site contain radionuclides and chemicals that are both naturally occurring and anthropogenic (i.e., resulting from human activity) from historical and current operations at the site. These media include soil, surface water, sediment, groundwater, and air. This section describes these radiological and chemical background and anthropogenic levels in terms of public and occupational exposure and health, as well as historical exposure levels for activities similar to the proposed action. It also summarizes the cancer incidence and death rates in the region, which were necessary to establish baseline information for the Chapter 4 analysis of impacts on public and worker health that may be due to the proposed action.

3.11.1 Background Radiological Exposure

Humans are exposed to ionizing radiation from many naturally occurring sources in the environment and created sources that include human enhancement of natural sources of radiation. The current sources of radiation at the proposed GLE site include natural background sources and created sources, including the GNF-A facility. Section 3.11.1.1 discusses the exposure from general background radiation that includes naturally occurring sources and created sources, excluding the exposure from GNF-A facility operations. Radiological exposures from the operation of the existing GNF-A facility are discussed in Section 3.11.1.2.

3.11.1.1 General Background Radiation

Radioactivity from naturally occurring elements in the environment is present in soil, rocks, and living organisms. A major proportion of natural background radiation comes from naturally occurring airborne sources such as radon. The natural radiation sources contribute approximately 3.11 millisievert per year (311 millirem per year) to the radiation dose that a member of the U.S. population receives annually. The majority of this exposure – approximately 2 millisievert per year (200 millirem per year) – is from inhalation of naturally occurring radon gas from soil, rock, and water. The other sources of exposure include external exposure from terrestrial sources and natural radiation of cosmic origin and exposure from

radionuclides that exist in the body. The radiation dose from natural sources of external gamma radiation in North Carolina is 1.2 millisievert per year (120 millirem per year) (Kathren, 1984).

Created sources include computed tomography (CT scan) for medical purposes, nuclear medicine, interventional fluoroscopy for medical purposes, X-rays for medical purposes, consumer products, industrial, and occupational exposure. A person living in the United States received an average effective dose of about 6.2 millisievert (620 millirem) in 2006 (NCRP, 2009). Figure 3-19 shows the percentage contribution to the total dose from different sources.

3.11.1.2 Radiological Exposure from GNF-A Operations

The existing facilities on the Wilmington Site that can contribute to radiological exposure are the nuclear fuel complex and WFSC. The fuel complex includes the FMO/FMOX buildings, the DCP building, the Waste Treatment Facility, process basins, and other support facilities. The SCO and FCO facilities handle only nonradioactive components. Therefore, no radioactivity is released to the environment from SCO and FCO facilities.

Radiological Exposure to the General Public

Airborne and liquid effluent releases of radionuclides from the existing operations of the nuclear fuel complex and WFSC at the Wilmington Site result in radiation exposure to people in the vicinity of the site. The most likely public exposure pathway is by inhalation of airborne effluents.

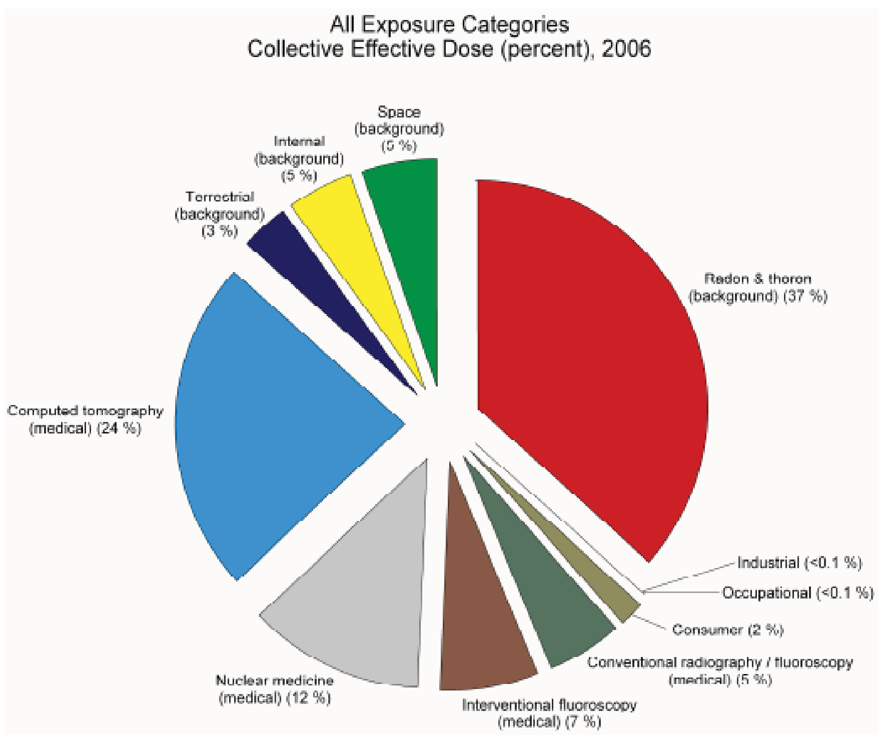

Figure 3-19 Percentage Contribution to the Effective Dose in the U.S. Population for 2006 (NCRP, 2009)

The gamma radiation exposure levels measured at the site boundary are at background levels (GLE, 2009a); therefore, direct radiation exposure is not a significant exposure pathway for the public from existing GNF-A operations.

The airborne effluent releases from the FMO facility vents are sampled continuously. For the period 1995 to 2005, the gross alpha activity released per year from the FMO facility vents ranged from 5.55×10^5 to 7.29×10^6 becquerels (15 to 197 microcuries) (GLE, 2008). The maximum release was in 1997, the year in which the FMO facility switched from a wet process of converting uranium hexafluoride (UF_6) to uranium dioxide (UO_2) to a dry conversion process; a decreasing trend has been observed since then.

The airborne effluent from WFSC stacks is monitored for gross beta emissions. Cobalt-60 is the main source of beta emissions. For the period 2006 to 2008, the gross beta concentrations at the release points ranged from 6.7×10^{-5} to 4.4×10^{-4} becquerels per cubic meter (1.8×10^{-15} to 1.2×10^{-14} microcuries per cubic centimeter) (GLE, 2009a).

Continuous ambient air monitoring for gross alpha activity is conducted at six air sampling stations as shown in Figure 3-20. For the period 1995 to 2005, average gross alpha measurements from GNF-A ambient air samplers ranged from 8.1×10^{-5} to 1.7×10^{-4} becquerels per cubic meter (2.2×10^{-15} to 4.5×10^{-15} microcuries per cubic centimeter) (GLE, 2008). These levels are approximately one order of magnitude below the most restrictive maximum allowable uranium air concentration limit of 5×10^{-14} microcuries per cubic centimeter in 10 CFR Part 20, Appendix B.

Ambient air radiation levels are also monitored by the North Carolina Radiation Protection Section (RPS) of the NCDENR. There are two RPS air samplers located on the Wilmington Site. The first is at the fence near the southern boundary of the site, and the second is located at the site dock on the Cape Fear River. Both of these air samplers are colocated with GNF-A ambient air samplers. In 1995, GNF-A monitoring and the RPS onsite sampling results were comparable (NRC, 1997). The RPS also has two monitoring stations offsite. A comparison of the GNF-A onsite air sampling results with offsite samplers indicates that the measured concentrations are at background levels and do not indicate any elevated levels of alpha activity (NCDENR, 2009b).

On the basis of modeling of total radionuclide releases to the air for the years 1995 to 2005 from the FMO facility stacks, the estimated radiation dose to the nearest resident assumed to be at the site boundary (located 130 to 384 meters [427 to 1260 feet] south of the FMO facility stack) by using the COMPLY code, ranged from 0.00027 millisievert (0.027 millirem) in 2002 to 0.0040 millisievert (0.40 millirem) in 1997 (GLE, 2008). These estimated doses to the nearest resident are well below the NRC limit of 1 millisievert per year (100 millirem per year) in 10 CFR 20.1301(a).

To confirm that air emissions are within regulatory requirements and are not harmful to human health, the dose to a hypothetical person living at the site boundary for 2006 to 2008 from FMO facility stack releases was also calculated. The yearly estimated doses from air effluent releases varied from 0.00035 to 0.00040 millisievert per year (0.035 to 0.040 millirem per year). The distance to the nearest site boundary from different stacks varied from 130 to 384 meters (427 to 1260 feet) (GLE, 2009a). The estimated doses are well below the EPA's NESHAPs limit

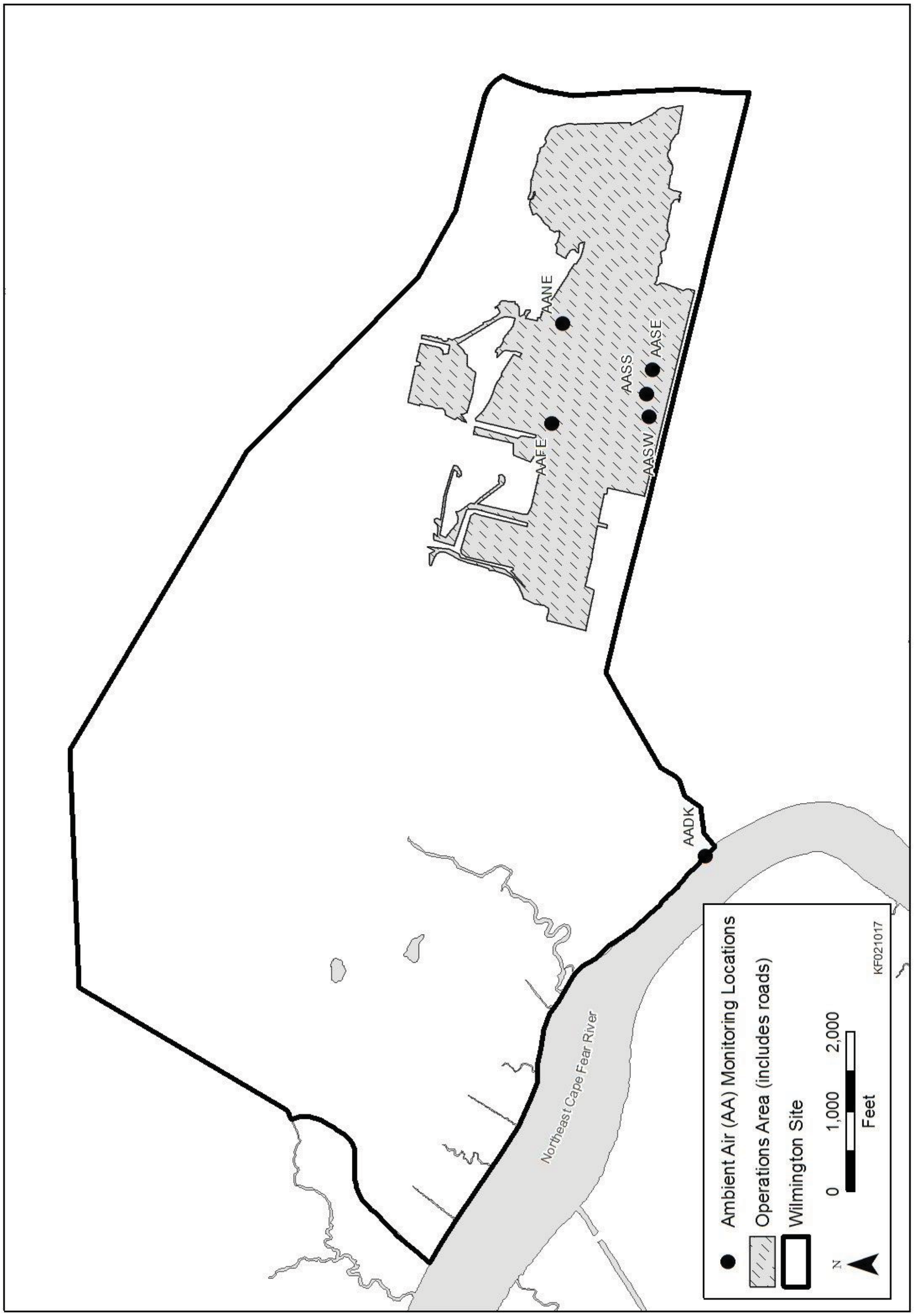

Figure 3-20 Onsite Ambient Air Monitoring Locations for Gross Alpha and Uranium Isotopes (GLE, 2008)

of 0.1 millisievert per year (10 millirem per year), and the NRC total effective dose equivalent limit of 1 millisievert per year (100 millirem per year).

There are no liquid effluent releases from the WFSC, and the airborne effluent releases are about four orders of magnitude lower than the 10 CFR Part 20, Appendix B, Table 2 value for Cobalt-60 (GLE, 2009a). The concentrations at the site boundary would be much lower than the concentration at the release point. These concentrations would result in a yearly dose less than 0.0001 millisievert (0.01 millirem) at the site boundary.

Doses from the existing liquid effluent releases at the site were calculated from the liquid effluent flow concentrations from the Final Process Lagoon. The concentrations for 2003 to 2007 varied from 2.0×10^{3} to 4.6×10^{3} becquerels per cubic meter (5.44×10^{-8} to 1.25×10^{-7} microcuries per milliliter) compared with the NRC uranium liquid effluent concentration limit of 1.1×10^{4} becquerels per cubic meter (3×10^{-7} microcuries per milliliter) in 10 CFR Part 20, Appendix B, Table 2. Assuming that an individual continuously ingests this water for one year, this concentration would result in the total effective dose equivalent (TEDE) in the range 0.09 to 0.21 millisievert per year (9 to 21 millirem per year) (NRC, 2009).

Radiological Exposure to Occupational Workers

The Wilmington Site's occupational radiation exposure data for the last 5 years (FY 2003 to FY 2007) were reviewed (Burrows and Hagemeyer, 2004, 2005, 2006; Dickson, 2007; Lewis et al., 2008). The TEDE to the average worker during this period varied from 0.77 to 1.06 millisievert (77 to 106 millirem). None of the workers received a dose greater than 7.5 millisievert (750 millirem). These doses are well below the NRC limit of 50 millisievert per year (5000 millirem per year) in 10 CFR 20.1201 and the Wilmington Site's administrative limit of 40 millisievert per year (4000 millirem per year). Most of this exposure came from inhalation of uranium dust and direct contact with uranium.

3.11.2 Background Chemical Exposure

The existing FMO facility is the main source of potential airborne chemical exposures to either onsite or offsite populations in the vicinity of the proposed GLE Facility. UF_6 and hydrogen fluoride (HF) are the primary chemicals of potential concern because of their toxicity and the fact that both may be emitted as gases or vapors. HF is formed from the conversion of UF_6 to UO_2F_2 (uranyl fluoride) upon contact of UF_6 emissions with water in air. Such conversion is the source of HF emissions from the existing GNF-A facility as well as from the proposed GLE Facility. HF is a gas at ambient temperatures, while UF_6 may be vaporized (sublimated) from a solid state upon heating and may be emitted as a vapor, before condensing (desublimating) back to solid form in air after release. Exposures to UF_6 may occur in either its vapor or solid particulate form in air. However, the range of transport would be somewhat more limited in air than HF because of the precipitation of particulate UF_6 or UO_2F_2.

HF and uranium have different modes of toxicity, as discussed in Section 3.11.3.3, while concentration levels of concern are at similar levels. Because the concentrations of the two chemicals are linked due to the production of HF from UF_6 and because they have similar toxicity benchmark levels, which of the two governs exposure limits depends on the specific benchmark chosen. HF exposure may be limiting when using available limits for ambient air exposures, such as the California Reference Exposure Level of 14 micrograms per cubic meter

(0.017 parts per million) for chronic exposures (Cal/EPA, 2003), or the State of Washington's Acceptable Source Impact Level of 8.7 micrograms per cubic meter (0.011 parts per million) (ATSDR, 2003).

Comparable public health benchmarks for uranium air concentrations are not available as such, since uranium is not typically an air pollutant. Occupational exposure standards, on the other hand, may be a bit more restrictive for uranium than for HF. For example, the 50 micrograms per cubic meter (soluble uranium forms) National Institute for Occupational Safety and Health (NIOSH) Time-Weighted Average (TWA) Recommended Exposure Level and the equivalent 50 micrograms per cubic meter Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (NIOSH, 1996, 2005) are more restrictive than OSHA's Permissible Exposure Limit for HF of 2.5 milligrams per cubic meter (3.1 parts per million) in air averaged over 8 hours. For further comparison, the NIOSH standard for uranium levels Immediately Dangerous to Life and Health (IDLH) is 10 milligrams per cubic meter over a 1-hour exposure, while the NIOSH IDLH for HF is 30 parts per million (25 milligrams per cubic meter) (ATSDR, 2003). Thus, the two chemicals have similar exposure limits in the workplace.

HF is produced at the FMO facility in a dry conversion process used to convert UF_6 to UO_2. Extensive measures are taken to prevent any significant emissions of HF, including the use of high-efficiency particulate air (HEPA) filters on general circulation air vents, and HEPA filter and permitted scrubbers, where needed, on process off-gas ventilation systems (NRC, 1997; NRC, 2009). A continuous HF monitoring system is operated on all process vents that may emit HF.

In 2004, the Wilmington Site emitted about 27 kilograms (60 pounds) of total fluorides and 15 kilograms (32 pounds) of hydrogen fluoride (Section 3.5.3.1), while in 2007, facility-wide fluoride emissions from the FMO and FCO complexes were 145 kilograms (320 pounds) (NRC, 2009). Current NCDENR Air Permit 1756R17 for the facility limits total HF emissions from the HF recovery building to no greater than 0.29 kilogram per day (0.63 pound per day) (24-hour period) and to no greater than 0.029 kilogram (0.063 pound) in any given hour and GNF-A facility-wide fluoride emissions to 9100 kilograms per year (20,000 pounds per year). As a "synthetic minor source," the site is required to report air emissions data to the State every 3 years, while facilities undergo permit verification annually by the State inspector.

Emissions of other criteria air pollutants and North Carolina TAPs from the FMO facility and other stationary sources near the Wilmington Site are discussed in Section 3.5.3.1. Among the TAPs, which include the Federal HAPs, the greatest emission quantities from the Wilmington Site for 2004 were for nitric acid (178 kilograms per year [393 pounds per year]) and ammonia (108 kilograms per year [237 pounds per year]). As noted in Section 3.5.3.1, these emissions rates are well below the major source thresholds of 9.1 metric tons per year (10 tons per year) for a single HAP and 23 metric tons per year (25 tons per year) for any combination of listed HAPs. Thus, emissions of TAPs are well below levels that would be of concern for health impacts, while those for HF and uranium are of relatively greater concern. Moreover, HF and uranium would be the main toxic air emissions of concern for the proposed GLE Facility.

UF_6 will also be used in the proposed GLE Facility, while both UF_6 and HF could be released from that facility under various accident scenarios. HF would be produced from the reaction of UF_6 with water in air (humidity) under an accidental release of UF_6.

Groundwater beneath the Wilmington Site has been affected by industrial operations at the site and is being actively remediated. Pollutants include VOCs, fluoride, nitrate, and uranium. Affected groundwater is not being used as a source of drinking water (Section 3.7.4.2). A network of groundwater monitoring wells is used to follow contaminant movements and to monitor the site perimeter. None of the surface water streams on the Wilmington Site are affected by chemical contamination. However, the Northeast Cape Fear River upstream of the site is listed as impaired because of mercury pollution, and a section of the river upstream is under a fish consumption advisory for mercury (NCDENR, 2007a).

GNF-A has discharge permits for treated process water and treated sanitary wastewater for an onsite effluent channel, which eventually empties into the Northeast Cape Fear River. The site is required to monitor wastewater discharges as well as stormwater surface runoff under its permits. Treated sanitary wastewater, however, is currently reused as cooling water onsite. Local surface water quality and the requirements of the Wilmington Site's water quality permits are discussed in Section 3.7.1.

The WFSC produces no liquid effluents and no air emissions of chemicals at levels of public health concern. The facility is not listed on either the site's air or water permit lists of site sources.

Hazardous chemical wastes produced at Wilmington Site facilities, the largest volume of which is etch-acid solution, are collected, packaged, temporarily stored on site, and periodically shipped to a Resource Conservation and Recovery Act (RCRA)-permitted facility in Indianapolis, Indiana (GLE, 2008).

3.11.3 Public Health Studies

3.11.3.1 Regulatory Requirements for Public and Occupational Exposure

NRC regulations in 10 CFR Part 20 identify maximum allowable concentrations of radionuclides in air and water above background at the boundary of unrestricted areas to control radiation exposures of the public and releases of radioactivity. The most restrictive maximum allowable concentration in air and water for uranium isotopes is 5×10^{-14} and 3×10^{-7} microcuries per cubic centimeter, respectively (10 CFR Part 20, Appendix B). Other 10 CFR Part 20 requirements are that the sum of the external and internal doses (TEDE) for a member of the public may not exceed 1 millisievert per year (100 millirem per year) (10 CFR 20.1301(a)(1)), and the radiation levels at any unrestricted area should not exceed 0.02 millisievert (2 millirem) in any 1 hour and 0.5 millisievert (50 millirem) in a single year. (10 CFR 20.1301(a)(2)).

In addition to keeping within NRC requirements, releases to the environment must comply with EPA standards in 40 CFR Part 190, "Subpart B – Environmental Standards for the Uranium Fuel Cycle." These standards specify limits on the annual dose equivalent from normal operations of uranium fuel-cycle facilities (except mining, waste disposal operations, transportation, and reuse of recovered special nuclear and by-product materials). The public dose limit for annual whole body and organ is 0.25 millisievert (25 millirem), and for the thyroid it is 0.75 millisievert (75 millirem).

10 CFR 20.1201 limits the TEDE of workers to ionizing radiation. Table 3-18 provides occupational dose limits for operational workers who work at nuclear facilities. Public and

Table 3-18 Occupational Dose Limits for Adults Established by 10 CFR Part 20

Tissue	Dose Limit
Whole body or any individual organ or tissue other than the lens of the eye	More limiting of 0.05 Sv/yr (5 rem/yr) TEDE to whole body or 0.5 Sv/yr (50 rem/yr) sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye
Lens of the eye	0.15 Sv/yr (15 rem/yr) dose equivalent
Extremities, including skin	0.50 Sv/yr (50 rem/yr) shallow dose equivalent

occupational standards for chemical exposures to HF and uranium are presented in the previous section.

3.11.3.2 Health Effects from Radiological Exposure

Radiation interacts with the atoms that form cells. There are two mechanisms by which radiation affects cells: direct action and indirect action. In a direct action, the radiation interacts directly with the atoms of the deoxyribonucleic acid (DNA) molecule or some other component critical to the survival of the cell. Since the DNA molecules make up a small part of the cell, the probability of direct action is small. Because most of the cell is made up of water, there is a much higher probability that radiation would interact with water (NRC, 2010). In an indirect action, radiation interacts with water and breaks the bonds that hold the water molecule together, producing reactive free radicals that are chemically toxic and destroy the cell. The body has mechanisms to repair damage caused by radiation. Consequently, the biological effects of radiation on living cells may result in one of three outcomes: (1) injured or damaged cells repair themselves, resulting in no residual damage; (2) cells die, much like millions of body cells do every day, being replaced through normal biological processes and causing no health effects; or (3) cells incorrectly repair themselves, which results in damaging or changing the genetic code (DNA) of the irradiated cell (NRC, 2004b). Stochastic effects, that is, effects that may or may not occur according to probability, may occur when an irradiated cell is modified rather than killed. The most significant stochastic effect of radiation exposure is that a modified cell may, after a prolonged delay, develop into a cancer.

The biological effects on the whole body from exposure to radiation depend on many factors, such as the type of radiation, total dose, time interval over which the dose is received, and part of the body that is exposed. Not all organs are equally sensitive to radiation. The blood-forming organs are most sensitive to radiation; muscle and nerve cells are relatively insensitive to radiation (NRC, 2010). Health effects may be characterized according to two types of radiation exposure: (1) a single accidental exposure to high doses of radiation for a short period of time (acute exposure), which may produce biological effects within a short time after exposure, and (2) long-term, low-level overexposure, commonly called continuous or chronic exposure. High doses of radiation can cause death. Other possible effects of a high radiation dose include erythema, dry desquamation, moist desquamation, hair loss, sterility, cataracts, and acute radiation syndromes (NRC, 2010).

Currently there are no data to unequivocally establish the occurrence of cancer following exposure to low doses and dose rates – below about 100 millisievert (10,000 millirem) (NRC, 2004b).

In estimating the health impacts from low dose or low dose rate exposure to occupational workers and the general public, the probability of a fatal cancer per unit of radiation exposure recommended by the International Commission on Radiological Protection (ICRP) was used. The estimated probability for workers is 4×10^{-2} sievert^{-1} and for the public it is 5×10^{-2} sievert^{-1} (ICRP, 1991). The estimated probability for the public is higher because it includes young people who are more sensitive to radiation (ICRP, 1991).

The National Program of Cancer Registries (NPCR) is the Centers of Disease Control and Prevention (CDC) State-based cancer control program. Under this program, States collect, manage, and analyze data about cancer incidence and mortality. The CDC and the National Cancer Institute release U.S. Cancer Statistics annually. Table 3-19 lists the cancer incidence and death rates for all cancers for 2000 to 2005 for North Carolina and the United States.

3.11.3.3 Health Effects from Chemical Exposure

Chemicals may enter the body through absorption through the skin, by inhalation, or by ingestion. Chemical exposure produces different effects on the body depending on the mode of action of the chemical and the amount of exposure. Some chemicals can cause cancer, affect reproductive capability, disrupt the endocrine system, or have other health effects. Acute effects from exposure to high levels of toxic chemicals occur immediately (e.g., when somebody inhales or ingests a poisonous substance such as cyanide). Chronic or delayed effects may be more subtle and are due to long-term, low-level exposure to toxic chemicals.

The primary chemicals of interest associated with the existing GNF-A facility, as well as the proposed GLE Facility, are uranium and HF associated with the UF_6 reaction with moisture in air. HF is an irritant gas that causes eye, nose, and skin irritation. Breathing high levels can also harm the lungs and heart (ATSDR, 2003). Irritant effects in humans, including respiratory tract inflammation, begin to be observed in the range of 1 to 10 parts per million, similar to occupational exposure limits. Low-level exposure effects are reversible once the exposure is terminated. Members of the public are generally not exposed to levels that have observable health effects from routine industrial emissions. Various potentially relevant exposure benchmarks for the public and occupational exposure to HF are presented in Section 3.11.2.

Table 3-19 Cancer Incidence and Death Rates for All Cancers for 2000 to 2005[a]

Area	All Cancer Incidence Rate	All Cancer Death Rate
United States	467.6	189.8
North Carolina	453.8	196.1

[a] Per 100,000 persons and are age adjusted to the 2000 U.S. standard population.
Source: CDC, 2009.

Uranium exerts heavy metal toxicity, primarily to the kidney (ATSDR, 1999). Exposure to uranium may be via inhalation or ingestion. The degree of absorption of inhaled uranium from the lung or of ingested uranium into the bloodstream is greater for more soluble forms of uranium, such as UO_2F_2, which is formed from the reaction of UF_6 and water. Little direct toxicological data are available on chemical toxicity in humans at low inhalation exposures. Standards are based mainly on tests in mammals, which show low-level systemic health effects beginning at inhalation exposures in the 0.1 to 1 milligram per cubic meter range for chronic exposures. These levels generally correspond to the occupational exposure standards discussed in Section 3.11.2.

The EPA is responsible for regulating most chemicals that can enter the environment. This authority is typically delegated to the States for implementation, as it is in North Carolina.

Disposal of the hazardous chemicals used at GNF-A is regulated via permits issued under RCRA, while discharges to waterways are regulated via NPDES permits issued under the CWA and air emissions via permits issued under the CAA. These permits are administered and enforced by the NCDENR, Division of Water Quality and Division of Air Quality, respectively. GNF-A is required by the NRC to operate in compliance with all of its permits, therefore minimizing the impact on the environment and on workers and the public.

3.11.3.4 Health Study of Mercury Emissions

In early 2009, Intertox of Seattle, Washington, completed an independent, peer-reviewed, study of potential health impacts from exposure to mercury emissions from the proposed Carolinas Cement plant in Castle Hayne, about 10 kilometers (6 miles) northeast of the proposed GLE Facility. The study concluded that exposures to plant emissions by residents of Castle Hayne and the greater Wilmington area would be minor and would not lead to any health effects, even in maximally exposed individuals, including those who subsisted mainly on fish from the river. The study found that greater than 98 percent of the estimated mercury exposure originating from the cement plant would be via consumption of fish from the Northeast Cape Fear River, which would bioconcentrate mercury transported to the river via the atmosphere. The study did find, however, that some individuals interviewed currently consumed fish from the river in excess of fish advisories in place as a result of existing mercury sources in the area, and thus, could benefit from reducing fish consumption (Intertox, 2009).

Mercury in its various forms is a listed HAP. For New Hanover, Brunswick, and Pender Counties surrounding and including the Wilmington Site, the NCDAQ reported a total of 135 kilograms (297 pounds) of mercury emissions of all forms from stationary sources in 2007 (NCDAQ, 2011a-c). Of the nine source facilities listed by the NCDAC in New Hanover County, none are associated with the Wilmington Site. Mercury fish advisories, such as those that apply to regions of the Northeast Cape Fear River, may be the result of non-point sources or distant sources combined with bioaccumulation processes in fish.

3.11.4 Occupational Injury and Illness Rates

OSHA is responsible for developing and enforcing workplace safety regulations. Occupational hazards can be minimized when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries from accidents can still occur.

No fatalities have occurred in the nuclear facilities on the Wilmington Site. The GNF-A maintains a log and summary of recordable occupational injuries and illnesses under the guidance of OSHA's Occupational Injury and Illness Recording and Reporting Requirements in 29 CFR Part 1904. On the basis of the information provided by GLE (GLE, 2008, 2009a), the annual recordable accidents at the site varied from 3 to 22 for fiscal years 2000 to 2008. The number of recordable injuries/illnesses per year per 100 workers varied from 0.46 to 1.64 over the years 2000 to 2006 (GLE, 2008).

The U.S. Department of Labor, Bureau of Labor Statistics compiles annual injury and illness data, including the incidence rates by industry (DOL, 2010). GNF-A manufactures fuel assemblies and intermediate fuel components for the nuclear power industry, and its operations may also be classified as chemical manufacturing. The Bureau of Labor Statistics' national average incidence rate of nonfatal occupational injuries and illnesses for chemical manufacturing facilities for calendar year 2007 is 3.1, which is higher than the rates of 0.46 to 1.64 for GNF-A.

3.12 Waste Management

This section describes the solid and liquid, nonhazardous, hazardous, and radioactive wastes currently generated and managed by GE at the Wilmington Site. No radioactive mixed waste is currently generated. This reflects the baseline condition and is aside from the wastes that the proposed GLE Facility would generate and manage under the proposed action, which are described in Chapter 2. This section also describes the existing waste management practices used at the Wilmington Site, most of which would also be used to manage wastes from the proposed GLE Facility.

3.12.1 Current Waste Management Program

The Wilmington Site generates a range of gaseous, liquid, and solid waste streams from its current manufacturing operations. The radioactive and nonradioactive air emissions are discussed in Section 3.5.3.1. The liquid and solid wastes generated are regulated by the EPA's waste management and disposal programs implemented under RCRA Subtitle C (Hazardous Wastes) and Subtitle D (Nonhazardous Wastes). Wastewater treatment is discussed in Section 3.12.2. The treatment and disposal of solid waste generated from manufacturing operations and wastewater treatment are covered in Section 3.12.4. The liquid and solid wastes currently generated at the Wilmington Site are summarized in Table 3-21 in Section 3.1.2.3.

3.12.2 Wastewater Treatment

Sanitary wastewater and process wastewater effluents are the largest liquid waste streams generated at the Wilmington Site. The process wastewater effluents are from the current manufacturing operations, and the sanitary wastewater effluents are from the existing building restrooms, cafeteria, and other sanitary facilities. The wastewater streams generated by current operations are summarized in Table 3-20.

Table 3-20 Wastewater Streams Generated by Current Operations at the Wilmington Site

Wastewater Stream	Generation Frequency	NPDES Limit[a]	2006 Average Daily Flow Rate	Wastewater Treatment
Process wastewater	Continuous	6,813,741 lpd (1,800,000 gpd)	1,802,613 lpd (476,200 gpd)	pH adjustment, settling, aeration
Sanitary waste effluent	Continuous	283,906 lpd (75,000 gpd)	124,919 lpd (33,300 gpd)	Dual-train, extended, activated sludge-aeration wastewater treatment facility with chlorination/dechlorination[b]

[a] gpd = gallons per day; lpd = liters per day.
[b] The Wilmington Site sanitary wastewater treatment facility has recently been upgraded to a single-train, extended aeration activated sludge wastewater treatment facility with membrane ultrafiltration and ultraviolet (UV) filtration (operational March 2008).
Source: GLE, 2008.

3.12.2.1 Sanitary Wastewater

Sanitary wastes at the Wilmington Site are collected in a sewer system that routes the waste to an onsite, activated sludge-aeration, treatment plant that incorporates a membrane bioreactor (GLE, 2008; GNF-A, 2008). The activated sludge process is a biological wastewater treatment process in which wastewater is fed into an aerated tank where microorganisms feed on the waste organic material (the bioreactor). The activated sludge (the microorganisms) is subsequently separated from the treated wastewater along with waste by-products by an ultrafiltration membrane and disposed of. The current activated sludge–aeration treatment plant was commissioned in April 2008. At that time, a water reuse permit from the NCDENR (NCDENR, 2007b) was obtained to allow the use of the treated sanitary wastewater effluent as makeup water for Wilmington Site cooling towers (GLE, 2008). All treated sanitary wastewater effluent is currently used as makeup water for the cooling towers.

Prior to 2008, the treated sanitary wastewater effluent was released to the effluent channel, which flows into Unnamed Tributary #1, which empties into the Northeast Cape Fear River (Waters of the United States). The NPDES discharge permit (NPDES Permit NC0001228) for this activity allows up to 283,906 liters per day (75,000 gallons per day) of sanitary wastewater effluent to be discharged from the Wilmington Site (GLE, 2008). Figure 3-21 shows the discharge location of the sanitary wastewater treatment facility (Discharge Location 002). Prior to facility upgrades, the 2006 average daily discharge from the sanitary wastewater treatment facility to the effluent channel through Outfall 002 on its way to Discharge Location 002 was 124,919 liters per day (33,000 gallons per day) (Table 3-20). Sanitary wastewater must meet the monitoring requirements and effluent limitations as set forth in the NPDES permit from the NCDWQ. The sanitary wastewater effluent is monitored at Outfall 002, which is a location along the discharge pipe that drains from the sanitary wastewater treatment facility to the effluent channel just south of the treatment facility. Although GNF-A currently uses sanitary wastewater effluent for cooling tower makeup water, the NPDES discharge permit has been renewed. Therefore, discharge of treated sanitary wastewater to the effluent channel could be resumed, if necessary.

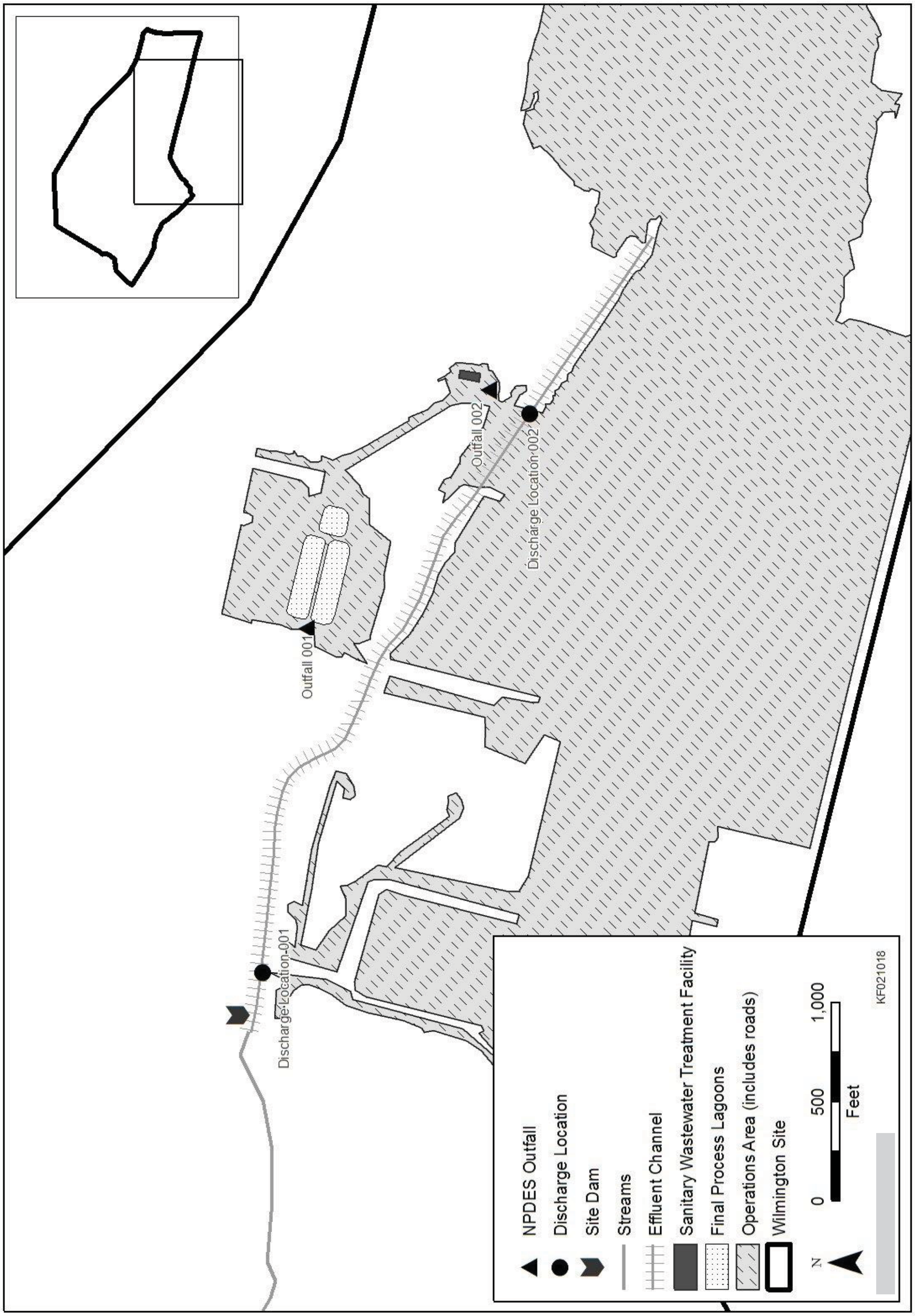

Figure 3-21 Existing Wastewater Treatment Facilities and Discharge Points at the Wilmington Site (GLE, 2008)

3.12.2.2 Process Wastewater

Current operations at the Wilmington Site include the combined GNF-A FMO facility, GNF-A FCO facility, GE AE operations, and GE SCO facility. These facilities all share a common wastewater treatment system designed to handle pre-treated process wastewater, nontreated process wastewater, filter backwash water, and noncontact cooling water (GLE, 2008). All treated wastewater is sent to the final process lagoon treatment facility (FPLTF), which discharges to the effluent channel (Discharge Location 001 in Figure 3-21). The 2006 average daily discharge from the final process lagoon facility was 1,802,613 liters per day (476,200 gallons per day) (see Table 3-21), approximately one quarter of the 6,813,741 liters per day (1.8 million gallons per day) of treated process wastewater allowed under the current NPDES discharge permit (NPDES Permit NC0001228) (GLE, 2008).

The FMO facility uses a DCP to convert its UF_6 waste directly to the oxide (UO_2). Two liquid waste streams are generated – one with a dilute HF concentration (approximately 1–2 percent HF), and a second with a higher concentration of HF (<50 percent). The dilute HF waste solution is mixed with lime ($Ca(OH)_2$) to form calcium fluoride (CaF_2) which is insoluble in water and precipitates out as a solid. The CaF_2 solid phase is dewatered and sent to the Energy*Solutions* disposal facility in Clive, Utah, along with other wastes (see Section 3.12.4.2). The liquid phase from the dewatering unit is pH-adjusted and combined with other waste streams before any final treatment and discharge to the effluent channel. The more concentrated HF solution produced during the conversion of UF_6 to UO_2 is sold for industrial and commercial uses. Under safety condition S-2 of NRC license SNM-1097, GNF-A is granted the special authorizations stated in Section 1.3 of its license renewal application, including authorization to transfer liquid HF to commercial chemical companies or suppliers as long as the concentration of uranium is maintained below three parts per million by weight, uranium-235 enrichment is less than 5 percent, and members of the general public are not exposed through any pathway to trace uranium concentrations higher than natural levels in products formed from its use (see Section 1.3.3.2 of [GNF-A, 2007]).

3.12.3 Other Liquid Waste

Aside from sanitary and process wastewater streams, other nonhazardous and hazardous liquid wastes are generated at the Wilmington Site. Nonhazardous industrial wastes, such as the 1592 metric tons (1755 tons) of used oils are sent offsite to the FCC Environmental Treatment Facility in Concord, North Carolina, for recycling and reuse as shown in Table 3-21. The GNF-A FCO facility also generates a sodium hydroxide (NaOH) waste solution and an etch-acid waste solution that are treated separately. The NaOH solution waste, 70 metric tons (77 tons) in 2006, is shipped to Heritage Environmental Services, Indianapolis, Indiana, for recycling (GLE, 2008).

The predominant hazardous waste generated at the Wilmington Site is the spent etch-acid solution (a solution containing HF and nitric acid [HNO_3]) from GNF-A FCO activities. Minor quantities of hazardous waste paints and solvents are also generated. The hazardous wastes are collected and temporarily stored, less than 90 days, in U.S. Department of Transportation (DOT)-approved shipping containers before being shipped offsite to the Heritage Environmental Services RCRA-permitted Subtitle C treatment, storage, and disposal facility (TSDF) (GLE, 2008).

Table 3-21 Solid and Liquid Wastes Generated by Current Operations at the Wilmington Site

Waste Type	Waste Generation Source (Wilmington Site)	Waste Composition	Annual[a] Quantity Generated	Offsite Treatment or Disposal Facility (Type and Location)
Municipal solid waste	GNF-A operations and GE AE/SCO	• Refuse and other nonhazardous solid wastes accepted at landfill	898 metric tons (990 tons)	New Hanover County Landfill Wilmington, North Carolina
Nonhazardous industrial wastes	GNF-A operations	• Used NaOH solution[b] • Clean-room sludge • Spent coolant • Used tube reducer • Nonhazardous caustic • Filter medium	97 metric tons (107 tons)	Heritage Environmental Services RCRA Permitted TSDF[c] Indianapolis, Indiana, or other facilities depending on the composition of the waste[d]
	GE AE/SCO	• Pre-rinse emulsifier • Spill cleanup adsorbent media • Mixed dry batteries • Metal chips • Process tank and drain cleanout sludges	36 metric tons (40 tons)	
	GNF-A and GE AE/SCO	• Used oils[e]	1592 metric tons (1755 tons)	FCC Environmental Treatment Facility Concord, North Carolina
Hazardous waste	GNF-A and GE AE/SCO	• HF/HNO_3 waste[f] • Minor quantities of waste paints and solvents and X-ray wastes	1973 metric tons (2175 tons)[g]	Heritage Environmental Services RCRA Permitted TSDF[c] Indianapolis, Indiana
LLRW	GNF-A operations	• Metal parts, filters, and other noncombustible wastes • Dewatered CaF_2[h] solids • Waste incinerator ash	188 metric tons (208 tons)[i]	EnergySolutions LLRW Disposal Facility Clive, Utah

[a] Annual waste quantity records for existing Wilmington Site facilities operations for 2006, with the exception of LLRW.
[b] Used NaOH solution manifested to Heritage Environmental Services is recycled and reused. In 2006, the quantity of recycled/reused NaOH was 70 metric tons (77 tons) of the total 97 metric tons (107 tons) of nonhazardous industrial waste manifested to Heritage Environmental Services from GNF-A operations.
[c] TSDF = Treatment, storage, and disposal facility permitted under RCRA Subtitle C requirements to manage hazardous wastes. Also accepts nonhazardous wastes for treatment and recycling/reuse.
[d] Depending on the composition of the nonhazardous waste, these materials are either shipped directly to the Heritage Environmental Services facility in Indianapolis, Indiana, for treatment and burial and/or routed through Heritage Environmental Services for reuse, reclaim, or treatment at other GE-approved facilities.
[e] Used oils manifested to FCC Environmental are recycled and reused.
[f] HF/HNO_3 waste = hydrofluoric acid (HF) and nitric acid (HNO_3) wastes.
[g] Hazardous waste predominately generated by GNF-A operation with a small quantity from the GE AE operation.
[h] Calcium fluoride (CaF_2).
[i] The value for LLRW is an estimate of annual waste quantity for 2008 and future years to reflect the current LLRW management practices used by GNF-A operations, which reduce the quantity of LLRW shipped to Energy*Solutions* from the historical levels for 2006 and earlier.
Source: GLE, 2008.

3.12.4 Solid Waste

The types of solid wastes generated currently at the Wilmington Site include municipal solid waste (MSW), nonhazardous industrial waste, and low-level radioactive wastes (LLRW). Table 3-21 summarizes the amounts generated and their offsite treatment or disposal.

3.12.4.1 Municipal Solid Waste and Nonhazardous Industrial Wastes

The GNF-A and GE AE/SCO facilities generated approximately 898 metric tons (990 tons) of MSW in 2006 (GLE, 2008). The waste is disposed of offsite at the RCRA-permitted Subtitle D New Hanover County municipal landfill, and constitutes less than 1 percent of the approximately 151,000 tons (approximately 210,000 cubic yards [compacted]) of waste received annually at the landfill (NCDENR, 2009a). The county has recently permitted the expansion of the landfill from 1.5 million to 2.4 million tons (5.7 million to 8.9 million cubic yards) (NCDENR, 2008a,b). The permit allows for 5 years of operation with a renewal permit to continue operations required at the end of the 5 years.

As shown in Table 3-21, the miscellaneous nonhazardous industrial wastes generated at the Wilmington Site are shipped to the Heritage Environmental Services RCRA-permitted Subtitle C TSDF in Indianapolis, Indiana, or other approved treatment and disposal facilities. Industrial waste that is neither a RCRA MSW nor a RCRA hazardous waste under Federal or State laws is regulated under RCRA Subtitle D as nonhazardous waste.

3.12.4.2 Low-Level Radioactive Waste

No LLRW is generated by the GE/SCO operations. LLRW generated by GNF-A operations are segregated into uranium contaminated-combustible and noncombustible materials. The noncombustible materials are collected and stored onsite until a full shipment is ready and then sent to the EnergySolutions LLRW disposal facility in Clive, Utah. These materials are summarized in Table 3-21 and consist of the CaF_2 generated from the conversion of UF_6 to UO_2 and of items from ongoing plant maintenance activities.

The combustible LLRW is incinerated in an onsite natural gas-fired, multiple-chamber waste incinerator. About 166,468 kilograms (367,000 pounds) of LLRW are burned per year in the incinerator; the remaining ash is sent to the EnergySolutions facility in Clive, Utah, for disposal (GLE, 2008).

3.13 Socioeconomics

This section describes current socioeconomic conditions within the region surrounding the Wilmington Site that have the potential to be directly or indirectly affected by the construction, operations, and decommissioning of the proposed GLE Facility. The proposed GLE Facility and the communities that support it can be described as a dynamic socioeconomic system. The communities provide the people, goods, and services required to operate the facility. Facility operations, in turn, provide wages and benefits for people and dollar expenditures for goods and services. The measure of a communities’ ability to support the proposed GLE Facility operations depends on the ability of the community to respond to changing environmental, social, economic, and demographic conditions.

The socioeconomic region of influence (ROI)is defined by the area where GLE workers and their families are expected to live and spend most of their income, thereby affecting the economic conditions of the region. The socioeconomic ROI, corresponds to the Wilmington Metropolitan Statistical Area (MSA), a three-county area comprising Brunswick, New Hanover, and Pender Counties. These three counties cover an area that extends up to approximately 80 kilometers (50 miles) from the Wilmington Site (Figure 3-22).

3.13.1 Population Characteristics

The ROI population is predominantly situated in major population centers around the Wilmington Site. Population growth trends and significant transient and special populations are described in the following sections. Minority and low-income populations are discussed in Section 3.14.

3.13.1.1 Major Population Centers

Within the ROI, one city, Wilmington (the county seat) (estimated 2006 population 95,944), is located in New Hanover County; several small towns are located in the remainder of the ROI. In Pender County, Burgaw is the county seat and had an estimated 3904 residents in 2006. The largest town in Brunswick County is Oak Island, with 8152 residents in 2005 (USCB, 2009a). Bolivia is the county seat.

Population density in the ROI is the highest in New Hanover County, with 358.5 persons per square kilometer (928.9 persons per square mile) in 2008. The remaining counties have more land area than New Hanover County with smaller populations resulting in much lower population densities. In Brunswick County, there were 45.9 persons per square kilometer (119.1 persons per square mile), and 22.9 persons per square kilometer (59.5 persons per square mile) in Pender County (USCB, 2009b).

3.13.1.2 Population Growth Trends

Table 3-22 presents recent and projected populations in the ROI and the State of North Carolina. As shown, population in the ROI stood at 346,990 in 2008, having grown at an average annual rate of 3.0 percent since 2000. This growth was higher than the growth rate for North Carolina, 1.7 percent, over the same period.

Each of the counties in the ROI experienced population growth since 2000. Brunswick County recorded a population growth rate of 4.4 percent between 2000 and 2008, while Pender County and New Hanover County grew by 2.9 and 2.3 percent, respectively, in the same decade. The ROI population is expected to increase to 394,925 by 2014, and to 426,797 by 2018. Each of the counties in the ROI is projected to experience population growth between 2008 and 2018.

3.13.1.3 Transient and Special Populations

Institutional, transient, and seasonal populations are not included in the residential population. Institutional populations include school and hospital populations. The transient population consists of visitors participating in various seasonal, social, and recreation activities within the local area. Communities in the ROI experience large increases in population during the summer. The seasonal population of the region has exceeded the off-season population by up

Figure 3-22 Region of Influence for the Proposed GLE Facility

Table 3-22 Population in the ROI and North Carolina

Location	2000	2008	Average Annual Growth (%) 2000-2008	2014	2018
Brunswick County	73,143	102,877	4.4	125,123	139,954
New Hanover County	160,307	192,279	2.3	208,084	218,620
Pender County	41,082	51,834	2.9	61,718	68,223
ROI	274,532	346,990	3.0	394,925	426,797
North Carolina	8,049,313	9,227,016	1.7	10,259,526	10,936,904

Sources: USCB, 2009a; NCOSBM, 2009.

to 47,100 people, or 14.9 percent. The ROI has a small number of temporary farmworkers (USDA, 2009) and also hosts temporary workers in the construction and hospitality sectors (Griffith, 2007).

3.13.2 Economic Trends and Characteristics

3.13.2.1 Employment

Employment in the ROI stood at 120,803 in 2006 (Table 3-23). Over the past decade, there has been a slight employment shift from the government, construction, and farm sectors toward the service, wholesale and retail trade, and manufacturing sectors within the ROI. Currently, the service sector provides the highest percentage of employment in the region, at 49.6 percent, followed by the wholesale and retail trade with 21.2 percent. Smaller employment shares are held by construction (9.5 percent), manufacturing (6.9 percent), and finance, insurance, and real estate (6.6 percent). Within the ROI, the distribution of employment across sectors is similar to that of the ROI as a whole, with higher shares of employment in agriculture (19.8 percent) and manufacturing (10.5 percent) in Pender County, in manufacturing in Brunswick County (8.3 percent), and in wholesale and retail trade (24.5 percent) and construction (11.8 percent) in Pender County. Brunswick County (40.9 percent) and Pender County (30.8 percent) have less service employment than in the ROI as a whole.

3.13.2.2 Unemployment

Unemployment rates have varied across the counties in the ROI (Table 3-24). Over the 10-year period 1999 to 2008, the average rates in Brunswick and Pender Counties were 5.4 percent and 5.3 percent, respectively, with a lower rate of 4.5 percent in Hanover County. The average rate in the ROI over this period was 4.8 percent, lower than the average rate for the State of 5.2 percent. Unemployment rates for the first two months of 2009 contrast markedly with rates for 2008 as a whole; in Brunswick and Pender Counties, unemployment rates increased to 12.1 and 11.7 percent, respectively, while in New Hanover County the rate reached 9.2 percent. The average rate for the ROI (10.4 percent) during this period was higher than the corresponding average rates for 2008, while the rate for the State (6.3 percent) remained the same.

Table 3-23 ROI Employment in 2006

Industry	Brunswick County	% of Total	New Hanover County	% of Total	Pender County	% of Total	Region of Influence	% of Total	North Carolina
Agriculture[a]	710	3.0	232	0.3	1919	19.4	2861	2.4	81,150
Mining	60	0.2	60	0.1	60	0.6	180	0.1	60
Construction	3024	12.9	7314	8.3	1138	11.5	11,476	9.5	242,148
Manufacturing	1942	8.3	5424	6.2	1014	10.3	8380	6.9	535,689
Transportation and Public Utilities	1749	7.5	2633	3.0	133	1.3	4515	3.7	137,968
Wholesale and Retail Trade	4387	18.7	18,883	21.5	2373	24.0	25,643	21.2	637,411
Finance, Insurance, and Real Estate	1984	8.5	5733	6.5	257	2.6	7974	6.6	240,232
Services	9586	40.9	47,383	54.0	2982	30.2	59,952	49.6	1,721,983
Other	5	0.0	29	0.1	10	0.1	44	0.0	750
Total	23,446	(100)	87,679	(100)	9886	(100)	120,803	(100)	3,602,214

[a] Agricultural employment includes 2007 data for hired farmworkers.

Sources: USCB, 2009c; USDA, 2009.

Table 3-24 ROI Unemployment Rates (percent)

Location	1999–2008	2008	2009[a]
Brunswick County	5.4	6.6	12.1
New Hanover County	4.5	5.3	9.2
Pender County	5.3	6.2	11.7
ROI	4.8	5.8	10.4
North Carolina	5.2	6.3	6.3

[a] Rates for 2009 are the average for January and February.
Sources: DOL, 2009a–d).

3.13.2.3 Income

Personal income in the ROI stood at $10.8 billion in 2006 and has grown at an annual average rate of 3.5 percent over the period 1997 to 2006 (Table 3-25).[1] ROI personal income per capita also rose over the same period, but at a slower rate of 1.0 percent, increasing from $29,783 to $32,897. Per capita incomes were higher in New Hanover County ($35,862) and in Brunswick County ($30,007) in 2006 than in Pender County ($25,361). Although personal income and per capita income growth rates in the ROI have been higher than for the State as a whole, personal income per capita was slightly higher in the State ($34,310) in 2006 than in the ROI.

The median value of owner-occupied housing in the three-county ROI over the period 2006-2008 was $178,567 (USCB, 2009d).

3.13.3 Housing Resources and Community and Social Services

This section describes housing and social services in the ROI, including schools, hospitals and nursing homes, law enforcement, and firefighting.

3.13.3.1 Housing

Between 2005 and 2007, there were nearly 196,000 housing units in the three counties, with more than half of these located in New Hanover County, and another third in Brunswick County (Table 3-26). The vast majority of housing units in the region are single-family structures, but the number of multifamily structures is increasing as the region develops (GLE, 2008). Vacancy rates varied significantly across the three counties, from 42 percent in Brunswick County, which had 15,000 seasonal, recreational, or occasional-use units vacant at the time of the 2000 Census, 24 percent in Pender County, and 17 percent in New Hanover County. Owner-occupied units comprise 71 and 78 percent of the occupied units in Brunswick and Pender Counties, respectively, but only 63 percent of the occupied units in New Hanover County, reflecting the concentration of seasonal and recreational activities in the ROI.

1 All direct income and direct sales tax impact estimates are provided in 2008 dollars.

Table 3-25 ROI and State Personal Income

Location	1997	2006	Annual Average Growth, 1997-2006 (%)
Brunswick County			
Total income[a]	1.7	2.8	5.1
Per capita income	25,939	30,007	1.4
Median household income	–	45,596[b]	–
New Hanover County			
Total income[a]	5.0	6.7	3.1
Per capita income	32,406	35,862	1.0
Median household income	–	49,068[b]	–
Pender County			
Total income[a]	1.0	1.3	2.7
Per capita income	19,383	25,361	0.4
Median household income	–	42,630[b]	–
ROI			
Total income[a]	7.7	10.8	3.5
Per capita income	29,783	32,897	1.0
Median household income	–	45,765[b]	–
North Carolina			
Total income[a]	180.2	286.0	2.4
Per capita income	31,447	34,310	0.9
Median household income	–	46,107[b]	–

[a] Billion 2008 dollars.
[b] 2006–2008 3-year average
Source: DOC, 2009; USCB, 2009d.

Housing density in the ROI was 38.9 units per square kilometer (100.8 units per square mile) on average during the period 2005–2007, compared with 32.6 units per square kilometer (84.7 units per square mile) for the State. There were 182.1 units per square kilometer (471.8 units per square mile) in New Hanover County, with lower densities in Brunswick County (32.6 units per square kilometer [84.5 units per square mile]) and Pender County (11.1 units per square kilometer [28.7 units per square mile]) (USCB, 2009a).

Housing stock in the ROI as a whole grew at an annual rate of 3.0 percent over the period 2000 to 2005–2007, with 43,840 new units added to the existing housing stock in the ROI (Table 3-26). With an overall vacancy rate of 27 percent, there were 52,749 vacant housing units in the ROI in 2005–2007, of which 11,199 (5206 in Brunswick County, 5015 in

Table 3-26 ROI Housing Characteristics

Parameter	2000	2005–2007[b]
Brunswick County		
Owner-occupied	25,013	29,934
Rental	5425	12,381
Vacant units	20,993	30,703
Seasonal and recreational use	15,540	NA[a]
Total units	51,431	73,018
Median Value of Owner-Occupied Units		$178,100[c]
New Hanover County		
Owner-occupied	44,109	51,184
Rental	24,074	30,330
Vacant units	11,433	16,150
Seasonal and Recreational Use	4387	NA[a]
Total units	79,616	97,664
Median Value of Owner-Occupied Units		$228,400[c]
Pender County		
Owner-occupied	13,260	14,960
Rental	2794	4147
Vacant units	4744	5896
Seasonal and recreational use	2881	NA[a]
Total units	20,798	25,003
Median Value of Owner-Occupied Units		$129,200[c]
ROI Total		
Owner-occupied	82,382	96,078
Rental	32,293	46,858
Vacant units	37,170	52,749
Seasonal and recreational use	22,808	NA[a]
Total units	151,845	195,685
Median Value of Owner-Occupied Units		$178,567[c]

[a] NA = not available.
[b] 2005–2007, 3-year average.
[c] 2006–2008, 3-year average.
Sources: USCB, 2009a,b,d.

New Hanover County, and 978 in Pender County) are expected to be rental units available to construction workers at the proposed GLE Facility.

New Hanover County has the highest housing values in the ROI, with a median value of $228,400 over the 3-year period 2006–2008 for owner-occupied units (USCB, 2009d). The median values in Brunswick and Pender Counties were $178,100 and $129,200, respectively.

3.13.3.2 Schools

The ROI has a total of 90 public and private elementary, middle, and high schools, the majority of which are in the Brunswick County, New Hanover County and Pender County school districts. In addition, the University of North Carolina at Wilmington, Brunswick Community College, and Cape Fear Community College are located in the region (NCES, 2009). Table 3-27 provides summary statistics for the schools in the three county school districts, including enrollment, educational staffing and two indices of educational quality – student–teacher ratios and levels of service. Of the 90 schools in the region, only one is within a 6.4 kilometer (4-mile) radius of the proposed GLE site, the Wrightsboro Elementary School, while 21 schools are within a 12.8-kilometer (8-mile) radius of the site (GLE, 2008).

3.13.3.3 Public Safety

The principal law enforcement agency in New Hanover County is the New Hanover County Sheriff's Office, which in 2007 had 275 officers providing law enforcement services, including provision in the unincorporated areas in the vicinity of the proposed GLE Facility (Table 3-28).

Several State, county, and local police departments provide law enforcement in the ROI, including the City of Wilmington police department, which employs 252 law enforcement officers. Other counties in the region have a total of 157 full-time officers – 108 in Brunswick County and 49 in Pender County.

Two fire departments in the ROI, the Wilmington Fire Department and the New Hanover County Fire Department, have 228 career firefighters (Table 3-28). The firefighting service provider closest to the Wilmington Site is the Castle Hayne Volunteer Fire & Rescue, with one full-time firefighter and 10 volunteer firefighters equipped with two pumper trucks, two water trucks, one squad truck, and one heavy rescue truck (GLE, 2008). If the Castle Hayne Volunteer Fire & Rescue would need additional assistance in the event of an incident at the Wilmington Site, an existing mutual aid agreement among Castle Hayne Fire Volunteer Fire & Rescue (GLE, 2008) and the six other fire departments in the county would provide additional support.

3.13.4 Tax Structure and Distribution

The principal sources of tax revenues in the ROI are taxes on real estate and personal property and include taxes levied at the county and municipal level (NCDOR, 2009). In 2009, county property tax rates for New Hanover County and Pender County were $0.45 and $0.65 per $100 of appraised valuation, respectively, while the rate in Brunswick County was $0.31. The municipal tax rate in Wilmington was $0.33 per $100, levied in addition to county property taxes (NCDOR, 2009). A corporate income tax rate of 6.9 percent is levied by the State, which also collects sales and use tax of 4.25 percent of sales, in addition to local sales and use tax rates in most areas of 2.5 percent (NCDOR, 2009).

Table 3-27 School District Data for the ROI in 2007

Location	Number of Students	Number of Teachers	Student-Teacher Ratio	Level of Service[a]
Brunswick County	11,749	836	14.1	9.5
New Hanover County	24,001	1763	13.6	9.7
Pender County	7889	572	13.8	12.5
ROI	43,639	3170	13.8	10.0

[a] Number of teachers per 1000 population.
Source: NCES, 2009.

Table 3-28 Public Safety Employment in the ROI in 2009

Location	Number of Police Officers	Level of Service[a]	Number of Firefighters[b]	Level of Service[a]
Brunswick County	108	1.2	206	2.3
New Hanover County	275	1.5	22	0.1
Pender County	49	1.1	0	0.0
ROI	432	1.4	228	0.7

[a] Number per 1000 population.
[b] Number does not include volunteers.
Sources: FBI, 2009; FireDepartments.net, 2009.

3.14 Environmental Justice

On February 11, 1994, the President signed Executive Order 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” which directs all Federal agencies to develop strategies for considering environmental justice in their programs, policies, and activities. Environmental justice is described in the Executive Order as “identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.” On December 10, 1997, the Council on Environmental Quality (CEQ) issued “Environmental Justice Guidance under the National Environmental Policy Act” (NEPA) (CEQ, 1997). The Council developed this guidance to, "further assist Federal agencies with their National Environmental Policy Act (NEPA) procedures." On August 24, 2004, the Commission issued a Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040), which states, “the Commission is committed to the general goals set forth in E.O. 12898, and strives to meet those goals as part of its NEPA review process.”

In addition to the general guidelines on the evaluation of environmental analyses set forth in the document *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (NUREG-1748) (NRC, 2003), the NRC issued environmental justice procedures to be followed in NEPA documents prepared by the NRC's Office of Nuclear Material Safety and Safeguards (NRC, 2004a).

Data on minority and low-income populations within a 6.4-kilometer (4-mile) radius of the proposed GLE Facility site were compiled from the 2000 U.S. Census (see Appendix G). The 6.4-kilometer (4-mile) radius is consistent with the NRC final policy statement on the treatment of environmental justice matters (69 FR 52040; August 24, 2004). This area includes a total of 15 Census block groups, including one in Brunswick County, 10 in New Hanover County, the location of the proposed GLE Facility, and four in Pender County (USBC, 2009a). To determine whether environmental justice will have to be considered in greater detail, the percentage of minority and low-income populations in Census block groups located in the 6.4-kilometer (4-mile) radius are compared with the State and county percentages. According to NRC guidance and procedures, if the minority or low-income population in a given block group exceeds 50 percent or is 20 percentage points or more than the State or county percentage, environmental justice impacts must be considered in greater detail.

3.14.1 Minority Populations

The CEQ guidelines define "minority" to include members of American Indian or Alaska Native, Asian or Pacific Islander, Black non-Hispanic, and Hispanic populations (CEQ, 1997). Minority individuals are persons who identify themselves as members of the following population groups: Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, some other race, and two or more races (meaning individuals who identified themselves on the 2000 Census form as being a member of two or more races, for example, White and Hispanic), and Hispanic or Latino. The 2000 Census allowed individuals the option of identifying themselves in one or more race categories, thereby creating the multiracial census category of "two or more races." They are generally counted as part of the minority group they identified.

Minority populations can be determined by subtracting White, not Hispanic or Latino populations from the total population. Figure 3-23 identifies the three Census block groups within a 6.4-kilometer (4-mile) radius of the proposed GLE Facility site that contain minority populations. Two block groups had minority populations that were more than 20 percentage points higher than the respective county average, while one Census block group had a minority population that was also more than 20 percentage points higher than the State average. Two of these Census block groups also had a minority population that exceeded 50 percent of the total population. Table 3-29 presents data for minority populations for the 6.4-kilometer (4-mile) area, for each county, and for the State. Appendix G presents the data for the 15 Census block groups that completely or partially fall within the 6.4-kilometer (4-mile) radius.

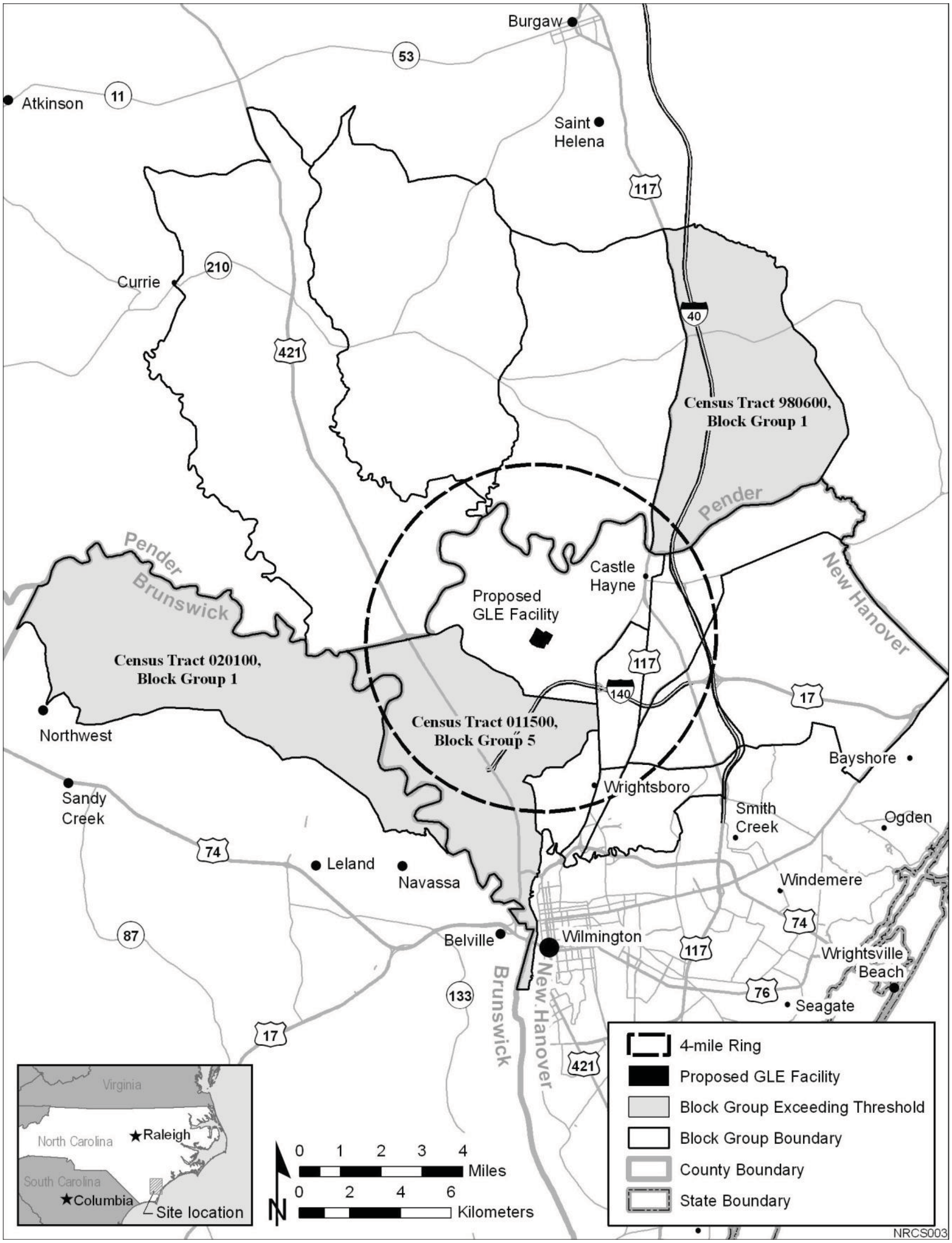

Figure 3-23 Census Block Groups within a 6.4-kilometer (4-mile) Radius of the Proposed GLE Facility with Minority Populations that Exceed 50 Percent of Total Population or Exceed State and County Percentages by More than 20 Percentage Points

3.14.2 Low-Income Populations

Low-income populations are those that fall below the poverty level identified by the U.S. Census Bureau. If the total income for a family or individual falls below the poverty threshold, then the family or individual is determined by the U.S. Census Burear as living “below the poverty level.” For example, in 1999, the most recent year for which census block group data on poverty was available at the time of this analysis, the poverty threshold for a family of five with three children below the age of 18 was $19,882.

Figure 3-24 identifies Census block groups within a 6.4-kilometer (4-mile) radius of the proposed GLE Facility site that contain low-income populations that exceed state and county percentages by more than 20 percentage points. In one Census block group, the low-income population was more than 20 percentage points higher than both the State and county average. Table 3-29 presents data for low-income populations for the 6.4-kilometer [4-mile area]), for each county, and for the State. Appendix G presents the data for the 15 Census block groups that completely or partially fall within the 6.4-kilometer (4-mile) radius.

Table 3-29 Minority and Low-Income Populations within a 6.4-kilometer (4-mile) Radius of the Proposed GLE Site

	4-mile Radius				
County	**Total Population[a]**	**Minority Population**	**Percent Minority**	**County Percent Minority**	**State Percent Minority**
Brunswick County	2030	926	45.6	20.4	32.6
New Hanover County	15,725	3881	24.7	22.1	
Pender County	9044	2753	30.6	30.9	
	4-mile Radius				
County	**Total Population[b]**	**Low-Income Population**	**Percent Low-Income**	**County Percent Low-Income**	**State Percent Low-Income**
Brunswick County	1952	283	14.5	12.6	12.3
New Hanover County	15,217	1488	9.8	13.1	
Pender County	8948	1430	16.0	13.6	

[a] 2000 data.
[b] 1999 data.
Source: USCB, 2009a.

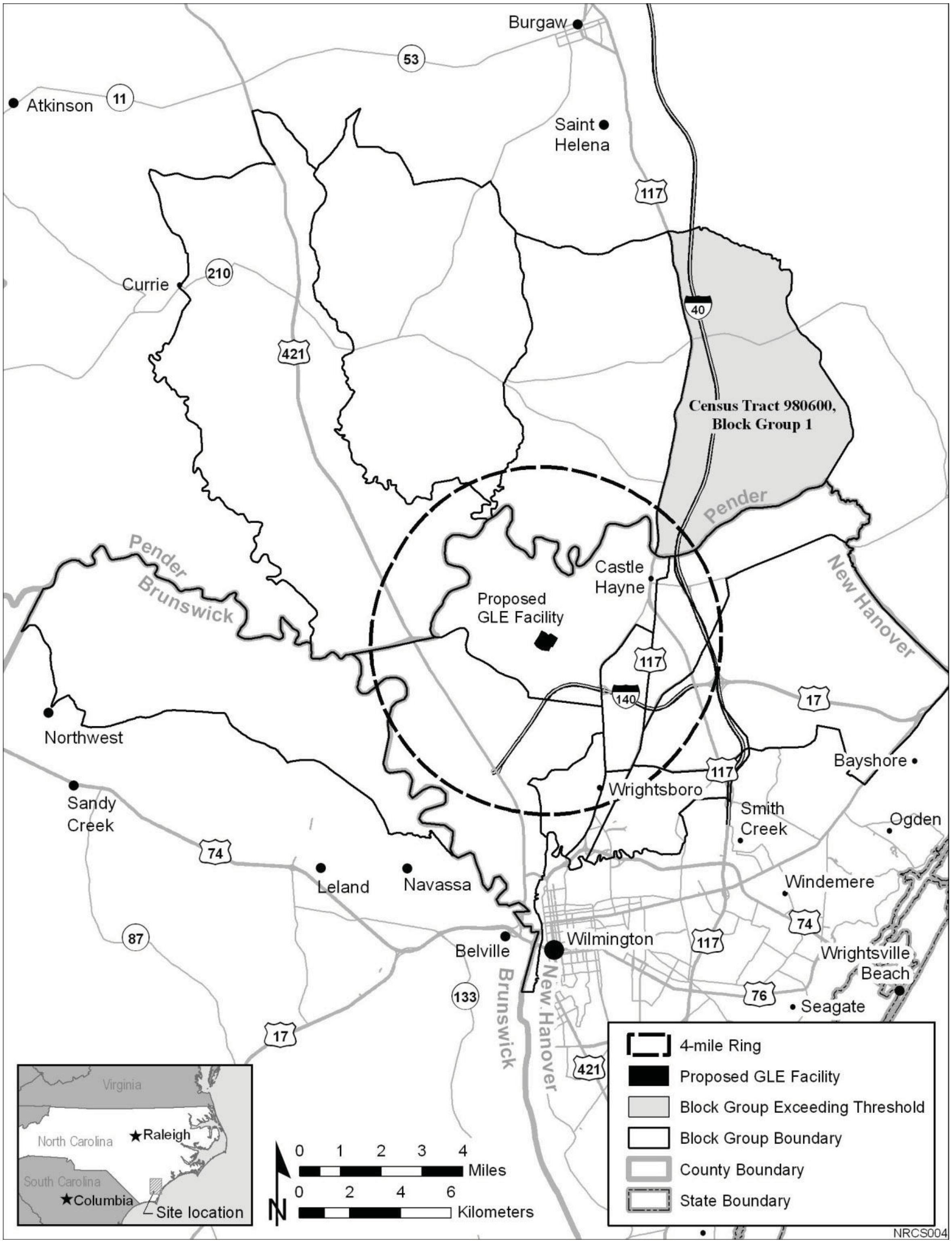

Figure 3-24 Census Block Groups within a 6.4-kilometer (4-mile) Radius of the Proposed GLE Facility with Low-Income Populations that Exceed 50 Percent of the Total Population or Exceed State and County Percentages by More Than 20 Percentage Points

3.15 References

(ASA, 1983) Acoustical Society of America. "American National Standard Specification for Sound Level Meters." ANSI S1.4-1983.

(ASA, 1985) Acoustical Society of America. "American National Standard Specification for Sound Level Meters." ANSI S1.4A-1985 Amendment to ANSI S1.4-1983. June 26.

(Ashley and Rachels, 2005) Ashley, K.W., and R.T. Rachels. "Cape Fear River Basin Recreational Angler Creel Survey, 2003-2004. Coastal Fisheries Investigations, Federal Aid in Fish Restoration Project F-22, Project Type: Survey, Period Covered: 1 July 2003-30 June 2004." North Carolina Wildlife Resources Commission, Division of Inland Fisheries. February.

(ATSDR, 1999) Agency for Toxic Substances and Disease Registry. "Toxicological Profile for Uranium." September. ADAMS Accession No. ML120410417.

(ATSDR, 2003) Agency for Toxic Substances and Disease Registry. "Toxicological Profile for Fluorides, Hydrogen Fluoride, and Fluorine." September. <http://www.atsdr.cdc.gov/toxprofiles/tp11.pdf> (Accessed January 31, 2012).

(BLM, 2009) Bureau of Land Management, U.S. Department of the Interior. "Manual 8400 Visual Resource Management." <http://www.blm.gov/nstc/VRM/8400.html> (Accessed September 27, 2009).

(Brunswick County, 2006) Brunswick County. "Brunswick County Core Land Use Plan." Draft under Review by the North Carolina Division of Coastal Management. <http://dcm2.enr.State.nc.us/Planning/under_review.htm> (Accessed September 29, 2009).

(Buchanan and Finnegan, 2008) Buchanan, M.F., and J.T. Finnegan (Ed.). "Natural Heritage Program List of Rare Plant Species of North Carolina." North Carolina Natural Heritage Program, Office of Conservation and Community Affairs, Department of Environment and Natural Resources. <http://www.ncnhp.org/Images/2008%20Rare%20Plant%20List.pdf> (Accessed January 29, 2010).

(Burns and Cusick, 1983) Burns, J.F., and A.W. Cusick. "*Sagittaria graminea Michx*. Grass-leaf Arrowhead." Ohio Department of Natural Resources, Division of Natural Areas and Preserves. <http://www.dnr.State.oh.us/Portals/3/Abstracts/Abstract_pdf/S/Sagittaria_graminea.pdf> (Accessed October 1, 2009).

(Burrows and Hagemeyer, 2004) Burrows, S., and D.A. Hagemeyer. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2003." NUREG-0713, Volume 25. U.S. Nuclear Regulatory Commission. October. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713> (Accessed January 29, 2010).

(Burrows and Hagemeyer, 2005) Burrows, S., and D.A. Hagemeyer. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2004." NUREG-0713, Volume 26. U.S. Nuclear Regulatory Commission. December. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713> (Accessed January 29, 2010).

(Burrows and Hagemeyer, 2006) Burrows, S., and D.A. Hagemeyer. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2005." NUREG-0713, Volume 27. U.S. Nuclear Regulatory Commission. December. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713> (Accessed January 29, 2010).

(Cal/EPA, 2003) California Environmental Protection Agency. Office of Environmental Health Hazard Assessment. "Adoption of Chronic Reference Exposure Level for Fluorides Including Hydrogen Fluoride [08/15/03]." <http://www.oehha.ca.gov/air/chronic_rels/hyfluocrel.html> (Accessed July 21, 2009).

(CDC, 2009) Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. "United States Cancer Statistics: 1999-2005 Incidence and Mortality Web-based Report." <http://www.cdc.gov/uscs> (Accessed September 18, 2009).

(CEQ, 1997) Council on Environmental Quality. "Environmental Justice Guidance under the National Environmental Policy Act." December 10. <http://ceq.hss.doe.gov/nepa/regs/ej/justice.pdf> (Accessed September 18, 2009).

(City of Wilmington and New Hanover County, 2006). City of Wilmington and New Hanover County. "Wilmington-New Hanover County Joint Coastal Area Management Plan 2006 Update." May 8. http://www.wilmingtonnc.gov/portals/0/documents/Development%20Services/Environment%20and%20Historic%20Preservation/Environmental/CAMA_Plan%202006_cert_080106.pdf (Accessed September 29, 2009).

(Claggett, 1996) Claggett, S.R. "North Carolina's First Colonists: 12,000 Years Before Roanoke." <http://www.archaeology.ncdcr.gov/ncarch/articles/1stcolo.htm> (Accessed July 15, 2009).

(Cowardin et al., 1979) Cowardin, L.M, et al. "Classification of Wetlands and Deepwater Habitats of the United States." FWS/OBS-79. U.S. Fish and Wildlife Service. <http://www.nwrc.usgs.gov/wdb/pub/others/79-31.pdf> (Accessed January 29, 2010).

(CPC, 2008a) Center for Plant Conservation. "CPC National Collection Plant Profile *Solidago villosicarpa*." <http://www.centerforplantconservation.org/Collection/CPC_ViewProfile.asp?CPCNum=44450> (Accessed October 2, 2009).

(CPC, 2008b) Center for Plant Conservation. "CPC National Collection Plant Profile *Stylisma pickeringii var. pickeringii*." <http://www.centerforplantconservation.org/Collection/CPC_ViewProfile.asp?CPCNum=4157> (Accessed October 2, 2009).

(CPC, 2008c) Center for Plant Conservation. "CPC National Collection Plant Profile *Lysimachia asperulifolia*." <http://www.centerforplantconservation.org/Collection/CPC_ViewProfile.asp?CPCNum=2750> (Accessed October 2, 2009).

(CPC, 2008d) Center for Plant Conservation. "CPC National Collection Plant Profile *Solidago verna.*" <http://www.centerforplantconservation.org/Collection/CPC_ViewProfile.asp?CPCNum=4050> (Accessed October 2, 2009).

(Crone and Wheeler, 2000) Crone, A.J., and R.L. Wheeler. "Data for Quaternary Faults, Liquefaction Features, and Possible Tectonic Features in the Central and Eastern United States, East of the Rocky Mountain Front." U.S. Geological Survey, Open-File Report 00-260. <http://pubs.usgs.gov/of/2000/ofr-00-0260/ofr-00-0260.pdf> (Accessed May 6, 2009).

(CSC, 2009) Coastal Services Center, National Oceanic and Atmospheric Administration. "Historical Hurricane Tracks." <http://www.csc.noaa.gov/hurricanes)> (Accessed February 8, 2012).

(Dart et al., 2010) Dart, R.L., et al. "Earthquakes in South Carolina and Vicinity 1698 –2009: Open File Report 2010-1059." U.S. Department of the Interior, U.S. Geological Survey. September. <http://pubs.usgs.gov/of/2010/1059/pdf/OF10-1059.pdf> (Accessed December 14, 2011).

(Dickson, 2007) Dickson, E.D., et al. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2006." NUREG-0713, Volume 28. U.S. Nuclear Regulatory Commission. December. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713> (Accessed January 29, 2010).

(DOC, 2009) U.S. Department of Commerce, Bureau of Economic Analysis. "Local Area Personal Income." <http://www.bea.gov/regional/reis/default.cfm?selTable=CA1-3&section=2> (Accessed June 2009).

(DOL, 2009a) U.S. Department of Labor, Bureau of Labor Statistics. "Local Area Unemployment Statistics: States and Selected Areas: Employment Status of the Civilian Noninstitutional Population, 1976 to 2007. Annual Averages." <http://www.bls.gov/lau/staadata.txt> (Accessed September 18, 2009).

(DOL, 2009b) U.S. Department of Labor, Bureau of Labor Statistics. "Local Area Unemployment Statistics: Unemployment Rates for States." <http://www.bls.gov/web/laumstrk.htm> (Accessed September 18, 2009).

(DOL, 2009c) U.S. Department of Labor, Bureau of Labor Statistics. "Local Area Unemployment Statistics: County Data." <http://www.bls.gov/lau/laucntycur14.txt> (Accessed September 18, 2009).

(DOL, 2009d) U.S. Department of Labor, Bureau of Labor Statistics. "Consumer Price Index, All Urban Consumers – (CPI-U) U.S. City Average, All Items." <ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt> (Accessed September 18, 2009).

(DOL, 2010) U.S. Department of Labor, Bureau of Labor Statistics. "Table 1, Incident rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2009." October 21. <http://www.bls.gov/iif/oshwc/osh/os/ostb2435.pdf> (Accessed February 8, 2012).

(DuMond, 1984) DuMond, D. "Conservation Resources in New Hanover County. New Hanover County Planning Department." <http://www.nhcgov.com/PlanInspect/Documents/Conservation%20Resources%20in%20NHC.pdf> (Accessed June 6, 2009).

(Eldred, 1982) Eldred, K.M. "Standards and Criteria for Noise Control – An Overview." *Noise Control Engineering*, 18(1): 16-23.

(EPA, 1974) U.S. Environmental Protection Agency. "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety." EPA-550/9-74-004. <http://www.nonoise.org/library/levels74/levels74.htm> (Accessed October 5, 2009).

(EPA, 2001) U.S. Environmental Protection Agency. "2001 National Land Cover Database (NLCD 2001)." <http://www.epa.gov/mrlc/nlcd-2001.html> (Accessed October 8, 2009).

(EPA, 2007a) U.S. Environmental Protection Agency. Western Ecology Division. "Ecoregion Maps and GIS Resources." <http://www.epa.gov/wed/pages/ecoregions.htm> (Accessed October 27, 2009).

(EPA, 2007b) U.S. Environmental Protection Agency, Western Ecology Division. "Level III Ecoregions." <http://www.epa.gov/wed/pages/ecoregions/level_iii.htm> (Accessed October 27, 2009).

(EPA, 2009a) U.S. Environmental Protection Agency. "SCRAM Surface Meteorological Archived Data: 1984-1992." <http://www.epa.gov/scram001/surfacemetdata.htm> (Accessed May 16, 2009).

(EPA, 2009b) U.S. Environmental Protection Agency. "The Green Book Nonattainment Areas for Criteria Pollutants." <http://www.epa.gov/air/oaqps/greenbk/> (Accessed June 2, 2009).

(EPA, 2009c) U.S. Environmental Protection Agency. "AirData: Access to Air Pollution Data." <http://www.epa.gov/air/data> (Accessed May 12, 2009).

(EPA, 2009d) U.S. Environmental Protection Agency. "Wetlands Definitions." <http://www.epa.gov/wetlands/what/definitions.html> (Accessed January 12, 2010).

(EPA, 2010a) U.S. Environmental Protection Agency. "National Ambient Air Quality Standards (NAAQS)." <http://www.epa.gov/air/criteria.html> (Accessed March 16, 2010).

(EPA, 2010b) U.S. Environmental Protection Agency. Personal communication from D. Deroeck (U.S. Environmental Protection Agency) to Y.-S. Chang (Argonne National Laboratory). February 18.

(ESI, 2008) Environmental Services, Inc. "An Intensive Cultural Resource Investigation: Potential GE Expansion New Hanover County, North Carolina." ESI Report of Investigations No. 1126, March.

(FAA, 2009) Federal Aviation Administration. "Airport Data (5010) & Contact Information." <http://www.faa.gov/airports/airport_safety/airportdata_5010> (Accessed September 27, 2009).

(FBI, 2009) Federal Bureau of Investigation. "Crime in the United States: 2006." <http://www2.fbi.gov/ucr/cius2006/data/table_80_nc.html> (Accessed September 18, 2009).

(FireDepartments.Net, 2009). FireDepartments.Net "North Carolina Fire Departments." <http://www.firedepartments.net/NorthCarolina/NC.html> (Accessed September 18, 2009).

(Floridata, 2003) Floridata. "Floridata #923 *Dionaea muscipula*." <http://www.floridata.com/ref/D/dion_mus.cfm> (Accessed October 3, 2009).

(Frankel, et al., 2005) Frankel, A.D., et al. "Seismic-hazard Maps for the Conterminous United States: Peak Horizontal Acceleration with 10 Percent Probability of Exceedence in 50 Years." U.S. Geological Survey, Scientific Investigations Map 2883. <http://pubs.usgs.gov/sim/2005/2883> (Accessed May 6, 2009).

(FWS, 1990) U.S. Fish and Wildlife Service, Division of Habitat and Resource Conservation, U.S. Department of the Interior. "National Wetlands Inventory: Castle Hayne, North Carolina Quadrangle." <http://www.fws.gov/wetlands/Data/Mapper.html> (Accessed October 5, 2009).

(FWS, 1998) U.S. Fish and Wildlife Service, Air Division Branch. "Fish and Wildlife Service Class I Units." February 27. <http://www.nature.nps.gov/air/maps/docs/fws.pdf> (Accessed January 26, 2010).

(FWS, 2003a) U.S. Fish and Wildlife Service, U.S. Department of the Interior. "Shortnose Sturgeon in North Carolina." <http://www.fws.gov/nc-es/fish/shortst.html> (Accessed October 2, 2009).

(FWS, 2003b) U.S. Fish and Wildlife Service, U.S. Department of the Interior. "Red-cockaded Woodpecker in North Carolina." <http://www.fws.gov/nc-es/birds/rcwood.html> (Accessed June 4, 2009). Document no longer available online.

(FWS, 2008a) U.S. Fish and Wildlife Service, U.S. Department of the Interior. "Endangered Species, Threatened Species, Federal Species of Concern, and Candidate Species, New Hanover County, North Carolina." <http://www.fws.gov/nc-es/es/cntylist/new_hanover.html> (Accessed July 10, 2009).

(FWS, 2008b) U.S. Fish and Wildlife Service, U.S. Department of the Interior. "Species Profile Red-cockaded Woodpecker *(Picoides borealis)*." <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B04F> (Accessed July 10, 2009).

(FWS, 2008c) U.S. Fish and Wildlife Service, U.S. Department of the Interior. "American Alligator *Alligator mississippiensis*." <http://www.fws.gov/endangered/factsheets/alligator.pdf> (Accessed October 1, 2009). Document no longer available online.

(FWS, 2008d) U.S. Fish and Wildlife Service, U.S. Department of the Interior. "Endangered Species Glossary." <http://www.fws.gov/endangered/about/glossary.html> (Accessed March 23, 2010).

(FWS, 2009a) U.S. Fish and Wildlife Service. U.S. Department of the Interior. Letter from H. Hall (U.S. Fish and Wildlife Service) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 8. "Subject: Docket No. 70-7016; General Electric-Hitachi Global Laser Enrichment Facility, New Hanover County, North Carolina." ADAMS Accession No. ML091700024.

(FWS, 2009b) U.S. Fish and Wildlife Service, U.S. Department of the Interior. “Fish Facts – American Eel.” <http://www.fws.gov/r5crc/Fish/zj_anro.html> (Accessed October 9, 2009).

(GLE, 2008) GE-Hitachi Global Laser Enrichment LLC. “Environmental Report for the GLE Commercial Facility, Revision 0.” December. ADAMS Accession No. ML090910573.

(GLE, 2009a) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 8. “Subject: GE-Hitachi Global Laser Enrichment Submittal of Additional Information Related to NRC Review of GLE Environmental Report.” Letter number GLEL-09-004. ADAMS Accession No. ML092110764.

(GLE, 2009b) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (Environmental Health and Safety Manager, GLE) to A. Kock (Chief, Environmental Review Branch, U.S. Nuclear Regulatory Commission) dated November 5. “Subject: GE-Hitachi Global Laser Enrichment Response to Request for Additional Information Related to NRC Review of GLE Environmental Report.” ADAMS Accession No. ML093170517.

(GLE, 2009c) GE-Hitachi Global Laser Enrichment LLC. “Global Laser Enrichment Environmental Report Supplement 2.” November. ADAMS Accession No. ML093240935.

(GNF-A, 2007) Global Nuclear Fuel – Americas, LLC. “License Renewal Application for Global Nuclear Fuel – Americas LLC, NRC License SNM-1097.” NRC Docket 70-1113. April 2. ADAMS Accession No. ML071000128.

(GNF-A, 2008) Global Nuclear Fuel – Americas, LLC. Letter from GNF-A to U.S. Nuclear Regulatory Commission, dated May 14. “Subject: Response to Environmental Assessment Request for Additional Information (TAC L32670) March 27, 2008.”

(Griffith et al., 2002) Griffith, G.E., J.M. Omernik, J.A. Comstock, M.P. Schafale, W.H. McNab, D.R. Lenat, T.F. MacPherson, J.B. Glover, and V.B. Shelburne. “Ecoregions of North Carolina and South Carolina.” U.S. Geological Survey. <http://www.epa.gov/wed/pages/ecoregions/ncsc_eco.htm> (Accessed June 5, 2009).

(Griffith, 2007) Griffith, D. “Guestworkers, Enganchadores, and Changing Labor Relations in U.S. Rural Communities.” Presented at the University of California at Davis Conference Immigration Reform: Implications for Farmers, Farm Workers, and Communities, Washington, D.C, June 13-14. <http://migration.ucdavis.edu/cf/files/2007-June/Griffithpaper.pdf> (Accessed October 5, 2009).

(Harden et al., 2003) Harden, S.L., J.M. Fine, and T.B. Spruill. “Hydrogeology and Ground-Water Quality of Brunswick County, North Carolina.” U.S. Geological Survey Water-Resources Investigations Report 03-4051. <http://nc.water.usgs.gov/reports/wri034051/pdf/report.pdf> (Accessed November 15, 2010).

(Holzworth, 1972) Holzworth, G.C. “Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States.” Office of Air Programs Publication No. AP-101, U.S. Environmental Protection Agency. January.

(Hubricht, 1985) Hubricht, L. "The Distributions of the Native Land Mollusks of the Eastern United States." *Fieldiana Zoology New Series*, No. 24, Publication 1359, Field Museum of Natural History.

(ICRP, 1991) International Commission on Radiological Protection. "1990 Recommendations of the International Commission on Radiological Protection." ICRP Publication 60. April.

(Intertox, 2009) Intertox. Press Release: "Intertox Study Concludes That Mercury Emissions from Proposed Carolinas Cement Plant Pose Nominal Risk for Local Population." March 30. <http://www.carolinascementproject.com/environmental_impact/studyrelFinal3.pdf> (Accessed January 29, 2010).

(Jennings and Reganold, 1989) Jennings, M.D., and J.P. Reganold. "Local Government Policies toward Environmentally Sensitive Areas in British Columbia, Canada; Washington and Oregon, USA." *Environmental Management* 13(4):443–453.

(Jordan, 1998) Jordan, R.A. "Species Profile: Southern Hognose Snake (*Heterodon simus*) on Military Installations in the Southeastern United States." Technical Report SERDP-98-4. U.S. Army Corps of Engineers. March. <http://el.erdc.usace.army.mil/tes/pdfs/serdp984.pdf> (Accessed January 29, 2010).

(Kathren, 1984) Kathren, R.L. *Radioactivity in the Environment, Sources, Distribution, and Surveillance*, Harwood Academic Publishers.

(Klein et al., 1994) Klein, T.H., et al. "Phase I Archaeological Survey, Wilmington Bypass, New Hanover and Brunswick Counties, North Carolina." North Carolina Office of State Archaeology, Raleigh, North Carolina.

(Klimek, 2004) Klimek, A.W. "National Pollutant Discharge Elimination System Permit No. NC0001228." State of North Carolina Department of Environment and Natural Resources, Division of Water Quality. February 16. ADAMS Accession No. ML091490113.

(Klimek, 2007a) Klimek, A.W. "Wastewater Treatment and Reclaimed Water Reutilization System Permit No. WQ0031317." State of North Carolina Department of Environment and Natural Resources, Division of Water Quality. March 29. ADAMS Accession No. ML091490131.

(Klimek, 2007b) Klimek, A.W. "National Pollutant Discharge Elimination System Permit No. NCS000022." State of North Carolina Department of Environment and Natural Resources, Division of Water Quality. March 30. ADAMS Accession No. ML091490112.

(Lautier, 1998) Lautier, J.C. "Hydrogeologic Assessment of the Proposed Deepening of the Wilmington Harbor Shipping Channel, New Hanover and Brunswick Counties, North Carolina." North Carolina Department of Environment, Health, and Natural Resources, Division of Water Resources. February. <http://www.ncwater.org/Reports_and_Publications/GWMS_Reports/WilmingtonHarborFeb98.pdf> (Accessed January 29, 2010).

(LeBlond and Grant, 2003) LeBlond, R.J., and G.S. Grant. "Natural Area Inventory of New Hanover County, North Carolina." Department of Environment and Natural Resources, Office of Conservation and Community Affairs, North Carolina Natural Heritage Program. May. <http://digital.ncdcr.gov/cdm4/document.php?CISOROOT=/p249901coll22&CISOPTR=192104&REC=4> (Accessed January 29, 2010).

(LeGrand et al., 2008) LeGrand, H.E., Jr., et al. "Natural Heritage Program List of the Rare Animal Species of North Carolina." North Carolina Natural Heritage Program, Division of Natural Resource Planning and Conservation, Department of Environment and Natural Resources. <http://www.ncnhp.org/Images/2008-animal-book-complete.pdf> (Accessed January 29, 2010).

(Lewis et al., 2008) Lewis, D.E., et al. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2007." NUREG-0713, Volume 29. U.S. Nuclear Regulatory Commission. December. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713 (Accessed January 29, 2010).

(Miller, 2002) Miller, N.P. "Transportation Noise and Recreational Lands." *Proceedings of Inter-Noise 2002*, Dearborn, Michigan. August 19-21.

(Moser and Ross, 1995) Moser, M.L., and S.W. Ross. "Habitat Use and Movements of Shortnose and Atlantic Sturgeons in the Lower Cape Fear River, North Carolina." *Transactions of the American Fisheries Society* 124:225-234.

(National Audubon Society, 2009a). National Audubon Society. "North Carolina Important Bird Areas of North Carolina." <http://nc.audubon.org/birds-science-education/important-bird-areas/important-bird-areas-north-carolina> (Accessed June 5, 2009).

(National Audubon Society, 2009b). National Audubon Society. "What Is an Important Bird Area?" <http://www.audubon.org/bird/iba/iba_intro.html> (Accessed June 5, 2009).

(NatureServe, 2009) NatureServe. "NatureServe Explorer: An Online Encyclopedia of Life." Version 7.1. <http://www.natureserve.org/explorer> (Accessed September 21, 2009).

(NCCIA, 2004) North Carolina Commission of Indian Affairs. "Annual Report 2003-2004." <http://www.doa.state.nc.us/cia/documents/annualrpts-plans/2003-2004-AnnualReport.pdf> (Accessed January 21, 2010).

(NCDAQ, 2004a) North Carolina Division of Air Quality, North Carolina Environmental Management Commission, Department of Environment and Natural Resources. "Permit No. 1161R19 Issued to General Electric Company, Wilmington, New Hanover County, North Carolina." December 3.

(NCDAQ, 2004b) North Carolina Division of Air Quality, North Carolina Environmental Management Commission, Department of Environment and Natural Resources. "Permit No. 1756R17 Issued to Global Nuclear Fuel – Americas, LLC, Wilmington, New Hanover County, North Carolina." December 15.

(NCDAQ, 2009a) North Carolina Division of Air Quality, North Carolina Department of Environment and Natural Resources. "North Carolina Criteria and Toxic Air Pollutant Point Source Emissions Report: 2007, Brunswick County, All Pollutants." <http://xapps.enr.State.nc.us/aq/ToxicsReport/toxrpt.jsp?ibeam=true> (Accessed October 3, 2009).

(NCDAQ, 2009b) North Carolina Division of Air Quality, North Carolina Department of Environment and Natural Resources. "North Carolina Criteria and Toxic Air Pollutant Point Source Emissions Report: 2007, New Hanover County, All Pollutants." <http://xapps.enr.State.nc.us/aq/ToxicsReport/toxrpt.jsp?ibeam=true> (Accessed October 3, 2009).

(NCDAQ, 2009c) North Carolina Division of Air Quality, North Carolina Department of Environment and Natural Resources. "North Carolina Criteria and Toxic Air Pollutant Point Source Emissions Report: 2007, Pender County, All Pollutants." <http://xapps.enr.State.nc.us/aq/ToxicsReport/toxrpt.jsp?ibeam=true> (Accessed October 3, 2009).

(NCDAQ, 2009d) North Carolina Division of Air Quality, North Carolina Department of Environment and Natural Resources. "North Carolina Criteria and Toxic Air Pollutant Point Source Emissions Report: 2007, General Electric Company." <http://xapps.enr.State.nc.us/aq/ToxicsReport/toxrpt.jsp?ibeam=true> (Accessed October 3, 2009).

(NCDAQ, 2009e) North Carolina Division of Air Quality, North Carolina Department of Environment and Natural Resources. Personal communication from T. Sabetti (North Carolina, Division of Air Quality) to Y-S. Chang (Argonne National Laboratory). May 19.

(NCDAQ, 2011a) North Carolina Division of Air Quality, North Carolina Department of Environment and Natural Resources. "North Carolina Criteria and Toxic Air Pollutant Point Source Emissions Report: 2007, Facilities in New Hanover County Reporting Mercury & Compounds." <http://xapps.enr.State.nc.us/aq/ToxicsReport/toxrpt.jsp?ibeam=true> (Accessed April 28, 2011).

(NCDAQ, 2011b) North Carolina Division of Air Quality, North Carolina Department of Environment and Natural Resources. "North Carolina Criteria and Toxic Air Pollutant Point Source Emissions Report: 2007, Facilities in Brunswick County Reporting Mercury & Compounds." <http://xapps.enr.State.nc.us/aq/ToxicsReport/toxrpt.jsp?ibeam=true> (Accessed April 28, 2011).

(NCDAQ, 2011c) North Carolina Division of Air Quality, North Carolina Department of Environment and Natural Resources. "North Carolina Criteria and Toxic Air Pollutant Point Source Emissions Report: 2007, Facilities in Pender County Reporting Mercury & Compounds." <http://xapps.enr.State.nc.us/aq/ToxicsReport/toxrpt.jsp?ibeam=true> (Accessed April 28, 2011).

(NCDC, 2009a) National Climatic Data Center, National Oceanic and Atmospheric Administration. "U.S. Climate Normals – Climate of North Carolina." <http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl> (Accessed May 10, 2009).

(NCDC, 2009b) National Climatic Data Center, National Oceanic and Atmospheric Administration. "2008 Local Climatological Data Annual Summary with Comparative Data, Wilmington, North Carolina (KILM)." <http://www1.ncdc.noaa.gov/pub/orders/IPS-37433F91-1949-469E-9A9A-85BC04BFC4D5.pdf> (Accessed February 1, 2012).

(NCDC, 2009c) National Climatic Data Center, National Oceanic and Atmospheric Administration. "Integrated Surface Data (ISD), DS3505 Format, Database." <ftp://ftp3.ncdc.noaa.gov/pub/data/noaa> (Accessed August 1, 2009).

(NCDC, 2009d) National Climatic Data Center, National Oceanic and Atmospheric Administration, Satellite and Information Service. "Storm Events." <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms> (Accessed April 13, 2009).

(NCDEHNR, 1991a) North Carolina Department of Environment, Health, and Natural Resources. Letter from A.P. Howard, Jr. (North Carolina Department of Environment, Health, and Natural Resources) to B. Wolfe (General Electric Nuclear Energy) dated October 30. "Subject: Notice of Violation 15A NCAC 2L." ADAMS Accession No. ML091490115.

(NCDEHNR, 1991b) North Carolina Department of Environment, Health, and Natural Resources. Letter from A.P. Howard, Jr. (North Carolina Department of Environment, Health, and Natural Resources) to B. Wolfe (General Electric Nuclear Energy) dated December 6. "Subject: Notice of Violation 15A NCAC 2L." ADAMS Accession No. ML091490129.

(NCDENR, 2001) North Carolina Department of Environment and Natural Resources, North Carolina Natural Heritage Program, Division of Parks and Recreation. "Guide to Federally Listed Endangered and Threatened Species of North Carolina." <http://www.ncnhp.org/Pages/guide.htm> (Accessed January 29, 2010).

(NCDENR, 2007a) North Carolina Division of Water Quality, Department of Environment and Natural Resources. "North Carolina Water Quality Assessment and Impaired Waters List (2006 Integrated 305(b) and 303(d) Report), Final." May. <http://portal.ncdenr.org/c/document_library/get_file?uuid=e3cfb62f-0798-480d-90d7-6a0e866f55de&groupId=38364> (Accessed February 1, 2012).

(NCDENR, 2007b) North Carolina Department of Environment and Natural Resources. "Wastewater Treatment and Reclaimed Water Utilization System Permit." Final. ADAMS Accession No. ML091530549.

(NCDENR, 2008a) North Carolina Department of Environment and Natural Resources, Division of Waste Management. "Fact Sheet. Permit Number 65-04, New Hanover County Integrated Solid Waste Management." <http://www.wastenotnc.org/sw/Scan_Docs/4245.pdf> (Accessed October 12, 2009). Document no longer available online.

(NCDENR, 2008b) North Carolina Department of Environment and Natural Resources, Division of Waste Management. "Municipal Solid Waste Facility, Permit No. 65-04." June 19. <http://www.wastenotnc.org/sw/Scan_Docs/4778.pdf> (Accessed October 12, 2009). Document no longer available online.

(NCDENR, 2008c) North Carolina Department of Environment and Natural Resources. Letter from F. Rohde (North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries) to H. Wicker (U.S. Army Corps of Engineers) dated August 8. "Subject: ID#SAW-2007-00073, Carolina Cement Company (Titan America)."

(NCDENR, 2009a) North Carolina Department of Environment and Natural Resources. "North Carolina Solid Waste Management Annual Report, July 1, 2007 – June 30, 2008." January. <http://portal.ncdenr.org/web/wm/sw/swmar?p_p_id=110_INSTANCE_V4fV&p_p_lifecycle=0&p_p_state=maximized&p_p_mode=view&p_p_col_id=column-3&p_p_col_count=1&_110_INSTANCE_V4fV_struts_action=%2Fdocument_library_display%2Fview&_110_INSTANCE_V4fV_folderId=4649254> (Accessed February 12, 2012).

(NCDENR, 2009b) North Carolina Department of Environment and Natural Resources. Personal communication from D. Dusenbury (North Carolina Radiation Protection Section) to C. Ridge (U.S. Nuclear Regulatory Commission). September 1.

(NCDENR, 2009c) North Carolina Department of Environment and Natural Resources, Division of Waste Management. Letter from C.V. Jesneck (North Carolina Department of Environment and Natural Resources) to H.R. Strickler (General Electric Company) dated January 15. "Subject: Inactive Hazardous Waste Sites Priority List." ADAMS Accession No. ML091490132.

(NCDENR, 2009d) North Carolina Department of Environment and Natural Resources. Letter from R. Berry (Division of Water Quality) to S. O'Connor (Global Nuclear Fuel-Americas) dated September 23. "Subject: Draft of Renewal Permit."

(NCDENR, 2009e) North Carolina Department of Environment and Natural Resources, North Carolina Natural Heritage Program, "North Carolina Heritage Program Virtual Workroom." <http://nhpweb.enr.state.nc.us/nhis/public/gmap75_main.phtml> (Accessed June 23 and October 1, 2009). Document no longer available online.

(NCDENR, 2010) North Carolina Department of Environment and Natural Resources, Division of Coastal Management. "Communities with CAMA Land Use Plans." <http://dcm2.enr.State.nc.us/Planning/LUP%20Submittal_Approval_website.pdf> (Accessed January 21, 2010).

(NCDMF, 2006) North Carolina Division of Marine Fisheries, Department of Environment and Natural Resources. "Fishery Nursery Areas Map 25." July. <http://www.ncfisheries.net/maps/FNA_maps/map25.pdf> (Accessed October 1, 2009).

(NCDMF, 2009) North Carolina Division of Marine Fisheries, Department of Environment and Natural Resources. "North Carolina's Nursery System." <http://www.ncfisheries.net/habitat/pna.htm> (Accessed October 1, 2009).

(NCDOR, 2009) North Carolina Department of Revenue (Web site). <http://www.dornc.com/index.html> (Accessed September 18, 2009).

(NCDOT, 2005) North Carolina Department of Transportation. "Southeastern North Carolina Passenger Rail Study." July. <http://www.bytrain.org/future/pdf/July05SENCRPT.pdf> (Accessed June 19, 2009).

(NCDOT, 2008) North Carolina Department of Transportation. "Annual Average Daily Traffic, Wilmington, North Carolina." February. <http://dotw- xfer01.dot.State.nc.us/imgdot/DOTTSUMaps/AADT_URBANS/WILMINGTON(NEW_HANOVER)_URBAN/2007/Sheet1.pdf> (Accessed April 28, 2009).

(NCES, 2009) National Center for Educational Statistics. "Search for Public School Districts." <http://www.nces.ed.gov/ccd/districtsearch/> (Accessed June 2009).

(NCGS, 2007) North Carolina Geological Survey, North Carolina Department of Environment and Natural Resources, Division of Land Resources. "Geologic Hazards in North Carolina – Sinkholes (Karst)." <http://www.geology.enr.state.nc.us/Geologic_hazards_sink_holes_karst/sinkholes.htm#karst> (Accessed July 14, 2009). Document no longer available online.

(NCOSBM, 2009) North Carolina Office of State Budget and Management. "Population Estimates and Projections." <http://demog.state.nc.us> (Accessed September 18, 2009).

(NCRP, 2009) National Council on Radiation Protection and Measurements. Press Release, "Report No. 160, Ionizing Radiation Exposure of the Population of the United States." March. <http://www.ncrponline.org/Press_Rel/Rept_160_Press_Release.pdf> (Accessed July 20, 2009). Document no longer available online.

(NCWRC, 2007) North Carolina Wildlife Resource Commission. Personal communication from B. Barwick (North Carolina Wildlife Resources Commission, Division of Inland Fisheries) to J. Schimek (RTI International) dated December 18. "Subject: Commercial and Recreational Fisheries on the Northeast Cape Fear River."

(New Hanover County, 2009a) New Hanover County. "County Code of Ordinances, Chapter 23, Environment, Article II, Noise." <http://www.municode.com/resources/gateway.asp?pid=11337&sid=33> (Accessed April 7, 2009).

(New Hanover County, 2009b) "New Hanover County. Zoning Map." <http://wwwdefault.nhcgov.com/website/zoning/viewer.htm?Title=Map%20of%20New%20Hanover%20Co.%20NC> (Accessed October 2, 2009).

(New Hanover County, 2009c) New Hanover County Planning Department. Letter from C. O'Keefe (New Hanover County Planning Department) to A. Kock (U.S. Nuclear Regulatory Commission). "Subject: Request for Information Regarding Land Use in the Vicinity of the Proposed General Electric-Hitachi Global Laser Enrichment Facility." Document is undated. ADAMS Accession No. ML092360197.

(NHC, 2009) National Hurricane Center. "Hurricane Preparedness: Return Periods." <http://www.nhc.noaa.gov/HAW2/english/basics/return_printer.shtml> (Accessed May 14, 2009).

(NIOSH, 1996) National Institute for Occupational Safety and Health. "IDLH Documentation: Uranium." August. <http://www.cdc.gov/niosh/idlh/uranium.html> (Accessed October 26, 2009).

(NIOSH, 2005) National Institute for Occupational Safety and Health. "NIOSH Pocket Guide to Chemical Hazards: Uranium." September. <http://www.cdc.gov/niosh/npg/npgd0651.html> (Accessed October 26, 2009).

(NOAA, 2002) National Oceanic and Atmospheric Administration, U.S. Department of Commerce. "Reasor Chemical Company." <http://archive.orr.noaa.gov/book_shelf/257_reasor.pdf> (Accessed February 8, 2012).

(NOAA, 2009) National Oceanic and Atmospheric Administration. "1996-2005 Flash Density Map, 10 Kilometer Grid." <http://www.lightningsafety.noaa.gov> (Accessed May 15, 2009).

(NOAA, 2011) National Oceanic and Atmospheric Administration, National Geophysical Data Center. "NOAA/WDC Global Historical Tsunami Database at NGDC." <www.ngdc.noaa.gov/hazard/tsu_db.shtml> (Accessed December 12, 2011).

(NRC, 1997) U.S. Nuclear Regulatory Commission. "Environmental Assessment for Renewal of Special Nuclear Material License No. SNM-1097 (NRC Docket 70-1113) General Electric Company, Nuclear Energy Production Facility, Wilmington, NC." May.

(NRC, 2003) U.S. Nuclear Regulatory Commission. "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs." NUREG-1748. August. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1748/sr1748.pdf> (Accessed January 29, 2010).

(NRC, 2004a) U.S. Nuclear Regulatory Commission. "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions," Final Policy Statement (69 FR 52040, 52041-52; August 24, 2004).

(NRC, 2004b) U.S. Nuclear Regulatory Commission. "Fact Sheet: Biological Effects of Radiation." <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/bio-effects-radiation.pdf> (Accessed September 18, 2009).

(NRC, 2009) U.S. Nuclear Regulatory Commission. "Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM-1097 for Global Nuclear Fuel-Americas, Wilmington Fuel Fabrication Facility," Docket No. 70-1113. May 14. ADAMS Accession No. ML091180239.

(NRC, 2010) U.S. Nuclear Regulatory Commission. "Biological Effects of Radiation." Reactor Concepts Manual, Workshop Manual. <http://www.nrc.gov/reading-rm/basic-ref/teachers/09.pdf> (Accessed March 22, 2010).

(NSSL, 2009) National Severe Storms Laboratory, National Oceanic and Atmospheric Administration. "Severe Thunderstorm Climatology." <http://www.nssl.noaa.gov/hazard/index.html> (Accessed May 11, 2009).

(Omernik et al., 2000) Omernik, J.M., et al. "Ecoregions of Wisconsin." *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters* 88: 77-1-3.

(Ozier et al., 1999) Ozier, J.C., et al. “Protected Animals of Georgia.” Georgia Department of Natural Resources, Wildlife Resources Division, Nongame Wildlife-Natural Heritage Section.

(Patrick et al., 1995) Patrick, T.S., et al. “Protected Plants of Georgia, an Information Manual on Plants Designated by the State of Georgia as Endangered, Threatened, Rare, or Unusual.” Georgia Department of Natural Resources, Wildlife Resources Division.

(Pender County, 2006) Pender County Planning Board. “Pender County CAMA Land Use Plan, 2005 Update.” Final. <http://dcm2.enr.state.nc.us/Planning/Pender/Revised%20final%20LUP5.24.06.pdf> (Accessed September 29, 2009).

(Petersen et al., 2008) Petersen, M.D., et al. “Documentation for the 2008 Update of the United States National Seismic Hazard Maps: Open-File Report 2008-1128.” U.S. Department of the Interior, U.S. Geological Survey. May. <http://pubs.usgs.gov/of/2008/1128/pdf/OF08-1128_v1.1.pdf> (Accessed December 14, 2011).

(Robinson, 2005) Robinson, P.J. *North Carolina Weather & Climate*. The University of North Carolina Press, Chapel Hill, North Carolina.

(RTI, 1992) Research Triangle Institute. “Remedial Action Plan for Organic Compounds in Groundwater.” RTI Report No. 5040-01F. December 14. ADAMS Accession No. ML112500151.

(RTI, 1994) Research Triangle Institute. “Corrective Action Plan for Organic Compounds in Groundwater.” RTI Report No. 5040/006/01F. March 30. ADAMS Accession No. ML112500163.

(RTI, 1996) Research Triangle Institute. “Comprehensive Site Assessment and Corrective Action Plan for Organic Compounds in Groundwater – Vicinity of Northern Property Boundary Area.” RTI Report No. 5040/022/01F. ADAMS Accession No. ML112500169.

(RTI, 1997) Research Triangle Institute. “Technical Update of Hydrogeological and Groundwater Quality Conditions in the Northwest Site Area.” RTI Document No. 6448-018/001/01F. October 30.

(RTI, 1998a) Research Triangle Institute. “Fourth Quarter 1997 Groundwater Monitoring Report for the FMO/FMOX Building Area.” RTI Report No. 6448/002/021/01F. June 15. ADAMS Accession No. ML092100659.

(RTI, 1998b) Research Triangle Institute. “Technical Update of Groundwater Contamination beneath the FCO Building Cleaning Room Area.” RTI Document No. 6448-012/005/01F. September 8. ADAMS Accession No. ML092110739.

(RTI, 1999a) Research Triangle Institute. “Corrective Action Plan for the Northwest Site Area.” RTI Report No. 6448-018/004/01F. ADAMS Accession No. ML112500149.

(RTI, 1999b) Research Triangle Institute. “Waste Treatment Area Investigation Report.” RTI Report No. 6448-020/001/01F. December 22. ADAMS Accession No. ML091820113.

(RTI, 2008a) Research Triangle Institute. “Northwest Site Area 2006-2007 Monitoring Report, General Electric/Global Nuclear Fuel Site, Wilmington, North Carolina.” RTI Project No. 0600002.000.005. December. ADAMS Accession No. ML091820027.

(RTI, 2008b) Research Triangle Institute. “2006-2007 Report of Organic Compounds in Groundwater, General Electric/Global Nuclear Fuel Site Wilmington, North Carolina.” RTI Project No. 0600002.000.003. December. ADAMS Accession No. ML091820023.

(Russ and Postlewaite, 2008) Russ, T., and M. Postlewaite. “An Intensive Cultural Resource Investigation: Potential GE Expansion New Hanover County, North Carolina.” ESI Report of Investigations No. 1126. Prepared by Environmental Services, Inc., for RTI International. March.

(Tarr and Wheeler, 2006) Tarr, A.C. and R.L. Wheeler. “Earthquakes in Virginia and Vicinity 1774 –2004: Open File Report 2006-1017.” U.S. Department of the Interior, U.S. Geological Survey. April. <http://pubs.usgs.gov/of/2006/1017/downloads/pdf/Map.pdf> (Accessed December 14, 2011).

(Turner and Schulze, 2007) Turner, D.B., and R.H. Schulze. “Practical Guide to Atmospheric Dispersion Modeling.” Trinity Consultants, Inc. and Air & Waste Management Association.

(University of Idaho, 2009) University of Idaho. “Köppen Climate Classification for the Conterminous United States.” <http://snow.ag.uidaho.edu/Clim_Map/koppen_usa_map.htm> (Accessed May 15, 2009).

(USCB, 2000) U.S. Census Bureau. “Decennial Census 2000 Summary File 1 (SF 1) 100-Percent Data.” <http://factfinder.census.gov/servlet/DatasetMainPageServlet> (Accessed September 29, 2009).

(USCB, 2009a) U.S. Census Bureau. “American Fact Finder.” <http://factfinder.census.gov> (Accessed September 18, 2009).

(USCB, 2009b) U.S. Census Bureau. “Land Area, Population, and Density for States and Counties: 1990.” <http://www.census.gov/population/censusdata/90den_stco.txt> (Accessed September 18, 2009).

(USCB, 2009c) U.S. Census Bureau. “County Business Patterns, 2006.” <http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html> (Accessed September 18, 2009).

(USCB, 2009d) U.S. Census Bureau. GCT1901. “Median Household Income, 2006-2008 American Community Survey 3-Year Estimates.” <http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=01000US&-_box_head_nbr=GCT1901&-ds_name=ACS_2008_3YR_G00_&-_lang=en&-mt_name=ACS_2008_3YR_G00_GCT1901_US25T&-format=US-25T> (Accessed January 26, 2010).

(USDA, 2009) U.S. Department of Agriculture, National Agricultural Statistics Service. “2007 Census of Agriculture: Volume 1, Chapter 2, County Level Data. North Carolina, Volume 1, Complete Report, All Tables.” <http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/North_Carolina/index.asp> (Accessed June 2009).

(USGS, 2005) U.S. Geological Survey, U.S. Department of the Interior. “Mineral Resources Data System.” <http://tin.er.usgs.gov/mrds> (Accessed October 2, 2009).

(USGS, 2009) U.S. Geological Survey, U.S. Department of the Interior. “Estimated Use of Water in the United States in 2000.” <http://water.usgs.gov/watuse/> (Accessed October 2, 2009).

(USGS 2010a) U.S. Geological Survey. “USGS Surface-Water Annual Statistics for the Nation, discharge data from 02108566 Northeast Cape Fear River near Burgaw, North Carolina.” <http://waterdata.usgs.gov/nwis/annual/?referred_module=sw&site_no=02108566&por_02108566_23=1031739,00060,23,2004,2006&year_type=W&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list> (Accessed January 27, 2010).

(USGS 2010b) U.S. Geological Survey. “USGS Surface-Water Annual Statistics for the Nation, discharge data from 02108000 Northeast Cape Fear River near Chinquapin, North Carolina.” <http://waterdata.usgs.gov/nwis/annual/?referred_module=sw&site_no=02108000&por_02108000_2=1031736,00060,2,1940,2010&year_type=W&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list> (Accessed January 27, 2010).

(USGS, 2011) U.S. Geological Survey. “Shakemap us082311a, Instrumental Intensity. September. <http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/082311a/> (Accessed December 7, 2011).

(Wang and Angell, 1999) Wang, J.X.L., and J.K. Angell. “Air Stagnation Climatology for the United States (1948–1998).” NOAA/ARL ATLAS No. 1. National Oceanic and Atmospheric Administration, Air Resources Laboratory. April. <http://www.arl.noaa.gov/documents/reports/atlas.pdf> (Accessed June 15, 2009).

(Wave Transit, 2009) Wave Transit (Cape Fear Public Transportation Authority). “About Wave Transit.” <http://www.wavetransit.com/about/history.aspx> (Accessed February 10, 2012).

(Weakley, 2008) Weakley, A.S. “Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas.” Working draft of April 7, 2008. <http://www.herbarium.unc.edu/WeakleyFlora_2008-Apr.pdf> (Accessed October 3, 2009).

(Weaver and Pope, 2001) Weaver, J.C. and B.F. Pope. “Low-Flow Characteristics and Discharge Profiles for Selected Streams in the Cape Fear River Basin, North Carolina, through 1998.” U.S. Geological Survey Water-Resources Investigations Report 01–4094. Prepared in cooperation with the North Carolina Department of Environment and Natural Resources, Division of Water Quality.

(Whigham and Brinson, 1990). Whigham, D.F., and M.M. Brinson. “Wetland Value Impacts.” *Wetlands and Shallow Continental Water Bodies* 1:401–421.

(Wilde-Ramsing, 1978) Wilde-Ramsing, M. "A Report on the New Hanover County Archaeological Survey: A C.E.T.A. Project, August 1977-July 1978." North Carolina Department of Cultural Resources, Office of Archives and History, Division of Historical Resources, North Carolina Office of State Archaeology. ADAMS Accession No. ML091610400.

4 ENVIRONMENTAL IMPACTS

4.1 Introduction

This chapter presents the potential impacts associated with the preconstruction activities, construction, operations, and decommissioning of the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility. For the proposed action, this Environmental Impact Statement (EIS) considers impacts from construction activities, normal operations, credible accidents, and cumulative impacts and resource commitments. As discussed in Section 4.2, preconstruction activities are not part of the proposed action. This chapter is organized by resource area (i.e., air, water, noise, public and occupational health, etc.), based on the descriptions of preconstruction activities and the proposed action that are included in Section 2.1 of this EIS. Impact discussions are divided into three categories: preconstruction and construction, operations, and decontamination and decommissioning.

Within each resource area, mitigation measures identified by GLE and U.S. Nuclear Regulatory Commission (NRC) staff are disclosed. While the NRC cannot impose mitigation outside its regulatory authority under the *Atomic Energy Act*, a discussion of mitigation measures is presented in this chapter. For the purposes of the *National Environmental Policy Act* (NEPA) per the U.S. *Code of Federal Regulations* (CFR) Title 10, “Energy,” 10 CFR 51.71(d), the NRC is disclosing mitigation measures that could reduce or avoid environmental effects of the proposed action. Mitigation measures identified by GLE in its Environmental Report (GLE, 2008) and factored into the NRC’s environmental impact analysis are presented in Table 5-1. Additional mitigation measures identified by the NRC are presented in Table 5-2. These mitigation measures are not requirements being imposed upon GLE.

Section 4.2 describes the impacts of preconstruction activities and the proposed action under consideration in this EIS – namely, the construction, operation, and decommissioning of the proposed GLE Facility at the existing GE site in Wilmington, North Carolina. Because decommissioning is not expected to occur until 40 years after the license is issued, decontamination and decommissioning impacts discussed in Section 4.2.17 are preliminary, or estimated, for the proposed GLE Facility. Within 12 months of its decision to cease enrichment activities, GLE will submit a decommissioning plan to the NRC in accordance with 10 CFR 70.38, and would begin the activities described in the decommissioning plan after approval by the NRC. The proposed activities in the decommissioning plan will be subject to further NEPA review, as appropriate, at that time.

In addition, this chapter discusses the potential cumulative impacts (Section 4.3) and impacts of the no-action alternative (Section 4.4). For the purposes of this EIS, the assessment of the cumulative impacts of the no-action alternative assumes that certain preconstruction activities have occurred, because these preconstruction activities are assumed to occur regardless of whether an NRC license for the proposed GLE Facility is granted.

Environmental impacts may be radiological or non-radiological. Radiological impacts include radiation doses to the public and workers from the routine operations, transportation, potential accidents, and decommissioning and environmental impacts from potential releases in the air, soil, or water. Non-radiological impacts include chemical hazards, emissions (e.g., vehicle fumes), occupational accidents and injuries (e.g., vehicle collisions), and workplace accidents.

The NRC defines three significance levels for rating impacts on a resource (NRC, 2003):

- ***Small impact**: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.*
- ***Moderate impact**: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.*
- ***Large impact**: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.*

The Commission's *Notice of Hearing and Commission Order* (75 FR 1819) specified that a licensing decision be made within 30 months of the Order (i.e., June 2012). Therefore, the analyses in this chapter are based on the assumption that a licensing decision will be made in June 2012, construction (if authorized) would begin in 2012, start-up and final construction would begin in 2014, full facility operations would be achieved in 2020, and termination of the 40-year license would occur in 2052. The NRC expects that any subsequent changes in the licensing and construction schedule could cause slight changes to certain analyses (e.g., air quality, socioeconomics, and cost-benefit) but would not affect the conclusions regarding impacts on these resource areas.

4.2 Preconstruction Activities and the Proposed Action

As described in Section 2.1 of this EIS, the proposed action is the construction, operation, and decontamination and decommissioning of the proposed GLE Facility. Under the proposed action, the NRC would issue a license to GE-Hitachi Global Laser Enrichment LLC in accordance with the requirements of 10 CFR Parts 70, 40, and 30 to possess and use by-product source and special nuclear material.

The NRC has granted an exemption (NRC, 2009a) for GLE to conduct certain preconstruction activities without an NRC license to construct and operate the proposed GLE Facility. The NRC concluded that the request to perform these activities is authorized by law, will not endanger life or property or common defense and security, and is in the public interest. The preconstruction activities covered by the exemption include:

- Clearing of approximately 40 hectares (100 acres) for the proposed GLE Facility;
- Site grading and erosion control;
- Installation of a stormwater retention system;
- Construction of main access roadway and guardhouse(s);
- Placement of utilities (electricity, potable water, process water, water for fire suppression, sanitary sewer, and natural gas);
- Construction of parking lots and minor roadways; and
- Construction of administrative building(s) (GLE, 2009b).

No core production facilities would be constructed as part of the preconstruction activities. Since preconstruction and construction activities are closely related, these impacts are evaluated together and an estimate is provided regarding the apportionment of impacts between preconstruction activities (authorized under the exemption and separate from the proposed action) and construction as defined in 10 CFR 51.4. Therefore, the impacting activities are organized into three phases:

- preconstruction and construction activities
- facility operations
- decontamination and decommissioning

4.2.1 Land Use Impacts

Land use impacts occur when an area is committed in a way that precludes all other future land use or alters the land use of adjacent properties. Land use impacts also occur when activities take place that are incompatible with the zoning designated by county or State officials. Most of the project area currently contains mixed pine forest. The proposed GLE Facility project area is bordered to the east by GE's Fuel Manufacturing Operation (FMO) plant and aircraft engine plant. To the west is the Northeast Cape Fear River. Residential developments are located to the northeast, east, and south. The project area under consideration is zoned by New Hanover County for heavy industrial use. West of the Northeast Cape Fear River is the L.V. Sutton Power Plant. The areas to the northeast, east, and south are zoned for residential development. The construction, operation, and decommissioning of the proposed GLE Facility are consistent with current zoning. The entire project area is owned by GE. The following sections discuss land use impacts resulting from various phases of the project.

4.2.1.1 Preconstruction and Construction Activities

As described in Section 1.4.1, preconstruction activities include clearing and grading of the land, vegetation removal, improvement of existing roads, and construction of support structures, among other activities. Preconstruction activities would remove the mixed pine forest. The current industrial land use of the proposed GLE Facility site would not change. Preconstruction activities would be consistent with current zoning and would not affect surrounding land use.

Construction of the proposed GLE Facility would not be in conflict with current zoning and would not affect surrounding land use. Most activities would occur on the Wilmington Site, which has restricted access. Potential impacts outside of the property boundary could result from construction traffic. These impacts are discussed in Section 4.2.10. Construction activities will be temporary (see Section 2.1.5). The project area is identified in the Wilmington-New Hanover County Coastal Area Management Act (CAMA) as a wetland and aquifer resource protection area. The designation as a wetland resource protection area is intended to limit the destruction of wetlands. No wetlands remain within the footprint of the project. Additionally, the aquifer would not be affected by construction activities. County officials have agreed that the resources identified in the CAMA plan are being appropriately considered and that construction, operation, and decommissioning of the facility are not expected to impact these resources (New Hanover County, 2009a). While the industrial use of the land would not change, land use impacts from preconstruction and construction activities would be SMALL. The estimated relative

contributions to impacts are 50 percent during preconstruction activities and 50 percent during construction.

4.2.1.2 Facility Operations

Operation of the proposed GLE Facility would not be in conflict with the current industrial zoning of the Wilmington Site. The operation of a uranium enrichment facility is a change from the current land cover (undeveloped forest). The proposed GLE Facility would be in an area that is zoned for heavy industrial use. It is possible that operation of the proposed GLE Facility could affect plans for nearby low-density residential land development to the north, east, and south. However, residential developments already exist in close proximity to the FMO plant, the GE aircraft engine plant, and the L.V. Sutton Power Plant. Operation of these facilities has not altered or affected surrounding land use. In addition, residential developments continue to be planned for the area (New Hanover County, 2009a). The greatest potential for impacts on land use would occur during operations because it would occur over the proposed 40-year license period. However, land use associated with operation of the proposed GLE Facility is consistent with other industrial development in the immediate area, which has not altered the surrounding land use. Therefore, overall impacts on land use from operations are expected to be SMALL.

4.2.1.3 Mitigation Measures

To mitigate land use impacts, GLE proposes to use existing service road routes and utility rights-of-way (to the fullest extent practicable) to minimize the need for clearing additional wooded areas, and to use existing wastewater treatment and solid waste management infrastructure (to the fullest extent practicable) to reduce the total area required for the proposed GLE Facility. In addition, the New Hanover County Soil Erosion and Sedimentation Control Ordinance identifies best management practices (BMPs) for construction in New Hanover County (New Hanover County, 2007). The BMPs are discussed in detail in Section 4.2.5.3. BMPs for construction would help moderate the short-term land use effects associated with preconstruction and construction activities. BMPs for controlling waste disposal, erosion, and runoff would help restrict the effect of facility operations on surrounding land use.

4.2.2 Historic and Cultural Resources Impacts

The *National Historic Preservation Act* (NHPA) requires Federal agencies to consider the effects of their undertakings on historic properties. Historic properties are defined as resources that are eligible for listing on the NRHP. The criteria for eligibility are listed in Title 36, “Parks, Forests, and Public Property,” Part 60, Section 4, “Criteria for Evaluation,” of the U.S. *Code of Federal Regulations* (36 CFR Part 60.4) and include (1) association with significant events in history; (2) association with the lives of persons significant in the past; (3) embodies distinctive characteristics of type, period, or construction, or (4) sites or places that have yielded or are likely to yield important information (ACHP, 2008). The historic preservation review process (Section 106 of the NHPA) is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in Title 36, “Parks, Forests, and Public Property,” Part 800, “Protection of Historic Properties,” of the U.S. *Code of Federal Regulations* (36 CFR Part 800). The NRC is coordinating its Section 106 review through NEPA per 36 CFR 800.8(c). The area of potential effect for the project is defined as the 106-hectare (263-acre) study area. The NRC has consulted with the North Carolina State Historic Preservation Office (SHPO), the ACHP, and several American Indian tribes.

Section 106 of the NHPA identifies the process for considering whether a project will affect a significant cultural resource. The Section 106 process requires consultation between the lead Federal agency and the SHPO, which is the custodian of information on cultural resources for the state. The Section 106 process also requires that Native American groups who have aboriginal ties to the project area be consulted to determine if resources important to the tribe are present.

Cultural resources, especially archaeological sites, are sensitive to disturbance and are nonrenewable. Much of the information possessed in an archaeological site is derived from the spatial relationships between soil layers and artifacts. Once these spatial relationships are altered, they can never be reclaimed. As a result, the greatest threats to archaeological resources are from ground-disturbing activities that will alter the spatial relationships. Most ground-disturbing activities would occur during preconstruction activities, when the site is cleared and prepared for construction.

4.2.2.1 Preconstruction and Construction Activities

Preconstruction activities have the potential to impact historic and cultural resources. Ground-clearing activities such as vegetation removal, grading and recontouring for drainage have the greatest potential for impacting historic and cultural resources. Much of the ground disturbance expected for the proposed GLE Facility would occur during preconstruction activities. The area that would be affected by preconstruction activities was surveyed for historic and cultural resources in 2008. Site 31NH801 was identified during the survey and was determined to be eligible for listing on the NRHP (GLE, 2008; NCDCR, 2009). The site is located adjacent to an access road that was identified for the proposed GLE Facility in the original construction designs. GLE has since reconfigured the access roads for the facility and will no longer develop the road adjacent to site 31NH801 (GLE, 2009b); therefore, no impacts are expected to site 31NH801 from preconstruction or construction activities. The newly defined areas were surveyed in 2009 and no additional NRHP-eligible cultural resources were identified (ESI, 2009).

The North Carolina SHPO requested that it be contacted in the event of an unanticipated discovery of cultural resources during the project. The SHPO also requested that, in the event that human remains are found during project activities, the applicable procedures in North Carolina General Statute 70 Article 3 be followed (NCDCR, 2009). The statute requires that when unmarked remains are encountered, work cease immediately in the vicinity of the find and that work not be allowed to continue without authorization from either the county medical examiner or the State Archaeologist (N.C. General Statute 70.3(b)). GLE developed Common Procedure CP-24-201, *Unexpected Discoveries of Artifacts or Human Remains*, which was reviewed by the North Carolina SHPO. The SHPO found the procedure to be adequate (NCDCR, 2010).

No NRHP-eligible cultural resources are expected to be directly impacted by preconstruction activities. Construction of the proposed GLE Facility would take place on ground previously disturbed by preconstruction activities. No construction activities would occur in the portion of the Wilmington Site where historic and cultural resources are known to exist. If the location for the proposed GLE Facility changes, GLE would supplement its license. The NRC would evaluate whether the change would alter the area of potential effect, and would notify the North Carolina SHPO.

Overall, the impacts on historic and cultural resources from both preconstruction activities and construction of the proposed GLE Facility would be SMALL to MODERATE, given the close proximity of significant resources and the possibility of an unanticipated discovery. While there is some potential for ground disturbance to occur in previously undisturbed areas during construction, most impacts on historic and cultural resources would occur during preconstruction (ground clearing). The estimated relative contributions to impacts are 95 percent during preconstruction activities and 5 percent during construction.

4.2.2.2 Facility Operations

Facility operations and maintenance activities at the proposed GLE Facility have the potential to affect historic and cultural resources. Operations could affect resources if expansion of the plant was deemed necessary in areas that contain historic and archaeological resources. Facility activities are not expected to affect site 31NH801. The North Carolina SHPO asked to review the measures that will be taken by GLE to ensure protection and preservation of site 31NH801 from future ground-disturbing activities (NCDCR, 2009). In response, GLE developed Common Procedure CP-24-201, *Unexpected Discoveries of Artifacts or Human Remains*. Additionally, NRC proposed a license condition that would require GLE to consider the potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed areas of the proposed GLE Facility site. Based on the procedure and proposed license condition, the NRC determined that operational impacts would range from SMALL to MODERATE, given the proposed GLE Facility's close proximity to significant historic and cultural resources and possibility for unanticipated discovery.

The NRC has determined that there would be no adverse effect to the historic resources from the proposed action. This determination is based on the license (if issued) containing the following condition:

> Before engaging in any GLE developmental activity not previously assessed by the NRC in the Final Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment LLC Facility in Wilmington, North Carolina (NUREG-1938) that would physically disrupt or disturb inventoried cultural sites that have been designated eligible for the National Register of Historic Places pursuant to 36 CFR 60.4, the licensee shall, in consultation with the North Carolina SHPO, identify mitigation measures intended to preserve the integrity of these sites. The licensee shall inform the NRC of such mitigation measures prior to engaging in any work at the identified site(s).
>
> Any work that results in the discovery of previously unknown cultural artifacts shall cease in accordance with GLE Common Procedure CP-24-201, *Unexpected Discoveries of Artifacts or Human Remains*. The artifacts shall be inventoried and evaluated, and no disturbance of the area shall occur in accordance with CP-24-201.
>
> All activities that affect cultural resources on the GLE site will be included in GLE's annual environmental monitoring report.
>
> Enforcement of this license condition is subject to the scope of the NRC's regulatory authority.

The North Carolina SHPO concurred with the NRC's determination, based on the license (should one be issued) containing this condition (NCDCR, 2011).

4.2.2.3 Mitigation Measures

No direct impacts on historic and cultural resources are expected. To protect site 31NH801, GLE posted signs stating that no unauthorized excavation is permitted. GLE also proposes to maintain the current graded and vegetated state of the bank at the side of the existing gravel road (GLE, 2008). GLE developed internal procedures (GLE Common Procedure CP-24-201) for the protection of historic and cultural resources in the event of unanticipated discoveries and/or human remains (GLE, 2009h). In the event that cultural resources are discovered in the area of potential effect, GLE would implement these procedures, which include notification of State and local agencies, including the State Archaeologist. The NRC recommends the proposed license condition be included in the license to protect historic and cultural resources.

4.2.3 Visual and Scenic Impacts

The following section discusses the potential visual impacts from preconstruction, construction, and operation of the proposed GLE Facility. Visual impacts would primarily occur during preconstruction and construction. Construction cranes, trucks, and the removal of vegetation represent the greatest potential for visual impacts.

4.2.3.1 Preconstruction and Construction Activities

As described in Section 1.4.1, actions associated with preconstruction include vegetation removal, grading, installation of utilities, and construction of support buildings, among other activities. Most visual impacts would result from vegetation removal and traffic in the northern portion of the Wilmington Site. The vegetation screen along the northern part of the site would not be altered by preconstruction activities. The greatest visual impacts would occur at properties located along Dekker Road. Preconstruction traffic on the site access road would not be visible from Dekker Road. Increased traffic along Castle Hayne Road would be noticeable and temporary.

Proposed GLE Facility construction activities would be limited to the Wilmington Site. Visual impacts could result from the increased traffic entering and leaving the site; however, these impacts would be temporary. The main construction area is surrounded by a vegetation barrier. Therefore, construction activities at the Wilmington Site would be largely screened even from the residences along Dekker Road. Construction cranes would be visible from greater distances. However, these would only be temporary impacts. The construction cranes would be visible from I-140 and likely south of I-140 as well as Castle Hayne Road.

Both preconstruction and construction activities would result in visual impacts. The estimated relative contributions to impacts are 25 percent during preconstruction activities and 75 percent during construction. Overall, the visual and scenic impact from preconstruction and construction activities would be SMALL.

4.2.3.2 Facility Operations

The two most visible features of the proposed GLE Facility would be the water tower at 39.6 meters (130 feet) tall and a portion of the operations building referred to as the operations building tower. The operations building tower would have front and side profiles of 37 meters (120 feet) by 200 meters (660 feet). The height of the operations building tower will depend on

the final process design; however, it could reach up to 49 meters (160 feet) above grade. The water tower would be visible from south of I-140 and from along Castle Hayne Road. The proposed water tower is the same height as the existing water tower, the top of which would be visible from south of I-140 (see Figure 3-3). Although the operations building tower could be approximately 10 meters (930 feet) taller than the water tower, it would be visible primarily from Castle Hayne Road and from the Wooden Shoe subdivision northeast of the Wilmington Site, because the proposed facility is set back further within the Wilmington Site than the existing water tower. The new water tower and the operations building tower would not represent a major alteration of the existing visual environment. Portions of the new plant may be visible from I-140. The planting of additional vegetation on the perimeter of the plant after construction may minimize visual impacts.

In Section 3.4, the U.S. Bureau of Land Management (BLM) Visual Resource Inventory process was applied to the study area. Based on that review, the industrial nature of the Wilmington Site was found to have low scenic quality. The site of the proposed GLE Facility is located adjacent to existing industrial facilities and is not a pristine environment. Likewise, the project area is not in a location that is sensitive to visual intrusions.

Operations of the proposed GLE Facility would not represent a major alteration from the current setting. Visual impacts during facility operations would be SMALL.

4.2.3.3 Mitigation Measures

To mitigate impacts on visual and scenic resources, GLE proposes to locate the proposed GLE Facility away from site boundaries bordering on existing development along NC133 and I-140, maintain the existing tree buffer along the northeast Wilmington Site boundary to limit visibility of the proposed GLE Facility from offsite, and use exterior building colors and landscaping to soften any visual impacts. Additional mitigation measures identified by NRC could include the planting of additional vegetation on the perimeter of the facility site to help screen the study area.

4.2.4 Air Quality Impacts

This section describes potential air quality impacts associated with construction and operation of the proposed GLE Facility in Wilmington, North Carolina. Because certain activities that can cause air quality impacts may take place in more than one of the project phases described in

Section 4.2, the lifespan of the GLE project is considered in four separate phases[1] for the air quality impacts analysis:

- access road construction and land clearing (does not include other preconstruction activities, such as ancillary building construction);

[1] As discussed in Section 4.1, any subsequent changes to the project schedule could cause slight changes to the air impact analysis because of seasonal effects, but are not expected to change any of the impact conclusions.

- building construction (including ancillary building construction that occurs as part of preconstruction activities);[2]
- start-up and final construction (includes concurrent indoor construction with staged testing and start-up of process units as completed); and
- facility operations.

Air emissions were estimated using the standard emission factor references followed by air dispersion modeling to estimate concentrations at and beyond the Wilmington Site boundaries. Potential impacts from access road construction, land clearing, building construction, and start-up and final construction are presented in Section 4.2.4.1; those from facility operations are discussed in Section 4.2.4.2. Mitigation measures for these phases are presented in Section 4.2.4.3. Potential impacts from decontamination and decommissioning are discussed in Section 4.2.17.4. Greenhouse gas (GHG) emissions are addressed in Section 4.2.18.

During the access road construction, land clearing, and building construction phases, the main source of emissions would be fugitive dust from soil disturbances. During the start-up and final construction phase and the operations phase, all non-radiological emissions would be small because no fossil fuels would be burned.

The applicant will obtain all required construction and operating air permits from the NCDENR.

4.2.4.1 Access Road Construction, Land Clearing, and Building Construction

Development of the proposed GLE Facility includes access road construction, land clearing, building construction activities (erection of main GLE buildings and ancillary buildings and structures), and start-up and final construction activities (concurrent indoor construction with staged testing and start-up of process units as completed). Construction would last 7–8 years, but facility operations would begin in 2014. Air quality impacts would be the highest during preconstruction activities and during the initial 2-year period of GLE Facility construction, which would include a high level of soil disturbance by heavy construction equipment. For air quality impact analysis, it is assumed that new onsite access road construction would take place during the two consecutive months of the year that result in the highest air quality impacts, followed by 1 year or more of land clearing. Because these activities have been authorized by exemption (see Section 1.4.1), changes in the licensing schedule discussed in Section 4.1 are not expected to change the schedule of these preconstruction activities.

During access road construction, land clearing, and building construction activities, air emissions of criteria pollutants,[3] volatile organic compounds (VOCs), and a small amount of

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[2] For the purposes of estimating emission inventories and air quality modeling, the construction of ancillary structures, which falls under preconstruction, is grouped into building construction.

[3] A list of six common air pollutants that are regulated by the U.S. Environmental Protection Agency (EPA) on the basis of certain criteria (i.e., information on human health and/or environmental effects of pollution). Criteria pollutants include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM_{10} with an aerodynamic diameter of 10 micrometers or less and $PM_{2.5}$ with an aerodynamic diameter of 2.5 micrometers or less), and lead (Pb).

hazardous air pollutants (HAPs) (e.g., benzene) would be released. The primary source of emissions would be fugitive dust emissions from soil disturbances and engine exhaust emissions from heavy equipment and commuter, delivery, and support vehicular traffic traveling within, to, and from the facility. Small quantities of additional VOCs and HAPs emissions would also be released from the refueling and onsite maintenance of the off-road construction equipment, and from certain painting and other construction-finishing activities.

For road construction, land clearing, and building construction activities, the primary concern is the potential air impact of fugitive dust that results from soil disturbances, such as site clearing, bulldozing, compacting, grading, and vehicular traffic on unpaved roads or bare grounds. These activities would involve the intense use of heavy equipment over a short time period. Air emissions from building construction such as erection of structures and equipment installation would be typically lower than those from road construction and land clearing. Wind erosion from material stockpiles and disturbed areas are also fugitive dust sources, especially under relatively high-wind conditions. Engine exhaust emissions from heavy equipment and vehicles would release small amounts of particulate matter (PM), mostly fine particles ($PM_{2.5}$), which are different from large particulate matter (PM_{10}) from mechanical soil disturbances. Potential impacts of fugitive dust emissions on ambient air quality would be high because of near-ground-level release, if there is a short-distance buffer to the site boundaries.

Typically, source types, air pollutants, and their levels of emissions into the atmosphere would vary over the life of the project. The level of fugitive dust emissions would vary from day to day and from location to location, depending on the specific type of operation involved, the level of activities, soil types, and prevailing meteorological conditions (e.g., wind speed and direction, atmospheric stability, recent precipitation). No information on the detailed time schedule, heavy equipment usage, and activity levels are available at this time. Detailed schedule, equipment usage, and activity levels typically become available when a construction contract is developed. General area-wide emission factors based on area of and duration of disturbances were used. A PM_{10} emission factor of 0.94 metric ton per hectare-month (0.42 ton per acre-month) was applied to large-scale earthmoving activities, such as road construction and land clearing, while a PM_{10} emission factor of 0.25 metric ton per hectare-month (0.11 ton per acre-month) was applied to building construction activities, such as erection of building structures and equipment installation (MRI, 1996). It is also assumed that 10 percent of PM_{10} emissions of fugitive dust is $PM_{2.5}$ (Countess Environmental, 2006). For this analysis, a control efficiency of 74 percent is assumed during the road construction and land clearing phase (Countess Environmental, 2006). No dust control was assumed by GLE during the building construction phase. Dust emissions caused by wind erosion might be small at the Wilmington Site compared with other fugitive dust emissions and are not estimated. This is because of: (1) infrequent wind speeds high enough to trigger wind erosion; (2) natural mitigation due to a high number of precipitation days (over 118 days per year with a precipitation ≥0.025 centimeter [0.01 inch]), and (3) tall trees surrounding the construction site acting as a wind barrier.

Engine exhaust emissions from on-road vehicles traveling to and from the Wilmington Site are estimated using emission factor motor vehicle model, MOBILE6.2 (EPA, 2003). Emission factors for off-road construction equipment were estimated using the U.S. Environmental Protection Agency's (EPA's) nonroad emission factor model (EPA, 2004). Daily and annual emissions for criteria pollutants and VOCs are presented in Table 4-1. During the construction phase, exhaust emissions from heavy equipment and vehicular traffic, including sulfur oxide (SO_x), nitrogen oxide (NO_x), carbon monoxide (CO), and VOCs are relatively small. However,

Table 4-1 Estimated Air Emissions of Criteria Pollutants and VOCs from Construction and Operation of the Proposed GLE Facility[a,b]

Phase	Source Location	Average Daily Emissions (lbs/day)					
		SO_2	NO_x	CO	VOCs	PM_{10}	$PM_{2.5}$
Early Construction							
Road Construction	Onsite	0.14	74.3	51.4	6.00	76.4	19.3
	Offsite	0.08	30.1	58.9	4.27	0.70	0.68
Land Clearing	Onsite	0.14	74.3	51.4	6.00	1395.9	151.2
	Offsite[c]	0.08	30.1	58.9	4.27	0.70	0.68
Building Construction	Onsite	0.11	42.6	114.9	6.33	867.9	92.9
	Offsite	0.76	235.2	505.7	35.3	6.29	6.10
Start-up and Final Construction	Onsite	1.28	16.2	55.6	2.75	13.9	13.9
	Offsite	0.52	105.0	308.8	20.0	4.33	4.20
Operations	Onsite	1.26	14.5	34.9	1.74	13.9	13.9
	Offsite	0.31	41.2	170.6	10.4	2.57	2.49
Early Construction							
Road Construction[e]	Onsite	0.004	2.23	1.54	0.18	2.29	0.58
	Offsite	0.003	0.90	1.77	0.13	0.02	0.02
Land Clearing	Onsite	0.03	13.56	9.38	1.10	254.75	27.6
	Offsite	0.02	5.50	10.75	0.78	0.13	0.12
Building Construction	Onsite	0.02	7.64	20.6	1.14	155.8	16.7
	Offsite	0.14	42.2	90.8	6.33	1.13	1.10
Start-up and Final Construction	Onsite	0.16	2.33	9.9	0.47	2.51	2.51
	Offsite	0.10	19.2	56.4	3.64	0.79	0.77
Operations	Onsite	0.15	2.01	6.11	0.29	2.50	2.50
	Offsite	0.06	7.51	31.1	1.90	0.47	0.45

[a] CO = carbon monoxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter ≤2.5 μm; PM_{10} = particulate matter ≤10 μm; SO_2 = sulfur dioxide, and VOCs = volatile organic compounds.

[b] Detailed information on assumptions, emission factors, and calculations are described in Appendix E.

[c] Offsite emission sources include vehicular traffic traveling on roadways to and from the proposed GLE Facility site.

[d] Assume that construction and operations activities would occur on weekdays and weekends throughout the year, except no work schedule on six holidays (New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day) during the construction phases. Annual emissions are not 365 times daily emissions due to the 2-month schedule of the road construction and due to intermittently operating emergency diesel generators during start-up and final construction phase and operations phase.

[e] Annual estimates are based on two months of access road construction.

as mentioned previously, fugitive dust emissions from soil disturbances, including PM, are a major concern during the construction phase and are about an order of magnitude higher than other criteria pollutant and VOC emissions. Detailed information on underlying assumptions, emission factors, and emission estimation methodology are described in Appendix E of this EIS.

For the air quality modeling analysis, the latest version of the AMS/EPA Regulatory MODel (AERMOD) model, Version 09292 (EPA, 2009a), which is the EPA's preferred or recommended model for a wide range of regulatory applications, was used to estimate concentration increments at receptors at and beyond Wilmington Site boundaries as a result of air emissions from the proposed GLE Facility.

Hourly surface and twice-daily upper sounding data from the nearest State Climate Office of North Carolina and National Weather Service (NWS) stations were used for the analysis. The nearest surface meteorological station is the Horticultural Crops Research Station, which is located about 3 kilometers (2 miles) directly east of the proposed GLE Facility. Surface characteristics for this station are representative of those for the proposed GLE Facility after tree removal, so this station is considered the primary meteorological station. Hourly surface meteorological data from Wilmington/New Hanover County Airport, which is located about 8 kilometers (5 miles) southeast of the proposed GLE Facility, are also used to supplement the missing onsite data and to estimate boundary layer parameters. Twice-daily upper sounding data from Charleston, South Carolina,[4] which is located about 249 kilometers (155 miles) southwest of the proposed GLE Facility, are used for estimating the heights of the convective boundary layer. Four years of meteorological data (2005 to 2008)[5] were processed for input to the AERMOD. For the analysis, receptors at Wilmington Site boundaries are set densely (a few tens of meters) at northern boundaries where maximum concentrations of air pollutants are anticipated, and sparsely (a few hundreds of meters) at other site boundaries where lower concentrations of air pollutants are anticipated. Polar grid receptors are set up to 50 kilometers (31 miles) from the center of the proposed GLE Facility. Detailed information on assumptions, parameter selection, modeling inputs, and air dispersion modeling is available in Appendix E.

Estimated maximum criteria pollutant concentrations during access road construction and land clearing are shown in Tables 4-2 and 4-3, respectively. Concentration increments for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and CO are predicted to be negligible. Predicted concentration increments for 24-hour and annual $PM_{2.5}$ are less than 54 percent of their respective standards. Although the modeled 24-hour PM_{10} concentration increment would be less than 32 percent of the standard during access road construction, it would exceed the standard (about 186 percent) during land clearing activities.

4 An upper air station at Morehead City, North Carolina, is about 113 kilometers (70 miles) northeast of the proposed GLE Facility, closer than Charleston, South Carolina. However, the latter was chosen considering the similarity of distance and orientation to the ocean.

5 Per EPA's modeling guidance (40 CFR Part 51, Appendix W – Guideline on Air Quality Models), the most recent consecutive five years of meteorological data representative of the site of interest should be used when estimating concentrations with an air quality model. However, four years of data (2005–2008) were used for this analysis. A problem in wind direction measurements was found at the Horticultural Crops Research Station in 2004 and wind sensor was replaced in January, 2005. Wind roses for 2001–2004 at the station indicated that wind patterns vary significantly from the general patterns in the area, rendering data from this period unusable.

Table 4-2 Maximum Air Quality Impacts Due to Emissions Associated with Road Construction Activities for the Proposed GLE Facility

		Concentration ($\mu g/m^3$)[b]				Percent of NAAQS/SAAQS	
Pollutant[a]	Averaging Time	Maximum Increment[c]	Background[d]	Total	NAAQS/ SAAQS	Increment	Total
SO_2	3 hours	0.57	213.0	213.6	1300	0.044%	16.4%
	24 hours	0.09	70.4	70.5	365	0.025%	19.3%
	Annual	0.003	17.1	17.1	80	0.004%	21.4%
NO_2	Annual	1.76	26.1	27.9	100	1.76%	27.9%
CO	1 hour	463.74	3543.0	4006.7	40,000	1.16%	10.0%
	8 hours	81.97	2556.0	2638.0	10,000	0.82%	26.4%
PM_{10}	24 hours	47.66	27.0	74.7	150	31.8%	49.8%
$PM_{2.5}$	24 hours	7.04	25.4	32.4	35	20.1%	92.7%
	Annual	0.28	9.0	9.3	15	1.9%	61.9%

[a] CO = carbon monoxide; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter ≤2.5 μm; PM_{10} = particulate matter ≤10 μm; and SO_2 = sulfur dioxide.
[b] To convert $\mu g/m^3$ to ppm for gaseous pollutants, such as SO_2, NO_2, and CO, divide values in $\mu g/m^3$ by product of 40.82 and molecular weight.
[c] For short-term (≤ 24 hours) averages, second-highest modeled concentrations among site boundary and offsite receptors except 24-hour PM_{10} and $PM_{2.5}$. For PM_{10}, highest of the 5th-highest over 4 years (2005–2008) was presented. For $PM_{2.5}$, the highest of the 4-year average of the 8th-highest concentration at each receptor is presented. For annual averages, highest annual average concentrations over 4 years are presented.
[d] Source: Buckler, 2009.

To obtain the total concentrations for comparison to applicable air quality standards, modeled concentration increments were added to measured background concentrations representative of the Wilmington Site (Buckler, 2009). For SO_2, NO_2, and CO, background concentrations, not GLE sources, account for most of the total concentrations. The total concentrations would be less than 28 percent of their respective standards. The total concentration for annual $PM_{2.5}$ is estimated to be less than 78 percent of its applicable standard. Total 24-hour $PM_{2.5}$ concentrations would exceed the standard (about 126 percent), but the contribution from background would be higher than from GLE emissions. Total 24-hour PM_{10} concentrations would be above the applicable standard, about 204 percent. Note that the concentration increment causes 24-hour PM_{10} exceedances irrespective of background concentration, while the sum of background concentration and the project-related increment contributes to exceeding the 24-hour $PM_{2.5}$ standard. Maximum PM_{10} and $PM_{2.5}$ concentrations associated with road construction and land clearing activities are predicted to occur at the proximate northern boundary of the Wilmington Site near the proposed GLE Facility (less than 50 meters [164 feet] from the boundary) and would last for the duration of land clearing activities. Comparably high PM_{10} and $PM_{2.5}$ concentrations are also predicted at the northern Site boundary near the Wooden Shoe residential subdivision, close to which the North access road would be located (about 25 meters [82 feet] from the boundary). These high concentrations would result from

Table 4-3 Maximum Air Quality Impacts Due to Emissions Associated with Land-Clearing Activities for the Proposed GLE Facility

		Concentration (µg/m³)[b]				Percent of NAAQS/SAAQS	
Pollutant[a]	Averaging Time	Maximum Increment[c]	Background[d]	Total	NAAQS/ SAAQS	Increment	Total
SO_2	3 hours	0.24	213.0	213.2	1300	0.019%	16.4%
	24 hours	0.04	70.4	70.4	365	0.010%	19.3%
	Annual	0.004	17.1	17.1	80	0.004%	21.4%
NO_2	Annual	1.87	26.1	28.0	100	1.87%	28.0%
CO	1 hour	148.47	3543.0	3691.5	40,000	0.37%	9.2%
	8 hours	33.12	2556.0	2589.1	10,000	0.33%	25.9%
PM_{10}	24 hours	279.06	27.0	306.1	150	186.0%	204.0%
$PM_{2.5}$	24 hours	18.74	25.4	44.1	35	53.5%	126.1%
	Annual	2.70	9.0	11.7	15	18.0%	78.0%

[a] CO = carbon monoxide; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter ≤2.5 µm; PM_{10} = particulate matter ≤10 µm; and SO_2 = sulfur dioxide.
[b] To convert µg/m³ to ppm for gaseous pollutants, such as SO_2, NO_2, and CO, divide values in µg/m³ by product of 40.82 and molecular weight.
[c] For short-term (≤ 24 hours) averages, second-highest modeled concentrations among site boundary and offsite receptors except 24-hour PM_{10} and $PM_{2.5}$. For PM_{10}, highest of the 5th-highest over 4 years (2005–2008) was presented. For $PM_{2.5}$, the highest of the 4-year average of the 8th-highest concentration at each receptor is presented. For annual averages, highest annual average concentrations over 4 years are presented.
[d] Source: Buckler, 2009.

fugitive dust emissions during road construction and vehicle traffic on unpaved roads during land clearing activities.

Estimated maximum pollutant concentrations during the building construction phase are presented in Table 4-4. Maximum concentration levels and patterns are similar to those for access road construction and land clearing activities. Concentration increments for SO_2, NO_2, and CO are predicted to be negligible and their total concentrations are well below their respective standards. Total annual $PM_{2.5}$ concentration would be below its respective standard. However, total 24-hour PM_{10} and $PM_{2.5}$ concentrations would be above their respective standards (about 201 percent and 123 percent, respectively). These exceedances would occur at the proximate northern boundary of the Wilmington Site near the proposed GLE Facility. Unlike impacts during access road construction and land clearing, concentrations at the northern Site boundary, near the North access road and Wooden Shoe residential subdivision, would be about an order of magnitude lower than at the northern Site boundary near the proposed GLE Facility. This is due to paving of the unpaved access road near the end of the road construction and land clearing phase.

Table 4-4 Maximum Air Quality Impacts Due to Emissions Associated with Building Construction Activities for the Proposed GLE Facility

		Concentration ($\mu g/m^3$)[b]				Percent of NAAQS/SAAQS	
Pollutant[a]	Averaging Time	Maximum Increment[c]	Background[d]	Total	NAAQS/ SAAQS	Increment	Total
SO_2	3 hours	0.33	213.0	213.3	1300	0.026%	16.4%
	24 hours	0.06	70.4	70.5	365	0.016%	19.3%
	Annual	0.012	17.1	17.1	80	0.015%	21.4%
NO_2	Annual	1.64	26.1	27.7	100	1.64%	27.7%
CO	1 hour	1057.28	3543.0	4600.3	40,000	2.64%	11.5%
	8 hours	242.69	2556.0	2798.7	10,000	2.43%	28.0%
PM_{10}	24 hours	274.63	27.0	301.6	150	183.1%	201.1%
$PM_{2.5}$	24 hours	17.64	25.4	43.0	35	50.4%	123.0%
	Annual	2.40	9.0	11.4	15	16.0%	76.0%

[a] CO = carbon monoxide; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter ≤2.5 µm; PM_{10} = particulate matter ≤10 µm; and SO_2 = sulfur dioxide.

[b] To convert $\mu g/m^3$ to ppm for gaseous pollutants, such as SO_2, NO_2, and CO, divide values in $\mu g/m^3$ by product of 40.82 and molecular weight.

[c] For short-term (≤ 24 hours) averages, second-highest modeled concentrations among site boundary and offsite receptors except 24-hour PM_{10} and $PM_{2.5}$. For PM_{10}, highest of the 5th-highest over 4 years (2005–2008) was presented. For $PM_{2.5}$, the highest of the 4-year average of the 8th-highest concentration at each receptor is presented. For annual averages, highest annual average concentrations over 4 years are presented.

[d] Source: Buckler, 2009.

During access road construction, land clearing, and building construction activities, potential impacts of SO_2, NO_2, and CO emissions from heavy equipment and vehicles on ambient air quality would be well below the applicable ambient air quality standards. These impacts on ambient air quality would be anticipated to be SMALL. However, total (background plus modeled) 24-hour PM_{10} and $PM_{2.5}$ concentrations mostly resulting from fugitive dust emissions are predicted to exceed the standards at the proximate northern site boundaries near the proposed GLE Facility during land clearing and building construction activities. In addition, high PM_{10} and $PM_{2.5}$ concentrations at the northern Site boundary near the Wooden Shoe residential subdivision result from fugitive dust emissions from vehicle traffic on the unpaved North access road during land clearing activities. These exceedances would occur when the wind blows from the directions ranging from south to west. Most of these exceedances are associated with a couple of hours of high concentrations in the early morning in colder months (late fall to early spring), typical of low wind speeds, stable conditions, and relatively low mixing height. The access road construction, land clearing, and building construction activities are assumed to last two months, 1 year or more, and 2 years, respectively. Accordingly, potential air quality impacts during road construction, land clearing, and building construction activities are expected to be MODERATE but temporary in nature. Although natural mitigation of fugitive dust emissions is considerably high due to high rates of precipitation in the area, aggressive dust control

measures should be implemented during road construction, land clearing, and building construction activities to minimize potential air quality impacts, as discussed in Section 4.2.4.3.

Estimated emissions from engine exhaust and vehicular traffic during the start-up and final construction phase, which is assumed to last from 2014 to 2020, would be comparable to those during road construction, land clearing, and building construction activities. However, PM emissions are more than an order of magnitude lower than the previous two phases. Accordingly, start-up and final construction activities would have SMALL impacts on ambient air quality for all criteria pollutants.

Concentration increments for the two remaining criteria pollutants, lead (Pb) and ozone (O_3), were not modeled. As a direct result of the phase-out of leaded gasoline in automobiles, average lead concentrations in urban areas throughout the country have decreased dramatically. It is expected that lead and ozone-precursor emissions from construction of the proposed GLE Facility would be negligible, and would therefore have SMALL impacts on surrounding areas.

The high ozone concentrations of regional concern are associated with precursor emissions (nitrogen oxides [NO_x] and VOCs) locally and long-range transport of precursor-laden air masses from neighboring areas under favorable meteorological conditions, such as high temperatures, low wind speeds, intense solar radiation, and an absence of precipitation. The New Hanover County encompassing the proposed GLE Facility is currently in attainment for ozone (40 CFR 81.334) but monitored 8-hour ozone levels in the area approach or are just below the standard (see Table 3-9). Ozone precursor emissions during the three construction phases would be relatively small. As shown in Table 4-1, the highest emissions would occur during the building construction phase, about 45.2 metric tons per year (49.9 tons per year) for NO_x and 6.8 metric tons per year (7.5 tons per year) for VOCs, which are about 0.7 percent and 0.3 percent of total emissions in New Hanover County, respectively. These emissions would be much lower than those for the regional airshed[6] in which emitted precursors are transported and formed into ozone. Accordingly, potential impacts of ozone precursor releases from all construction phases of the proposed GLE Facility on regional ozone would be SMALL.

4.2.4.2 Facility Operations

No criteria pollutants would be generated during operation of the proposed GLE Facility because no combustion is involved. A new operating permit would be required for the proposed GLE Facility. However, criteria pollutant and HAP emission rates are expected to be small during the operations phase, and thus, the proposed GLE Facility would not be a major source of air emissions as defined under the EPA and North Carolina Department of Air Quality (NCDAQ) air permit requirements. The laser uranium enrichment process would occur inside the main GLE building. Short-term uranium-related and/or hydrogen fluoride (HF) emissions would occur during the process and be drawn into the ventilation system with a series of emission control devices such as high-efficiency particulate air (HEPA) filters for ≥99.8 percent removal of PM, and activated carbon beds for ≥99 percent removal of HF. Then, the air stream would be released into the atmosphere through a single building roof stack; accordingly, air emissions through the stack would be minimal. Potential impacts associated with radiological and hazardous emissions are addressed in Section 4.2.11. No continuous combustion sources

6 A geographical area that shares the same air due to topography, meteorology, and climate.

for space heating (such as boilers) would be needed, because most of the heat generated by the process lasers would be used for building space heating. The only stationary combustion sources at the proposed GLE Facility would be two 382-horsepower auxiliary emergency diesel generator units. These units will be operating on an intermittent basis to provide backup electric power to the proposed GLE Facility in the event of power outage or load-shedding,[7] and to conduct routine maintenance testing. Based on air permit conditions for the existing emergency diesel generators at the Wilmington Site, the permitted number of operating hours per year is 240. However, actual operating hours would vary depending on the number and duration of power disruptions. The other stationary sources are two mechanical-draft cooling towers, which will not be a source of the typical combustion-related criteria pollutants or other toxic emissions, but emit small amounts of particulate matter as drift.

Other onsite miscellaneous sources include uranium hexafluoride (UF_6)-cylinder handling activities and routine equipment maintenance. Accidental releases associated with UF_6-cylinder handling activities would be possible, and associated emissions could be much higher than those from a process building stack. Potential impacts of these releases are addressed in Sections 4.2.11 and 4.2.15. Dedicated onsite transfer vehicles (OSTVs)[8] would be used to ferry the UF_6 cylinders between the proposed GLE Facility's main operations buildings and cylinder storage yards. Small quantities of organic solvents and lubricants would be used for process equipment and vehicle maintenance.

Mobile sources along the onsite roadways including commuting and delivery vehicles traveling to and from the proposed GLE Facility and existing FMO facility would also contribute emissions. Fugitive dust emissions from the disturbed areas during operations would be minimal because most working areas and roadways within the proposed GLE Facility would be paved.

As shown in Table 4-1, estimated emissions during the operations phase are presented for comparison along with construction emissions. Auxiliary diesel generator units account for most of SO_2 and NO_x emissions from onsite operations, while onsite gasoline-engine traffic is a primary contributor to CO and VOC emissions. Two mechanical-draft cooling towers account for most of the PM emissions. Emissions during the operations phase are lower than those during the start-up and final construction phase, and PM emissions are more than an order of magnitude lower than those during access road construction, land clearing, and building construction activities. Accordingly, potential air quality impacts of criteria pollutants resulting from operation of the proposed GLE Facility would be anticipated to be SMALL. Potential impacts of uranium and hydrogen fluoride emissions on public and occupational health associated with operation of the proposed GLE Facility are presented in Section 4.2.11.

As discussed in Section 4.2.4.1, lead emissions from construction of the proposed GLE Facility are expected to be negligible, and would therefore have no adverse impacts on surrounding areas.

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7 A program to cut off the electric current on certain large industrial electricity users during times of peak demand under a prearranged agreement.

8 Diesel-powered forklifts are the primary option, but other options, such as propane- and electric-powered OSTVs are also under consideration.

Ozone precursor emissions during operation of the proposed GLE Facility would be relatively small, about 8.6 metric tons per year (9.5 tons per year) for NO_x and 2.0 metric tons per year (2.2 tons per year) for VOCs, which are less than 0.13 percent and 0.09 percent of total emissions in New Hanover County, respectively. These emissions would be much lower than those for the regional airshed in which emitted precursors are transported and formed into ozone. Accordingly, potential impacts of O_3 precursor releases from facility operations on the regional ozone would not be of concern.

4.2.4.3 Mitigation Measures

As discussed above, air quality impacts are generally expected to be SMALL. However, potentially MODERATE air quality impacts of short duration are possible during road construction, land clearing, and building construction activities. To minimize potential air quality impacts during road construction, land clearing, building construction, start-up and final construction, operations, and decommissioning, best available practices should be implemented. Air emissions would need to comply with applicable laws, ordinances, regulations, and standards. Fugitive dust emissions and other combustion-related emissions would need to be controlled through stipulations included in the permitting processes. Below are mitigation measures that GLE has committed to implementing (GLE, 2008) and additional mitigation measures identified by NRC that could potentially reduce or minimize impacts.

Mitigation Measures for Road Construction, Land Clearing, and Building Construction

Mitigation Measures Identified by GLE

- Water the facility site and unpaved roads to reduce dust.
- Remove dirt from truck tires by driving over a gravel pad prior to leaving the facility site or unpaved access road to avoid spreading sediments on paved roads.
- Cover trucks carrying soil and debris to reduce dust emissions from the back of trucks driving on roadways.
- Pave access road and parking lots as soon as practicable.

Additional Mitigation Measures Identified by NRC

- Post speed limits (e.g., 10 miles per hour) visibly within the construction site, and enforce them to minimize airborne fugitive dust.
- Limit access to the construction site and staging areas to authorized vehicles only, through the designated treated roads.
- Stage construction to limit the exposed/disturbed area at any given time, when practical.
- Train workers to comply with the speed limit, use good engineering practices, minimize drop height of materials, minimize disturbed areas, and employ other BMPs as appropriate.

- To the extent practicable, conduct soil-disturbing activities and travel on unpaved roads during periods of favorable meteorological conditions, as conducting these activities during periods of unfavorable meteorological conditions[9] may result in exceedances of air quality standards. Unfavorable meteorological conditions are infrequent and include (1) periods of low winds, stable, and relatively low mixing height conditions (primarily encountered around sunrise in colder months from late fall to early spring) and (2) periods of high winds.

- All heavy equipment should meet emission standards specified in the *State Code of Regulations*, and routine preventive maintenance, including tuneup to the manufacturer's specification, should be implemented to ensure efficient combustion and minimum emissions.

- Fuel all diesel engines used in the facility and auxiliary diesel generator units with ultra-low sulfur diesel with a sulfur content of 15 parts per million or less.

- Limit idling of diesel equipment to no more than 10 minutes, unless idling must be maintained for proper operation; for example, drilling, hoisting, and trenching.

- Because GLE assumed a dust control efficiency of 55 percent (applying water twice per day for the unpaved North access road during land clearing), more aggressive dust control measures should be implemented (for the entire unpaved access road or for the segments that most contribute to exceedances) to minimize potential dust impacts at the Wilmington Site boundary and the nearby Wooden Shoe residential subdivision. Options include more frequent water spraying (e.g., at every 2-hour watering interval) and the application of a dust suppressant. Selection of the proper dust suppressant should be based on road conditions, environmental impacts (including surface and groundwater quality), and cost (Bolander and Yamada, 1999).

<u>Mitigation Measures for Operation</u>

<u>Mitigation Measures Identified by GLE</u>

- Conduct uranium-enrichment operations inside an enclosed building using a closed-system process with no routine venting of process gases.

- Install and operate leak-detection monitors for process equipment. In the event a leak is detected due to an equipment component malfunction or other reason, safety interlocks will isolate the section of the process where the leak is detected, limiting the potential quantity of gaseous material that could be released inside the proposed GLE Facility's operations building.

- Maintain process areas inside the operations building under continuous negative pressure relative to atmospheric pressure. In the event of a gaseous release in one of these process areas, the negative pressure conditions would prevent outflow of the air from the process areas, effectively containing the released gaseous material to the affected process area.

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[9] Stable meteorological conditions limit dilution of airborne pollutants, which can lead to potentially high pollutant concentrations at the ground level. High winds are unfavorable due to the increased potential for fugitive dust emissions.

- Ventilate the operations building with a high-efficiency, multi-stage air emissions control system. Components of the air emissions control system planned for the operations building consist of high-efficiency particulate arresting (HEPA) filters for removal of solid particulate matter and activated carbon beds for adsorption of HF. Exhaust gases from this emission-control system would be vented to the atmosphere through a single stack.

- Implement a periodic inspection and maintenance program for uranium hexafluoride (UF_6) cylinders stored in outdoor areas.

- Burn low-sulfur fuel oil in the auxiliary diesel generators.

- Store organic solvents, paints, and other volatile organic compound–containing liquids in containers covered with tightly fitting lids.

Additional Mitigation Measures Identified by NRC

No additional mitigation measures to minimize potential impacts on ambient air quality from the operation of the proposed GLE Facility are proposed by NRC.

4.2.5 Geology and Soil Impacts

Potential environmental impacts on geologic resources and soils during preconstruction, construction, and operation of the proposed GLE Facility are described in this section. Potential impacts include soil erosion due to ground disturbance and changes in drainage. Section 3.6 of this EIS provides a description of site soils and the geologic setting.

4.2.5.1 Preconstruction and Construction Activities

As described in Section 1.4.1, preconstruction activities would include clearing of about 40 hectares (100 acres) at the proposed GLE site (GLE, 2009b), among other activities. Because the site is generally level, regrading would be minimal. Additional activities may include construction of a wet detention basin and topsoil stripping and stockpiling. These ground-disturbing activities would result in short-term soil erosion, which could be minimized by following BMPs, including but not limited to the use of silt fencing, reseeding of areas, and proper construction of drainages and culverts. These activities are controlled by the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007), which authorizes permits as appropriate.

Under the proposed action, approximately 91 hectares (226 acres) of land would be disturbed in the Wilmington Site's North-Central and Eastern Site Sectors, including the approximately 40 hectares (100 acres) described above for the proposed GLE site in the north-central site sector, plus about 5 hectares (13 acres) for support structures to the east and about 13 hectares (33 acres) associated with the North access road.

Soil-related aspects of the construction phase would include soil excavation for foundations and buried utility lines, soil storage and removal, and stormwater management. These activities are controlled by the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007), which authorizes permits as appropriate. Most of the project area

is Murville sand, Leon sand, and Onslow loamy fine sand soil types (USDA, 2012), and the erosion potential of each of them is slight (USMC, 2009).

Preconstruction and construction vehicles and equipment could leak fuel, oil, or grease to site soils. Following BMPs, as discussed in Section 4.2.5.3, would reduce the associated impacts.

Preconstruction and construction activities would not impact site geologic resources because the site lacks significant geologic resources. Construction activities would require crushed stone and/or sand and gravel from offsite sources for use in construction of roads and buildings.

Overall, the impact on geology and soil is considered SMALL. The estimated relative contributions to the soil-related impacts are 50 percent during preconstruction activities and 50 percent during construction. These figures are estimated based on assumed similar disturbed land footprints and equipment use during both phases for similar durations.

4.2.5.2 Facility Operations

During proposed GLE Facility operations, soil disturbance would take place at a reduced level, as some construction projects would be completed while others would be ongoing. Restoration and seeding of cleared land would need to occur to limit erosion due to stormwater. Roads, parking lots, and roofs would create impervious surfaces and increase runoff, consequently increasing the erosion potential. Large storm events could create erosion along drainages or at culverts, causing a need for maintenance or drainage system improvement. Proper site development and culvert design would limit this impact. The county notifies owners of deficient components of a stormwater system (New Hanover County, 2009c). Correction is the responsibility of the owner, otherwise the county would mitigate and recover costs from the owner.

Vehicles and equipment used in unpaved areas could leak fuel, oil, or grease to site soils. Following BMPs, as discussed in Section 4.2.5.3, would reduce the associated impacts.

Groundwater extraction is expected to have a minimal effect on groundwater levels, and the associated degree of subsidence is expected to be negligible. Other geologic hazards to the site (e.g., volcano, tsunami, landslide, radon gas, methane gas, subsidence due to mining) are not anticipated. The overall impact on geology or soil during operations is expected to be SMALL.

4.2.5.3 Mitigation Measures

GLE proposes to employ a number of measures to mitigate impacts on soil and geological resources (GLE, 2008), including:

- minimize the size of the construction footprint
- minimize soil disturbance
- use of soils from onsite borrow pits that are accessible via existing roadbeds if additional soil is needed

- management of construction activities so that only designated areas within the GLE study area are disturbed and no heavy equipment or construction operations are allowed to affect areas outside the study area unless specifically designated
- use of adequate containment methods during excavation
- use of site-stabilization practices (e.g., placing crushed stone on top of disturbed soil in areas of concentrated runoff)
- use of silt berms, dikes, and sediment fences
- stabilization of drainage culverts and ditches by lining with rock aggregate/rip-rap to reduce flow velocity and prohibit scouring
- reuse and/or appropriate placement of excavated materials to decrease exposed soil piles
- placement of gravel construction pads at the entrance/exits of construction areas
- stabilization of the site with low-maintenance landscaping and pavement

In addition, the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007) contains BMPs for control of soil and sediment. For erosion control, BMPs include but are not limited to the use of silt fencing, reseeding of disturbed areas, minimizing soil disturbance during the construction phase through planning and engineering design, and proper construction of drainages and culverts. Implementation of BMPs would limit the impact of soil erosion and soil contamination. Soil-disturbing activities are controlled by the New Hanover County Erosion and Sedimentation Control Ordinance, which authorizes permits as appropriate. The county will periodically inspect land-disturbing activities at a site to ensure compliance with the permit. Failure to conform to the permit would lead to issuance of a Notice of Violation to GLE from New Hanover County, and continuing violations would lead to the imposition of penalties assessed against GLE (New Hanover County, 2007). Implementation of proper, generally accepted BMPs for storage, handling, spill prevention, and spill response would reduce the impact of contamination associated with fuels, oils, and grease from equipment used onsite (or from other chemicals or wastes managed onsite).

4.2.6 Surface Water Resources Impacts

This section discusses the assessment of potential environmental impacts on surface water during preconstruction activities, construction, and operation of the proposed GLE Facility. The discussion includes the potential impact due to turbidity from soil erosion and contaminants in runoff.

4.2.6.1 Preconstruction and Construction Activities

Preconstruction activities are expected to include the construction of a stormwater wet detention basin and the clearing of approximately 40 hectares (100 acres) of land at the proposed GLE Facility site. As discussed in Sections 4.2.5.1 and 4.2.5.3, BMPs would be implemented and the process would be inspected by the county so that soil erosion and the associated increase to turbidity would be minimized. Still, a short-term decrease in surface water quality in unnamed

tributaries of Prince George Creek and the Northeast Cape Fear River and potentially the creek and river themselves may be realized due to sedimentation and turbidity associated with erosion during preconstruction and construction activities.

Currently, the North Carolina Department of Environmental and Natural Resources (NCDENR) requires the permittee to monitor daily rainfall, visually inspect runoff outfalls on a regular basis, and thoroughly document monitoring activities and data (NCDENR, 2009b). Recent EPA rules address stormwater runoff at construction sites (EPA 2009d). As of August 2011, all sites that disturb 20 or more acres will require self-monitoring on a regular basis and will need to meet the EPA's effluent limitation guidelines for turbidity of 280 nephelometric turbidity units. The NCDENR issued a new general permit for construction activities, effective January 1, 2010 (NCDENR, 2009b), but the turbidity monitoring requirements are not included. The NCDENR general permit will be updated before August 2011 to include those requirements.

Construction of the proposed facility would involve new buildings, parking lots, UF_6 storage areas, and landscaping. Excavations for foundations or buried utility lines would lead to possible short-term soil erosion problems with associated impacts on surface water quality. Again, BMPs would be expected to minimize the impacts, as discussed in Section 4.2.5.3.

The proposed North access road would have a new stream crossing at a tributary of Prince George Creek and possibly change a jurisdictional channel. This could lead to erosion and increased sediment load. Following BMPs for this type of action would minimize the impact.

Use of construction vehicles and equipment during preconstruction or construction activities poses the possibility of leaks or spills of fuels, oil, or grease, which could run off and impact surface water in the unnamed tributaries of Prince George Creek and the Northeast Cape Fear River and potentially the creek and river themselves. As described in Section 4.2.6.3, BMPs for storing and handling these liquids and for dealing with such releases would limit or eliminate their effect on surface water quality. Because of the distance from the main work area to the drainages, it is unlikely that a minor spill would directly reach the Northeast Cape Fear River or Prince George Creek. Infiltration into site soil would likely eliminate runoff of the liquid.

Preliminary plans for the proposed GLE Facility include a holding pond to receive stormwater runoff from the UF_6 storage pads (tails), a State-permitted stormwater wet detention basin, a small cooling tower for heating, ventilation, and air conditioning (HVAC) equipment, a water tower for potable and perhaps process water, and a firewater pond. The design of the stormwater wet detention basin is not finalized, but it would be constructed according to State and County requirements (GLE, 2009f). It would likely have a clay liner and be designed for a 25-year storm event (GLE, 2009f). The holding pond for the UF_6 storage pad is anticipated to be approximately 3 acres, have a clay liner, and be designed in consultation with the State Department of Water Quality (GLE, 2009f). Overflow from these basins would presumably be routed to the effluent channel or to the natural drainage fed by the effluent channel.

The overall impact on surface water quality during preconstruction and construction activities is expected to be SMALL due to the nature of the work activities, the site soil characteristics and slopes, and the use of generally implemented BMPs to negate the effect of potential problems from erosion, spills, etc. The estimated relative contributions of these impacts are 50 percent during preconstruction activities and 50 percent during construction. These figures are

estimated based on assumed similar disturbed land footprints and equipment use during both phases for similar durations.

4.2.6.2 Facility Operations

A process wastewater effluent rate of about 35,000 gallons per day would result from the proposed action and be discharged at existing Outfall 001. The flow would include 5000 gallons per day of liquid radwaste (from decontamination, cleaning, and laboratory activities) and 30,000 gallons per day of noncontact cooling tower blowdown (GLE, 2008). The liquid radwaste would be pretreated in the proposed GLE Facility liquid effluent treatment system before transfer to the existing Wilmington Site final process lagoon wastewater treatment facility. The treatment process is very similar to that already in use at the Wilmington Site (GLE, 2009f). Steps in the process would include pH adjustment to precipitate uranium, addition of a flocculent, filtering and drying of uranium floc (flakes of precipitate), and offsite disposal of the resulting solids. The site's process wastewater volume would increase by 7 percent over the 2006 level, which is the latest data available (GLE, 2008). Treatment steps would produce an effluent with concentrations similar to those of current process wastewaters (GLE, 2008; GLE 2009f).

The wastewater treatment and industrial reuse system already in place at the Wilmington Site would receive the sanitary effluent from the proposed GLE Facility for use in the cooling tower. The National Pollutant Discharge Elimination System (NPDES) discharge permit remains valid if discharge to Outfall 002 becomes necessary in the future (GLE, 2008).

Stormwater runoff would be collected in a wet detention basin before discharge to a stream. Stormwater during the operational phase would be regulated by a NPDES permit, which would include a stormwater pollution prevention plan.

If radioactivity were detected in the UF_6 storage pad's stormwater holding pond, the contents would be allowed to settle and precipitate. Liquid would be pumped out and taken to the GLE liquid effluent treatment system. Residual solids would then be analyzed and, if necessary, disposed of as low-level radioactive waste (LLRW) at the Energy*Solutions* facility in Utah (GLE, 2008). When monitoring demonstrates a lack of radioactivity, the holding pond's effluent would be discharged to the stormwater wet detention basin and ultimately to the effluent channel above the dam.

Following construction of the North Road, together with completion of associated stream crossings, any increase in turbidity and sediment loading to streams realized during the preconstruction and construction phases would subside during the operational phase. Oil, grease, metals, and other automotive-related contaminants would be present in limited quantities due to general traffic.

The use of herbicides at the proposed facility's landscaped areas would be similar to their use elsewhere at the Wilmington Site. BMPs regarding the use of such chemicals would limit their impact on surface water quality.

No consumptive surface water use would take place during the proposed action.

Watershed modeling suggests that runoff at the proposed GLE Facility would increase by 36 percent over the current conditions in undeveloped land (GLE, 2008). This runoff would be detained in the wet detention basin designed for a 25-year storm. This basin would be designed during final design of the proposed GLE Facility, in compliance with State water quality treatment regulations and county regulations (GLE, 2009f). State regulations require treatment of the first 1.5 inches of rain to remove 85 percent of total suspended solids. New Hanover County (New Hanover County, 2009c) requires peak control of 2-, 10-, and 25-year storms to the predevelopment condition.

During operations, some construction projects would be completed while others would be ongoing. The potential increase in turbidity in site drainages would take place at a level proportional to the intensity and areal extent of soil disturbance. Restoration and seeding of cleared land would need to occur to limit erosion due to stormwater. Roads, parking lots, and roofs would create impervious surfaces and increase runoff, consequently increasing the erosion potential. Large storm events could create erosion along drainages or at culverts, causing a need for maintenance or drainage system improvement.

Overall, the impact on surface water during operations is anticipated to be SMALL due to planned systems for runoff, treatment, and monitoring and experience with the existing Wilmington Site facilities.

4.2.6.3 Mitigation Measures

GLE proposes to employ a number of measures to mitigate impacts on surface water resources (GLE, 2008), including:

- selection of a non-wetland, non-floodplain area for the proposed facility
- implementation of proper construction BMPs as specified by the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007)
- construction of the access road perpendicular to Unnamed Tributary #1 to minimize the impacted area
- design and construction of the upgraded crossing following procedures required by the *New Hanover County Flood Damage Prevention Ordinance* (New Hanover County, 2006)
- limitation of cut/fill slopes to a horizontal-vertical ratio of three to one or less
- use of silt fencing and covering soil stockpiles to prevent sediment runoff
- suspension of general construction activities during storms and impending precipitation
- construction of stream crossings (i.e., installation of culverts) following at least 48 hours of dry weather
- diversion of stream flow during stream-crossing construction to minimize excavation in flowing water

- maintenance of construction equipment to avoid visible leaks of oil, greases, or hydraulic fluids
- restoration of disturbed areas to original surface elevations, where possible
- compliance with all NPDES stormwater and wastewater permit requirements
- routing of stormwater to a new stormwater wet detention basin, designed in accordance with the NCDENR *Stormwater Best Management Practices Manual* (NCDENR, 2007)
- onsite treatment of process and sanitary wastewaters to NPDES-permit limits before discharge to receiving waters
- routine monitoring and inspection of onsite liquid waste storage tanks and containers to detect any leaks or releases to the environment to ensure prompt correction action under the Spill Prevention Control and Countermeasure (SPCC) Plan[10]
- discharge of UF_6 storage pads stormwater runoff to a holding pond for monitoring prior to discharge to the stormwater wet detention basin
- periodic visual inspection of the stormwater wet detention basin to verify proper function, at a frequency sufficient to allow for identification of basin high-water-level conditions and implementation of corrective actions to restore the water level prior to overflow
- construction of a stormwater wet detention basin and implementation of a Wilmington Site stormwater management plan to mitigate a portion of the increased floodwaters from extreme storm events and all stormwater from smaller storm events
- ensuring easy access to the stormwater wet detention basin to allow the prompt, systematic sampling of runoff

In addition, the New Hanover County Erosion and Sedimentation Control Ordinance (New Hanover County, 2007) contains BMPs for control of soil and sediment which relate closely to surface water quality due to sedimentation and turbidity. These are discussed in Section 4.2.5.3. The county notifies owners of deficient components of a stormwater system (New Hanover County, 2009c). Correction is the responsibility of the owner, otherwise the county will mitigate and recover costs from the owner. Implementation of BMPs for storage, handling, spill prevention, and spill response would reduce the impact of surface water contamination associated with the runoff of fuels, oils, and grease from equipment used onsite (or from other chemicals or wastes managed onsite). Implementing these BMPs would also limit the impact of soil erosion and soil contamination, as discussed in Section 4.2.5.3. Mitigation measures with respect to surface water usage are not relevant because no consumptive surface water use is included in the proposed action.

[10] SPCC plans are prepared to prevent the discharge of oil from a facility into navigable waters or adjoining shorelines. These plans require facilities to have adequate containment around oil tanks, such as berms and dikes, to protect soil and water in the event of a spill.

4.2.7 Groundwater Resources Impacts

This section describes the potential impacts on groundwater resources, which generally are related to possible spills or leaks of fuels or other liquids and to the groundwater-surface water interaction.

4.2.7.1 Preconstruction and Construction Activities

Construction equipment used for clearing, excavating, and construction pose the potential for leaks of fuel, oil, and grease to the soil and ultimately to the groundwater. Following BMPs would reduce the impact to site groundwater. The use of portable toilets would eliminate sanitary system impacts on groundwater. Potable and nonpotable water requirements would be met by transport of offsite water by tanker trucks. These would include acceptable amounts of water for concrete-making and possibly for dust suppression.

Altogether, the impact of preconstruction and construction activities on groundwater use and quality would be SMALL. The estimated relative amounts of impact are 50 percent during preconstruction activities and 50 percent during construction due to use of similar equipment and fuel during these two phases.

4.2.7.2 Facility Operations

During the operational phase, stormwater would collect in a clay-lined wet detention basin and eventually drain to surface water bodies. The stormwater is expected to have no more than trace amounts of radiological contaminants, and the clay liner (GLE, 2009f) would limit the amount of infiltration to groundwater.

Discharge at site Outfall 001 is and would continue to be from process wastewater. The effluent is and would continue to be received by the effluent channel, which may partially penetrate the semiconfining Peedee clay layer. Some portion of the effluent may therefore potentially infiltrate the Peedee sand aquifer, especially if its water level is drawn down by remedial extraction wells. This infiltration would be contained hydraulically by the site's groundwater remediation system.

Preliminary plans for the proposed GLE Facility include obtaining additional groundwater for potable purposes from the Wilmington Site’s existing production wells east of Castle Hayne Road. The estimated increase in potable water needs from the proposed facility is 11,000 gallons per day. These wells draw from the regionally important Peedee sand aquifer. Water level data show them to be cross-gradient of the overall Wilmington Site, and they do not result in significant drawdown (GLE, 2008). Additional groundwater will also be needed as a source of process water at an estimated rate of 75,000 gallons per day. This groundwater would be purified to remove iron and manganese. Increased drawdown of up to 4 feet in offsite areas is expected, without significant effect on flow directions, water quality, or availability of groundwater for offsite users, as calculated using a groundwater model that is included as an appendix to the Environmental Report (GLE, 2008). The increased drawdown in offsite areas that are over 2,000 feet from the Wilmington Site boundary is estimated to be generally less than one foot. Increased pumping of the site remediation wells would maintain the hydraulic containment of contaminated groundwater. The projected water demand of the proposed GLE Facility is less than the Wilmington Site’s water needs in the 1990s, and no water supply issues were known during that period (GLE, 2008).

Two diesel tanks would be present at the proposed GLE Facility site to supply fuel for backup power generation. The *North Carolina Administrative Code* (Title 15A, Chapter 2, Subchapter N [15A N.C. Admin Code 02N]) would govern their construction, leak detection equipment, and operation.

A groundwater monitoring plan for the proposed GLE Facility has not yet been prepared, but it would be developed after the facility design is finalized (GLE, 2009f).

Effluent treatment and monitoring are expected to result in no significant contaminant concentrations in the effluent channel, which has the potential to interact with the Peedee sand aquifer.

Based on the proposed design of site facilities, the treatment and monitoring of effluent, review of local water levels, and model calculations, the overall impact of site operations on groundwater is expected to be SMALL.

4.2.7.3 Mitigation Measures

Although no significant impact on the flow field is anticipated, GLE proposes to employ a number of measures to mitigate impacts on groundwater resources (GLE, 2008), including:

- implementation of hazardous material and waste-handling procedures and secondary containment, as required by applicable laws and regulations
- providing necessary construction water via tanker truck from offsite potable water sources
- reuse of treated sanitary wastewater effluent as makeup water in Wilmington Site cooling towers
- routine monitoring of sitewide groundwater levels, and continued analysis of groundwater monitoring-well and pumping-well networks to confirm that changes in groundwater levels associated with the proposed action are minimal
- readjustment of pumping well rates and/or performance of well maintenance or rehabilitation, as appropriate, in the event of unexpected changes in groundwater levels
- use of low-water-consumption landscaping
- installation of low-flow toilets, sinks, and showers
- performance of localized floor washing using mops and self-contained cleaning machines to reduce water usage compared to conventional washing techniques

In addition, proper BMPs for storage, handling, spill prevention, and spill response would reduce the impact of groundwater contamination associated with the accidental release of fuels, oils, and grease from equipment used onsite (or from other chemicals or wastes managed onsite). If measurable onsite changes in groundwater levels occur as a result of the proposed action, groundwater level monitoring should be expanded to offsite areas.

4.2.8 Ecological Impacts

This section describes the potential impacts on ecological resources that could occur during preconstruction and construction activities (Section 4.2.8.1) and during operation (Section 4.2.8.2) of the proposed GLE Facility. Ecological resources that could be affected include vegetation; wetlands; environmentally sensitive areas; wildlife; aquatic biota; and threatened, endangered, or other special status species. Section 4.2.8.3 presents a list of mitigation measures to minimize impacts on ecological resources, including those that have been identified by the applicant and those that are recommended by the NRC.

Overall, impacts from the proposed GLE Facility (including ancillary facilities such as the access road and transmission line) on ecological resources would depend on:

- the type and amount of habitat that would be disturbed
- the nature of the habitat disturbance (e.g., long-term reduction because of project structure and access road placement or complete, long-term alteration due to the transmission line right-of-way [ROW])
- the biota that occupy the proposed facility site and surrounding areas
- the timing of construction activities relative to the crucial life stages of biota (e.g., nesting or spawning season)

For the purposes of this assessment, impacts from the proposed GLE Facility on ecological resources were considered moderate or large if they would noticeably result in or contribute to any of the following:

- reduction of the quality and/or quantity of habitat for plants, wildlife, or aquatic biota
- an alteration in a species population that would either not destabilize the population (moderate impact) or would destabilize the population to below self-sustaining levels (large impact)
- establishment or increases of noxious weed populations
- interference with the movement of any resident or migratory fish or wildlife species
- violations of the *Endangered Species Act, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act*, or other applicable Federal and State laws

The changes in any of these conditions must be clearly linked to the proposed GLE Facility and not the result of an unassociated activity.

4.2.8.1 Preconstruction and Construction Activities

This section evaluates the potential impacts of proposed GLE Facility preconstruction and construction activities on ecological resources.[11] Preconstruction activities that could impact ecological resources at the Wilmington Site are listed in the introduction to Section 4.2. Construction activities that could impact ecological resources at the Wilmington Site include: adding the UF_6 storage pads; constructing the operations building; and adding security fencing around the proposed GLE Facility.

More than 75 percent of direct impacts on ecological resources would occur during preconstruction activities. This conclusion is based on professional judgment considerations on the degree of impacts that could occur during preconstruction and construction activities (e.g., vegetation clearing, habitat fragmentation, and injury, mortality, or disturbance to wildlife). The impacts would result primarily from clearing and grading, coupled with the construction of various buildings, the access road, substation and transmission line, stormwater wet detention basin, and parking lots. Most of the construction activities would occur within areas that would have been disturbed during preconstruction activities (although some revegetation may occur before the operations building and UF_6 storage pads are constructed).

Vegetation

The plant communities that occur on the Wilmington Site are shown in Figure 3-12 and are tabulated in Table 3-12. Table 4-5 summarizes the impacts on plant communities that could occur from preconstruction and construction activities for the proposed GLE Facility, the proposed North access road, and proposed utility structures.

Plant communities affected by preconstruction and construction activities associated with the proposed GLE Facility could incur short- or long-term changes in species composition, abundance, and distribution. Direct impacts would be primarily associated with the loss of habitat within the 81.2 hectares (200.7 acres) disturbed during preconstruction activities for the proposed GLE Facility North access road, and utility structures (Table 4-5). The proposed GLE Facility would eliminate 19.4 hectares (48 acres) of pine plantation, 21 hectares (52 acres) of pine forest, and 6.5 hectares (16 acres) of pine-hardwood forest. The remaining 0.8 hectare (2 acres) would be gravel roads (e.g., a component of the "operational area" habitat) (GLE, 2009e).

Additional impacts would occur within the 11.7 hectares (29 acres) that would be occupied by utility structures (e.g., access driveways, sanitary and process wastewater lift stations, clearings for utility lines, a stormwater wet detention basin, and a fire suppression line) and the 22.1 hectares (54.7 acres) for the proposed north access road (Table 4-5). About 13 hectares (33 acres) of this area would be the alteration of existing operations area to another type of operations area. This would have a small impact on vegetation on the Wilmington Site. The clearing of 3.0 hectares (7.4 acres) of pine-hardwood forest, 3.1 hectares (7.7 acres) of pine forest, 12 hectares (3.0 acres) of pine plantation, and 1 hectare (2.3 acres) of pocosin/bay forest would have a more measurable impact on vegetation (Table 4-5).

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[11] The significance level of impacts on vegetation, wetlands, wildlife, and aquatic biota from the preconstruction and construction of the GLE Facility are incorporated in Tables 4-6 through 4-8.

Table 4-5 Impacts on Plant Communities Due to Preconstruction and Construction Activities for the Proposed GLE Facility

Proposed Action	Plant Community[a]	Area (acres)[b]	Percent of Plant Community on Wilmington Site
GLE Facility	Operations area	2.0	--[c]
	Pine forest	51.0	17
	Pine-hardwood forest	16.0	7
	Pine plantation	48.0	15
	Subtotal	117.0	
North access road	Alluvial forest	0.6	15
	Canal corridor	0.4	2
	Operations area	25.8	--
	Pine forest	2.7	1
	Pine-hardwood forest	4.4	2
	Pine plantation	17.9	6
	Pocosin/bay forest	2.3	5
	Power line corridor	0.5	3
	Swamp forest	0.1	0
	Subtotal	54.7	
Utility structures[d]	Operations area	7.0	--
	Pine forest	5.0	2
	Pine-hardwood forest	3.0	1
	Pine plantation	12.0	3
	Power line corridor	2.0	11
	Subtotal	29.0	
	Total	200.7	

[a] Characteristic plant species in each community are listed in Table 3-12.
[b] To convert to hectares multiply by 0.4047.
[c] -- = no impact assumed from altering existing operations areas to another type of operations area.
[d] Includes access driveways, sanitary and process wastewater lift stations, clearings for utility lines, a stormwater wet detention basin, and a fire suppression line.
Source: GLE, 2009e.

Habitat fragmentation would also result from the clearing and grading activities conducted during preconstruction and construction activities. This would include the creation of isolated patches of forest habitat between utility structures. It is foreseeable that some of these patches could end up being cleared. Overall, this could impact an additional 4 to 6 hectares (10 to 15 acres) of forest (GLE, 2009e). As the utility corridor is routed along the North access road, overall habitat fragmentation resulting from the project would be reduced.

Soil compaction caused by heavy machinery could destroy ground flora and indirectly damage roots of trees (by reducing soil aeration and altering soil structure). These potential impacts would be localized in the areas immediately outside the facility site boundary. Excess soil from preconstruction and construction activities would be deposited in existing operational area habitat in the northwestern portion of the Wilmington Site.

Changes in forest or woodland interiors from tree removal or clearing of adjacent areas could include increased light levels, reduced soil moisture, increased transpiration, introduction of shade-intolerant species, and increased access of herbivores. Additional decline or mortality of trees near the construction boundary may subsequently occur. However, the proposed GLE Facility would be located within an area that has been impacted from logging operations.

Plant communities near preconstruction and construction areas could be affected by hydrologic changes such as reduced infiltration, increased runoff from exposed or compacted soils, and alteration in flow patterns from grading of the proposed GLE Facility site.

Other possible adverse preconstruction and construction effects on vegetation could include the localized deposition of dust and other particulate matter from clearing and grading and from the operation of vehicles and machinery. Dust can physically affect a plant by shading, interference with gaseous diffusion, abrasion of leaf surfaces, and modification of leaf temperature by black deposits. Impacts on vegetation that may occur from dust deposition would be expected to be localized and short-term.

Establishment of the entranceway from Castle Hayne Road and upgrading of the existing access road to the proposed GLE Facility would result in loss of some vegetation along the roadway and could result in indirect impacts on nearby areas from altered drainage patterns, runoff, and sedimentation. The access road to the proposed GLE Facility would mostly involve upgrading of existing roadway. Therefore, vegetation disturbance, and particularly fragmentation of vegetation communities, would be limited in comparison to those that would occur from establishing a completely new access road. Upgrading the access road to the proposed GLE Facility and establishment of the new entranceway to the Wilmington Site would impact areas already considered to be operations area habitat (i.e., 10.5 hectares [26 acres] of the 22 hectares [54 acres]). However, 11 hectares (27 acres) of pine–hardwood forest, pine plantation, pine forest, and pocosin/bay forest along the access road corridor and within the proposed entranceway would also be affected (GLE, 2009e).

Vehicle operation could promote the introduction and establishment of invasive plant species such as Japanese honeysuckle (*Lonicera japonica*), Chinese privet (*Ligustrum sinense*), and Japanese grass (*Microstegium vimineum*). These species can also become established in areas impacted by fragmentation and lead to limitations on the growth of native plants, disruption of natural succession, and limitations on species and structural diversity (Campbell and Johns, 2000).

Accidental releases of hazardous materials (e.g., fuels) could impact plant communities in the vicinity of the spills. Spills would only be expected within small, localized areas that have mostly been disturbed by clearing and grading. Potential adverse impacts from a spill would be minimized by taking corrective actions identified in the SPCC Plan.

In conclusion, MODERATE impacts on vegetation would occur from vegetation clearing, habitat fragmentation, alteration of topography, changes in drainage patterns, and soil compaction; remaining impacts would be SMALL (Table 4-6). Impacts considered MODERATE would occur primarily during preconstruction, as more than 75 percent of direct impacts would occur during this phase. Following preconstruction and construction activities, the proposed GLE Facility area, including the access road and utility structures, would be considered as part of an industrial land cover type on the Wilmington Site (i.e., be classified primarily as operations area habitat).

Table 4-6 Significance Levels of Potential Impacts on Vegetation, Wetlands, and Environmentally Sensitive Areas from the Proposed GLE Facility

	Potential Significance of Impacts According to Habitat Type[a]		
Impact Category	**Upland Vegetation**	**Wetlands**	**Environmentally Sensitive Areas**
Vegetation clearing	Moderate	Small	Small
Habitat fragmentation	Moderate	Small	Small
Alteration of topography	Moderate	Small	Small
Changes in drainage patterns	Moderate	Small	Small
Water depletions	Small	Small	Small
Erosion and sedimentation	Small	Small	Small
Contaminant spills	Small	Small	Small
Fugitive dust	Small	Small	Small
Soil compaction	Moderate	Small	Small
Disruption of groundwater flow patterns	Small	Small	Small
Spread of invasive plant species	Small	Small	Small
Vegetation maintenance	Small	Small	Small
Air emissions	Small	Small	Small
Radiological exposure	Small	Small	Small

[a] Small impact: environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Moderate impact: environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource. All moderate impacts would occur during the preconstruction phase.

Wetlands

Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow, particularly where facilities are located immediately adjacent to wetland areas. Executive Order 11990, "Protection of Wetlands," requires Federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial uses of wetlands. Unavoidable impacts on wetlands within the jurisdiction of the U.S. Army Corps of Engineers (USACE) might require a *Clean Water Act* (CWA) Section 404 Permit, which would trigger the need for a CWA Section 401 Water Quality Certification. An approved mitigation plan might be required prior to the initiation of preconstruction or construction activities.

No wetlands would be directly impacted by preconstruction or construction activities for the proposed GLE Facility. However, jurisdictional wetlands WD, WF, and WG, and one isolated wetland (Wetland WA) occur within the corridor for the revised entrance and roadway (GLE, 2009c). Jurisdictional wetlands have a connection to surface waters. The area of the three jurisdictional wetlands within the proposed access road is 0.021 hectare (0.052 acre). The width of disturbance during construction of the roadway would be 18 meters (60 feet); whereas the corridor analyzed for the access road was up to 61 meters (200 feet) wide. Therefore, it may be possible to avoid direct impacts on the jurisdictional wetlands during construction of the entrance and access road.

It is probable that Isolated Wetland WA would be directly impacted by construction of the access road, resulting in a wetland loss of 0.02 hectare (0.06 acre). Impacts on this wetland would require an Isolated Wetland Permit (GLE, 2008). Based on the North Carolina Division of Environmental Management (1995) guidance for evaluating North Carolina wetlands, the wetland had a rating of 6 (maximum rating is 100), indicating that the wetland is of low value (GLE, 2008).

Indirect impacts on wetlands could occur from increased stormwater runoff, decreased groundwater recharge, disconnected hydrologic conductivity, or changes in groundwater or surface water flow patterns. Impacts from increased or decreased runoff are expected to be negligible, as impacts on wetlands would be minimized by use of sediment and erosion control measures and wetland hydrology would be controlled by the tidal influence of the Northeast Cape Fear River (GLE, 2008).

A detailed construction design would be prepared prior to preconstruction activities. From this design, a more precise determination of the potential type and extent of impacts on wetlands can be determined; and the USACE and North Carolina Division of Water Quality would determine if wetland mitigation would be required (GLE, 2009e). In conclusion, impacts on wetlands associated with preconstruction and construction activities for the proposed GLE Facility, including the utility structures and access road, would be SMALL (Table 4-6).

Environmentally Sensitive Areas

As discussed in Section 3.8.3, the environmentally sensitive areas (i.e., landscape elements or places that are crucial to the long-term maintenance of biological diversity, soil, water, and other natural resources, especially as they relate to human health, safety, and welfare, both at a local and regional context [Jennings and Reganold 1989]) occurring on or near the Wilmington Site

include the Northeast Cape Fear River Floodplain (includes the southwestern portion of the Wilmington Site); the primary nursery area for shellfish and fish within the Northeast Cape Fear River (adjacent to the Wilmington Site); and the floodplains, wetlands, unstable soils, and steep slopes on the Wilmington Site. Except for the probable impact on a 0.02-hectare (0.06-acre) isolated wetland and the possible impact on to up to 0.021 hectare (0.052 acre) of three jurisdictional wetlands, no environmentally sensitive areas would be directly impacted by preconstruction or construction activities. Only minor, localized, indirect impacts on environmentally sensitive areas may occur from erosion and sedimentation or from changes in drainage patterns. Overall, impacts from proposed GLE Facility preconstruction and construction activities on environmentally sensitive areas would be SMALL (Table 4-6).

Wildlife

Impacts on wildlife from preconstruction and construction activities would include (1) habitat disturbance, (2) wildlife disturbance, and (3) injury or mortality of wildlife.

Habitat Disturbance

Most impacts on wildlife from preconstruction and construction activities would occur from habitat disturbance (e.g., clearing and grading for the proposed GLE Facility). Habitats within the footprint disturbed by preconstruction and construction activities would be reduced or altered. Preconstruction and construction activities would also result in habitat fragmentation, particularly at the proposed GLE Facility. The use of an existing accessway for the new access road would minimize habitat fragmentation compared to what would otherwise be caused by creating a new access corridor. As the utility corridor is routed along the North access road, habitat fragmentation would be reduced.

Preconstruction and construction activities for the proposed GLE Facility and its ancillary facilities would cause a loss of habitat, which could result in a long-term reduction in wildlife abundance and richness within the project area. A species affected by habitat disturbance might be able to shift its habitat use for a short period. For example, the density of several forest-dwelling bird species has been found to increase within a forest stand soon after the onset of fragmentation as a result of displaced individuals moving into remaining habitat (Hagan et al., 1996). However, it is generally assumed that the habitat into which displaced individuals move would be unable to sustain an increased level of use over the long term. For example, an increased competition for resources in adjacent habitats would likely preclude the incorporation of the displaced individual into the resident populations.

Habitat disturbance could facilitate the spread and introduction of invasive plant species. Roads (and other linear corridors) could facilitate the dispersal of invasive plant species by altering existing habitat conditions, stressing or removing native plant species, and allowing easier movement by wildlife or human vectors (Trombulak and Frissell, 2000). Wildlife habitat could also be adversely affected if invasive vegetation became established in the disturbed areas and adjacent offsite habitats. The establishment of invasive vegetation could reduce habitat quality for wildlife and locally affect wildlife occurrence and abundance.

Little information is available regarding the effects of fugitive dust on wildlife; however, if exposure was of sufficient magnitude and duration, the effects could be similar to those on humans (e.g., breathing and respiratory symptoms, including dust pneumonia). A more

probable effect would be the dusting of plants, which could make forage less palatable. This localized effect would be short-term and would generally coincide with the displacement of and stress to wildlife from human activity. Fugitive dust is not expected to result in any long-term individual or population-level effects.

Wildlife Disturbance

Activities associated with preconstruction and construction activities for the proposed GLE Facility could cause wildlife disturbance, including interference with behavioral activities. The response of wildlife to disturbances caused by noise and human presence would be highly variable and species-specific. Intraspecific responses could also be affected by the physiological or reproductive condition of individuals; distance from the disturbance; and type, intensity, and duration of the disturbance. Seasonal or daily time of noise events could also be a factor in how noise would impact wildlife. Wildlife could respond to a disturbance in various ways, including attraction, habituation, and avoidance (Knight and Cole, 1991). All three behaviors are considered adverse. For example, wildlife might cease foraging, mating, or nesting near areas where construction was occurring. In contrast, wildlife such as bears, foxes, and squirrels could readily habituate and might even be attracted to human activities, primarily when a food source is accidentally or deliberately made available.

Although habitats adjacent to the proposed GLE site would mostly remain unaffected, wildlife might tend to make less use of these areas (primarily because of the disturbance that would occur within the project site). This impact could be considered indirect habitat loss, and it could be of greater consequence than direct habitat loss. The loss of effective habitat (amount of habitat actually available to wildlife) due to roads was reported to be 2.5 to 3.5 times as great as the actual habitat loss (Reed et al., 1996). Many of the individuals that would make use of areas adjacent to a road or other development could be subjected to increased physiological stress as a result of complications from overcrowding (e.g., increased competition for space and food, increased vulnerability to predators, and increased potential for the propagation of diseases and parasites). This combination of avoidance and stress would reduce the capability of wildlife to use habitat effectively.

Principal sources of noise during preconstruction and construction activities would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a long-term reduction in use by wildlife in those areas. Responses of birds to disturbance often involve activities that are energetically costly (e.g., flying) or affect their behavior in ways that might reduce food intake (e.g., shift away from a preferred feeding site) (Hockin et al., 1992). A variety of adverse effects of noise on raptors have been demonstrated, but for some species, the effects were temporary, and the raptors became habituated to the noise (Brown et al., 1999; Delaney et al., 1999). A review of the literature by Hockin (1992) showed that the effects of disturbance on bird breeding and breeding success include reduced nest attendance, nest failures, reduced nest building, increased predation on eggs and nestlings, nest abandonment, inhibition of laying, increased absence from nest, reduced feeding and brooding, exposure of eggs and nestlings to heat or cold, retarded chick development, and lengthening of the incubation period. The most adverse impacts associated with noise could occur if critical lifecycle activities were disrupted (e.g., mating and nesting). For instance, disturbance of birds during the nesting season could result in nest or brood abandonment. The eggs and young of displaced birds would be more susceptible to cold or predators.

Overall, direct and indirect impacts from habitat and wildlife disturbance could potentially reduce the carrying capacity of a species range and result in reduced survival or reproduction.

Wildlife Injury or Mortality

Clearing, grading, and other preconstruction and construction activities could result in the direct injury or death of those wildlife species that were not mobile enough to avoid impact areas (e.g., reptiles, small mammals), those that used burrows (e.g., ground squirrels), or those that defend nest sites (e.g., ground-nesting birds). If clearing or other construction activities occurred during the spring and summer, bird nests and eggs or nestlings could be destroyed and more mobile wildlife species, such as white-tailed deer (*Odocoileus virginianus*) and adult birds, might avoid the initial clearing activity by moving into habitats in adjacent areas. However, as previously mentioned, it is conservatively assumed that adjacent habitats are at carrying capacity for the species that live there and could not support additional biota from the construction areas. The subsequent competition for resources in adjacent habitats would likely preclude the incorporation of the displaced individuals into the resident populations.

Direct mortality from construction equipment would be low, as most equipment would be slow moving or stationary. Mortality from vehicle collisions would be expected to occur along the access road.

Wildlife could be exposed to accidental fuel spills or releases of other hazardous materials. Potential impacts on wildlife would vary according to the material spilled, volume of the spill, location of the spill, and the exposed species. A spill would be expected to have a population-level adverse impact only if the spill was very large or if it contaminated a crucial habitat area where a large number of individual animals were concentrated. The potential for either event is very unlikely. In addition, use of the project area by wildlife during construction would be limited, since there would be construction-related disturbances, thus greatly reducing the potential for contaminant exposure.

In conclusion, impacts on some wildlife from vegetation disturbance, wildlife disturbance, and injury or mortality could be MODERATE for some groups of wildlife (Table 4-7). Over 75 percent of the impacts would occur during preconstruction activities, when most of the physical disturbance to habitats would occur. Overall, the adverse impacts of preconstruction and construction activities are expected to be limited to the immediate vicinity of the proposed GLE Facility (within areas subjected to periodic logging or to routine disturbances within or near the operations area) and should not affect the viability of any wildlife populations.

Aquatic Biota

No aquatic habitats are located within the footprint of the areas that will be cleared for the GLE Facility. Furthermore, no surface water withdrawals would be used during any phase of the project. However, portions of four jurisdictional channels, the effluent channel, and Unnamed Tributary #1 to Prince George Creek occur within the corridor for the new access road and entrance. Road-crossing construction over these channels could impact aquatic biota by direct disturbance, deposition of sediments, and degradation of water quality.

Vegetation clearing, grading, and other land-disturbing activities could increase sediment loadings to nearby water bodies (such as the four jurisdictional channels, the effluent channel,

Table 4-7 Significance Levels of Potential Impacts on Wildlife from the Proposed GLE Facility

Impact Category	Potential Significance of Impacts According to Species Type[a]					
	Amphibians and Reptiles	Shorebirds, Waterfowl, and Waterbirds	Landbirds	Raptors	Small Game and Nongame Mammals	Big Game Mammals
Vegetation clearing	Moderate	Small	Moderate	Moderate	Moderate	Moderate
Habitat fragmentation	Moderate	Small	Moderate	Moderate	Moderate	Moderate
Movement/dispersal blockage	Moderate	Small	Small	Small	Moderate	Moderate
Alteration of topography	Small	Small	Small	Small	Small	Small
Water depletions	Small	Small	Small	Small	Small	Small
Erosion and sedimentation	Small	Small	Small	Small	Small	Small
Contaminant spills	Small	Small	Small	Small	Small	Small
Fugitive dust	Small	Small	Small	Small	Small	Small
Injury or mortality	Moderate	Small	Small	Small	Moderate	Small
Collection	Small	Small	Small	Small	Small	Small
Human disturbance/harassment	Small	Small	Moderate	Moderate	Moderate	Moderate
Increases in predation rates	Small	Small	Small	Small	Small	Small
Noise	Small	Small	Moderate	Moderate	Moderate	Moderate
Spread of invasive plant species	Small	Small	Small	Small	Small	Small
Air pollution	Small	Small	Small	Small	Small	Small
Radiological exposure	Small	Small	Small	Small	Small	Small

[a] Small impact: environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Moderate impact: environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource. All moderate impacts would occur during preconstruction activities.

and Unnamed Tributary #1 to Prince George Creek listed above) and to Unnamed Tributary #1 to Northeast Cape Fear River. These water bodies would ultimately receive stormwater runoff from the proposed GLE Facility. The effects of suspended sediments on aquatic biota include: (1) lethal effects (e.g., direct mortality of individuals, population reduction, or damage to the ecosystem that affects its capacity to produce biota); (2) sublethal effects (e.g., injury to the tissues or physiology of the organism, but not to the extent that death occurs); and (3) behavioral effects (e.g., alteration of activity patterns or types of activities that an organism would normally undertake in an unaffected environment) (Newcombe and MacDonald, 1991). Implementation of measures to control erosion and runoff into aquatic habitats (Section 4.2.6.3) would reduce the potential for impacts on aquatic biota.

Contaminants could be introduced into aquatic habitats as a result of the accidental release of fuels and lubricants used during preconstruction and construction activities. The level of impacts from releases of toxicants would depend on the type and volume of chemicals entering the waterway, the location of the release, the nature of the water body (e.g., size, volume, and flow rates), and the types and life stages of organisms present in the receiving waterway. In general, lubricants and fuel would not be expected to enter waterways in appreciable quantities as long as heavy machinery is not used in or near waterways, fueling locations for construction equipment are situated away from the waterway, and measures are taken to control spills that do occur.

No significant adverse impacts on aquatic biota (e.g., population-level effects) are expected from preconstruction and construction activities. All activities associated with preconstruction and construction activities would result in SMALL impacts on aquatic biota (Table 4-8).

Threatened, Endangered, and Other Special Status Species

Tables 3-14 and 3-15 in Section 3.8.6 list the threatened, endangered, and other special status species reported from New Hanover County, and indicate which species have been reported or are potentially present on or near the Wilmington Site. The tables also indicate which species could potentially be present in the proposed GLE Facility area. The types of impacts that could affect species as a result of preconstruction and construction activities for the proposed GLE Facility would be fundamentally similar to or the same as those described above for vegetation, wildlife, and aquatic biota. The most important difference from these impacts is the potential consequence of the impacts. Because of low population sizes, threatened, endangered, and other special status species are more vulnerable to impacts (e.g., habitat disturbance) than more common and widespread species.

A copy of the consultation letters received from the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) are provided in Appendix B. The FWS expressed potential concerns for those species that could occur on the Wilmington Site – the West Indian manatee (*Trichechus manatus*), roughleaf loosestrife (*Lysimachia asperulaefolia*), and, in particular, the red-cockaded woodpecker (*Picoides borealis*) (FWS, 2009). The FWS also provided comments on the draft EIS (FWS, 2010), which is also provided in Appendix B. Information provided in the FWS correspondence has been incorporated into the evaluations below on Federally listed species and are listed as additional mitigation measures presented in Section 4.2.8.3.

Table 4-8 Significance Levels of Potential Impacts on Aquatic Biota from the Proposed GLE Facility

Impact Category	Potential Significance of Impacts on Aquatic Biota[a]
Sedimentation from runoff	Small
Water depletions	Small
Changes in drainage patterns	Small
Disruption of groundwater flow patterns	Small
Temperature increases in water bodies	Small
Contaminant spills	Small
Movement/dispersal blockage	Small
Increased human access	Small
Radiological exposure	Small

[a] Small impact: environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Impacts on aquatic biota would be small for all project phases (i.e., preconstruction, construction, and operations).

The NMFS provided various publications on the shortnose sturgeon (*Acipenser brevirostrum*). Information from these reports was considered in the assessment of potential impacts on the shortnose sturgeon presented below.

Federally Listed Species

The following text provides an assessment of impacts from preconstruction and construction activities for the proposed GLE Facility on the Federally listed species (endangered, threatened, and species of concern) that exist or may exist in the Wilmington Site area. No impacts would be expected on any of the listed species. The significance level of impacts on all listed species would be SMALL.

Carolina bishopweed (*Ptilimnium ahlesii*)

The Carolina bishopweed is a Federal species of concern that inhabits freshwater tidal marshes (Weakley, 2008). No occurrence records for the Carolina bishopweed occur within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Tidal marshes would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the Carolina bishopweed.

Coastal goldenrod (*Solidago villosicarpa*)

The coastal goldenrod is a Federal species of concern. It occurs in a wide variety of wooded habitats, occurring in areas associated with natural or human-caused disturbance (CPC, 2008a). An occurrence record for the coastal goldenrod occurs within 3.2 kilometers (2 miles) of the northern boundary of the Wilmington Site (NCDENR, 2009c). Habitat suitable for the coastal goldenrod occurs in the pine-hardwood forests in the north-central and south-

central portions of the Wilmington Site (GLE, 2008). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would be potentially suitable for the coastal goldenrod and may therefore also result in mortality to some individuals. Therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Grassleaf arrowhead (*Sagittaria graminea* var. *weatherbiana*)

The grassleaf arrowhead is a Federal species of concern. It inhabits shallow water and wet shores of ponds, marshes, and ditches. There are no occurrence records for the grassleaf arrowhead within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would be potentially suitable for the grassland arrowhead (e.g., the jurisdictional channels and wetlands associated with the North access road.) Therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Pickering's morning-glory (*Stylisma pickeringii* var. *pickeringii*)

The Pickering's morning-glory (also known as Pickering's dawnflower) is a Federal species of concern. The species occurs in dry to extremely dry, nutrient-poor, well-drained, coarse sandy soils. Tree cover, ground cover, and litter accumulation are generally sparse (Patrick et al., 1995). It generally forms large mats or clumps in dry, barren, deep sand areas such as the edge of Carolina bays and relic riverine dunes (CPC, 2008b; Weakley, 2008). Preferred locations include frequently burned or clearcut areas with little or no competing vegetation (CPC, 2008b). The only recorded occurrence of the Pickering's morning-glory near the proposed GLE Facility area is a 1958 record within 3.2 kilometers (2 miles) of the facility site (NCDENR, 2009c). The operations area in the northwestern portion of the Wilmington Site contains deep sands that are periodically disturbed, and may provide suitable habitat for the Pickering's morning-glory (GLE, 2008). This area may be used as a source of fill or for the deposition of soils excavated during preconstruction and construction activities for the proposed GLE Facility; therefore, these activities may affect, but are unlikely to adversely affect, the species. The need for or disposal of fill would primarily occur during preconstruction activities.

Pondspice (*Litsea aestivalis*)

Pondspice is a Federal species of concern. It inhabits the margins of swamps, cypress ponds, low wet woodlands, and sandhill depressions on wet, sandy or peaty, acidic soils. The only known occurrence for the pondspice within 8 kilometers (5 miles) of the proposed GLE Facility is the presence of 12 to 15 clumps of the shrub around the perimeter of an ephemeral pond within the north-central portion of the Wilmington Site (GLE, 2008; NCDENR, 2009c). Hydrological conditions of this pond have since been altered since the pondspice was first observed in 1977 and do not appear to support expansion of the species. During field surveys for the Environmental Report, the existing plants appeared stressed (GLE, 2008). The location of the proposed GLE Facility is over 150 meters (500 feet) southeast of the ephemeral pond (GLE, 2008). Habitat suitable for the pondspice would not be impacted by preconstruction and

construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Raven's seedbox (*Ludwigia ravenii*)

Raven's seedbox is a Federal species of concern. It is an obligate wetland species that inhabits open, wet, peaty areas such as ditches and the margins of swamps, ponds, and bogs. There are no occurrence records for the Raven's seedbox within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). A minor amount of habitat potentially suitable for the Raven's seedbox could not be impacted by preconstruction and construction activities for the proposed North access road. Therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Roughleaf loosestrife (*Lysimachia asperulaefolia*)

The roughleaf loosestrife is a Federally endangered species. It occurs in grass–shrub ecotones adjacent to longleaf pine/scrub oak, pine savanna, flatwoods, and pond pine pocosins (evergreen shrub bogs). It prefers full sunlight and is shade intolerant (CPC, 2008c; NCDENR, 2001). It grows on moist, seasonally saturated sands or shallow organic soils overlying sands. The roughleaf loosestrife has been found in roadside depressions, firebreaks, seeps, and power ROWs (NCDENR, 2001). Habitats within which the species occurs are usually fire-maintained (i.e., areas where natural fires or controlled burns occur). There are no occurrence records for the roughleaf loosestrife within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Most pocosin habitat that could potentially support the species has been drained from the Wilmington Site and the fire regime necessary for maintaining the species habitat does not occur on the site. Also, habitat for the species is not present within the proposed GLE Facility area (GLE, 2008); therefore, preconstruction and construction activities would have no effect on the roughleaf loosestrife.

Sandhills milkvetch (*Astragalus michauxii*)

The sandhills milkvetch is a Federal species of concern. It inhabits longleaf pine/scrub oak woodlands, growing best in disturbed or fire-prone open understory areas (e.g., xeric to dry-mesic, nutrient-poor soils, thickets, field edges, and road banks). There is a 1946 occurrence record for the sandhills milkvetch within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009c; GLE, 2008). The longleaf pine/scrub forest in the northwestern portion of the Wilmington Site and the pine plantation in the north-central portion of the site could provide suitable habitat for the species. Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the sandhills milkvetch; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Small-leaf meadowrue (*Thalictrum macrostylum*)

The small-leaf meadowrue is a Federal species of concern. Habitat for the species includes swampy woodlands, slopes, and cliffs. There are no occurrence records for the small-leaf

meadowrue within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Habitat suitable for the small-leaf meadowrue would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Spring-flowering goldenrod (*Solidago verna*)

The spring-flowering goldenrod is a Federal species of concern. It inhabits a wide variety of habitats such as pine savannas, pocosins, pine barrens, open woods, fields, dry bogs, and disturbed roadsides (CPC, 2008d). There are no occurrence records for the spring-flowering goldenrod within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Pocosin/bay and pine forests potentially provide limited habitat for the spring-flowering goldenrod on the Wilmington Site (GLE, 2008). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the spring-flowering goldenrod; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Venus' flytrap (*Dionaea muscipula*)

The Venus' flytrap is a Federal species of concern. It inhabits bogs and perennially wet areas, often located between longleaf pine savannas and pocosins on the coastal plains of the Carolinas (Floridata, 2003). Two occurrence records of the Venus' flytrap have been recorded within 3.2 kilometers (2 miles) of the Wilmington Site, one of which is also within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009c). Suitable habitat for the Venus' flytrap occurs within the western portion of the Wilmington Site where pine forest and pocosin habitats are adjacent to each other. Habitat suitable for the Venus' flytrap would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Cape Fear threetooth (*Triodopsis soelneri*)

The Cape Fear threetooth is a Federal species of concern. It is a terrestrial snail that occurs on logs and under litter in swamps and under trash in pine woods (Hubricht, 1985). There are no occurrence records for the Cape Fear threetooth within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would be potentially suitable for the Cape Fear threetooth (pine woods); therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Eastern arogos skipper (*Atrytone arogos arogos*)

The eastern arogos skipper is a Federal species of concern. It inhabits native grasslands and savannas. There are no occurrence records for the eastern arogos skipper within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Habitat suitable for the eastern arogos skipper would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Greenfield ramshorn snail (*Helisoma eucosmium*)

The Greenfield ramshorn snail is a Federal species of concern. Within New Hanover County, this freshwater snail is only known from Greenfield Lake in Wilmington. It is also known from Town Creek in Brunswick County and from the Wisconsin River in the northeastern portion of the State. Specimens from Town Creek inhabit densely vegetated areas at depths less than 3 meters (10 feet). There are no occurrence records for the Greenfield ramshorn snail within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Habitat suitable for the Greenfield ramshorn snail would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Rare skipper (*Problema bulenta*)

The rare skipper is a Federal species of concern. It inhabits marshes along tidal rivers. There are no occurrence records for the rare skipper within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Habitat suitable for the rare skipper would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

American eel (*Anguilla rostrata*)

The American eel is a Federal species of concern. It spawns in the Sargasso Sea and matures in fresh or brackish waters (estuaries, rivers, streams, ponds, and lakes (NatureServe, 2009). There are no occurrence records for the American eel within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). However, the American eel is expected to occur in the Northeast Cape Fear River near the Wilmington Site (NCDENR, 2008). The river's tributaries on the site could also provide suitable habitat for the American eel. Habitat suitable for the American eel would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Shortnose sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is Federally listed as endangered. It inhabits the lower reaches of large rivers and Atlantic coastal waters. It primarily occurs in brackish and salt waters of lower coastal river reaches and river estuaries. The shortnose sturgeon ascends into the freshwaters of larger coastal rivers to spawn. Larvae and juveniles prefer deep river channels. It is very rare in the Cape Fear River drainage. There is a 1993 occurrence record for the shortnose sturgeon within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). It may occur in the Northeast Cape Fear River and the lower portions of its unnamed tributaries that occur on the Wilmington Site. It does not ascend into smaller tributaries such as the Prince George Creek (NOAA, 2002). Habitat suitable for the shortnose sturgeon would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Carolina gopher frog (*Rana capito capito*)

The Carolina gopher frog is a Federal species of concern. Adults primarily inhabit xeric uplands, especially longleaf pine-turkey oak sandhill associations. They also occur in xeric to mesic longleaf pine flatwoods, sand pine scrub, and xeric oak hammocks. Burrows of gopher

tortoises (*Gopherus polyphemus*) and rodents are used for shelter. They will also hide in sewers, under logs, and in or under stumps. Breeding habitat includes ephemeral to semipermanent graminoid-dominated wetlands that lack large predatory fishes. There are no occurrence records for the Carolina gopher frog within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Habitat suitable for the Carolina gopher frog would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

American alligator (*Alligator mississippiensis*)

The American alligator is Federally listed as threatened due to its similarity of appearance with the American crocodile (*Crocodylus acutus*). However, the American alligator is not biologically threatened and does not have protection under the *Endangered Species Act* in North Carolina (FWS, 2009). It inhabits slow-moving coastal rivers, canals, lakes, impoundments, marshes, cypress ponds, and estuaries. The American alligator has been recorded from various localities near the Wilmington Site, including the Prince George Creek at its confluence with its Unnamed Tributary #1; the Northeast Cape Fear River at its confluence with Prince George Creek; upstream of the Wilmington Site in Turkey Creek, Morgan Creek, and Long Creek; and south of the Wilmington Site in Ness Creek (GLE, 2008). Occurrences of the American alligator have been reported within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009c). At the Wilmington Site, potential breeding habitat occurs along the Northeast Cape Fear River and its tributaries, and small alligators may occur within the streams and swamp forest area of the site. Habitat suitable for the American alligator would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

Mimic glass lizard (*Ophisaurus mimicus*)

The mimic glass lizard is a Federal species of concern. It inhabits longleaf pine savannas and conifer and mixed woodlands where it burrows in the soil or inhabits fallen logs and woody debris. There are no occurrence records for the mimic glass lizard within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the mimic glass lizard; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Northern pinesnake (*Pituophis melanoleucus melanoleucus*)

The northern pinesnake is a Federal species of concern. It inhabits xeric pine forest uplands. There is a pre-1927 occurrence record for the northern pine snake within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009c). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the northern pine snake; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Southern hog-nosed snake (*Heterodon simus*)

The southern hog-nosed snake is a Federal species of concern. It inhabits mature pine forests and sandhill habitats (Jordan, 1998) and spends most of its time buried in soil. Sightings of the southern hog-nosed snake have been made southwest of the Wilmington Site between the Northeast Cape Fear River and the Cape Fear River (GLE, 2008). There are no occurrence records for the southern hog-nosed snake within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Within the Wilmington Site, the snake could occur within the pine forests, longleaf pine/scrub forests, hardwood forests, and fields. The xeric, sandy soils in the northwestern portion of the site may also be suitable habitat. Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the southern hog-nosed snake; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Eastern painted bunting (*Passerina ciris ciris*)

The eastern painted bunting is a Federal species of concern. Habitat includes partly opened areas with scattered trees and brush, riparian thickets and brush, weedy and shrubby areas, woodland edges, yards, and gardens. Salt marsh/forest edges are preferred over interior forests. There are no occurrence records for the eastern painted bunting within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the eastern painted bunting; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker is Federally listed as endangered. No critical habitat has been designated for the species (FWS, 2008a). Habitat that probably supported the largest populations was Coastal Plain longleaf pine forests maintained by frequent fires (Ozier et al., 1999). It requires open stands of mature pine (over 60 years old) for nesting and roosting habitat. Nesting and roosting occur in cavities of live trees that range in age from 63 to over 300 years old for longleaf pine or 62 to over 200 years old for loblolly and other pines. An aggregate (cluster) of 1 to 20 cavity trees are used on an area of 1.2 to 24.3 hectares (3 to 60 acres) (FWS, 2003; NatureServe, 2009). Suitable habitat surrounding a cluster of cavity trees contains open, park-like conditions. Stands of pine or mixed pines and hardwoods that are over 30 years old are used for foraging. A group requires at least 32.4 to 50.6 hectares (80 to 125 acres) of foraging habitat. The territory for a group averages about 81 hectares (200 acres), but can range from 24.3 to over 243 hectares (60 to over 600 acres) (FWS, 2003).

An active red-cockaded woodpecker colony occurs within 8 kilometers (5 miles) northeast of the Wilmington Site. It is located just north of the Northeast Cape Fear River along NC 117 in Pender County (GLE, 2008). There are several occurrence records for the red-cockaded woodpecker within 3.2 kilometers (2 miles) of the western border of the Wilmington Site (NCDENR, 2009c). No cavity trees were observed on the Wilmington Site during field surveys conducted in support of the Environmental Report (GLE, 2008). The forested habitats on the

Wilmington Site meet the minimum area requirements needed for foraging habitat. However, the lack of mature forests would limit the value of the Wilmington Site as foraging habitat. The Sledge Forest, a property containing over 1619 hectares (4000 acres) of high-quality forests directly adjacent to and north of the Wilmington Site, does contain loblolly and longleaf pine trees that are over 300 years old. This area would be suitable as nesting and roosting habitat for the red-cockaded woodpecker. It is possible that woodpeckers that forage in the Sledge Forest could occasionally forage within the western forested portion of the Wilmington Site.

No cavity trees or trees more than 30 years old were observed in the proposed GLE Facility area. Most of the area within which the proposed GLE Facility would be located has been logged within the last 20 years or less (GLE, 2008). It is not expected that habitat suitable for the red-cockaded woodpecker would be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species. Prior to preconstruction activities, GLE would conduct surveys for the presence of suitable foraging trees. In the event that foraging trees are found, further surveys would be conducted to locate potential cavity trees. These surveys would be conducted in consultation with FWS, in accordance with the FWS red-cockaded woodpecker survey protocol, to evaluate any potential impacts to red-cockaded woodpecker foraging habitat (GLE, 2009e).

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)

The Rafinesque's big-eared bat is a Federal species of concern. The species occurs in forested areas. Summer roosts include hollow trees, loose bark, or abandoned buildings in or near wooded areas. Bridges are also used as day roosts and as maternity roosts. Foraging habitat is primarily among the canopies of mature upland and lowland forests (Ozier et al. 1999). There is a pre-2006 occurrence record for the Rafinesque's big-eared bat within 3.2 kilometers (2 miles) of the proposed GLE Facility area (NCDENR, 2009c). Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the Rafinesque's big-eared bat; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

Southeastern myotis (*Myotis austroriparius*)

The southeastern myotis is a Federal species of concern. It roosts in caves, buildings, and snags and hollow trees of pine and hardwood forests, and forages primarily in riparian areas, but also in various upland habitats. There is a 1986 occurrence record for the southeastern myotis within 3.2 kilometers (2 miles) of the proposed GLE Facility area from floodplains north of the Wilmington Site near the confluence of the Northeast Cape Fear River and Prince George Creek (NCDENR, 2009c; GLE, 2008). The riparian habitats and pine and hardwood forests on the Wilmington Site provide suitable foraging and breeding habitat for the southeastern myotis. It may also forage in the operations area and transmission line ROWs. Preconstruction and construction activities for the proposed GLE Facility would disturb habitat that would potentially be suitable for the southeastern myotis; therefore, these activities may affect, but are unlikely to adversely affect, the species. Clearing and grading that would take place during preconstruction activities would account for nearly the entire amount of habitat disturbance that would occur.

West Indian manatee (*Trichechus manatus*)

The West Indian manatee is Federally listed as endangered. It inhabits shallow coastal bays, lagoons, estuaries, and rivers. The manatee usually inhabits waters with a depth of 1 to 6 meters (3.3 to 20 feet) (FWS, 2009; NatureServe, 2009). Much of their time is spent submerged or partly submerged. Manatees feed on aquatic vegetation. It is a seasonal inhabitant of North Carolina, being present mainly from June through October. There are no occurrence records for the West Indian manatee within 3.2 kilometers (2 miles) of the Wilmington Site (NCDENR, 2009c). However, the Northeast Cape Fear River and some of its tributaries in the area of the Wilmington Site may provide suitable habitat for manatee (FWS, 2009). Habitat suitable for the West Indian manatee would not be impacted by preconstruction and construction activities for the proposed GLE Facility; therefore, these activities would have no effect on the species.

State-Listed Species

Based on the information provided in Table 3-15 (Section 3.8.6.2), a number of State rare species reported from New Hanover County could be impacted by preconstruction and construction activities for the proposed GLE Facility (i.e., those species listed as potentially present on or near the GLE Facility). Impacts on State-listed species would primarily be due to habitat disturbance that occurs from clearing and grading during preconstruction activities. No impacts would be expected to any of the State-listed species. The significance level of impacts on all State-listed species would be SMALL.

4.2.8.2 Operations and Maintenance

This section evaluates the potential impacts of the proposed GLE Facility's operations on ecological resources.

Vegetation

No additional lands beyond those disturbed during preconstruction and construction activities would be affected by operation of the proposed GLE Facility. Activities associated with the operation and maintenance of the proposed GLE Facility would include mowing, hand-cutting, and chemical control of vegetation at the proposed GLE Facility, adjacent facilities (e.g., substation), utility corridors, and along the access road. The transmission line ROW would be maintained on a 3-year cycle, while cutting of danger trees would occur on a 7- to 9-year cycle (GLE, 2009e). The diversity of plant species in these areas is generally kept at a reduced level. In addition to mowing or hand-cutting, herbicides may be used on a very limited basis to control vegetation within the transmission line ROW on a 5-year cycle (GLE, 2009e). Herbicide applications may result in impacts on nontarget species from herbicide drift during application.

Landscaping within the proposed GLE Facility area would be expected to be similar to other operations areas. Lawn areas would be planted in Bahia grass (*Paspalum notatum*) and centipede grass (*Eremochloa ophiuroides*) and various trees and shrubs (GLE, 2008). A cleared security buffer would be maintained around the GLE Facility (GLE, 2009e).

Due to the relatively small size of the cooling tower to be used at the proposed GLE Facility, humidity, fogging, or salt deposition would not be of concern to vegetation. At most, only a localized area of landscaped lawn near the cooling tower may be impacted. No apparent impacts on vegetation were observed near the similarly sized FMO cooling tower.

Normal operation of the proposed GLE Facility would result in the generation of air emissions, wastewaters, and solid wastes that would be treated onsite before being discharged or shipped for disposal offsite. Therefore, no impacts on vegetation due to GLE Facility operations would be anticipated.

The radiological exposures from the proposed GLE Facility's operations would be within regulatory limits, which are established to be protective of human health. The level of radiological safety required for the protection of humans is considered adequate for other animals and plants.[12] Therefore, normal operation of the proposed GLE Facility would not have adverse effects on ecological resources resulting from radionuclide releases.

Table 4-6 summarizes the significance levels of impacts on vegetation that could occur from the proposed GLE Facility. Impacts on vegetation related to the operation of the proposed GLE Facility would be SMALL.

Wetlands

The operation of the proposed GLE Facility would not result in further encroachment on wetlands. Impervious surfaces within a watershed generally result in increased runoff and reduced infiltration, causing changes in the frequency or duration of inundation or soil saturation and greater fluctuations in wetland water levels. However, the routing of GLE Facility drainage to the stormwater retention basin would minimize the potential for wetland water-level fluctuations.

Table 4-6 summarizes the significance levels of impacts on wetlands that could occur from the proposed GLE Facility. Impacts on wetlands related to the operation of the proposed GLE Facility would be SMALL.

Environmentally Sensitive Areas

Other than the potentially minor impacts on wetlands discussed above, no environmentally sensitive areas would be impacted by operation of the proposed GLE Facility. Therefore, impacts on environmentally sensitive areas from operation of the proposed GLE Facility would be SMALL (Table 4-6).

[12] Acute doses of 10 rad (0.1 gray) or less are very unlikely to produce persistent, measurable deleterious changes in populations or communities of terrestrial plants or animals. In addition, there is no convincing evidence from the scientific literature that chronic radiation dose rates below 0.1 rad per day (1.0 milligray per day) will harm animal or plant populations. These conclusions are based on population studies that were available at the time (IAEA, 1992; DOE, 2002). The International Atomic Energy Agency is continuing to review and discuss concepts for a radiological protection framework for the environment, to include appropriate effect levels and dose limits for biota.

Wildlife

Potential impacts on wildlife from operation of the proposed GLE Facility would include: (1) ongoing habitat disturbance (i.e., reduction, alteration, and fragmentation of habitat due to the presence and maintenance of the proposed GLE Facility and support facilities such as the substation, the access road, and transmission line); (2) wildlife disturbance (e.g., from noise and the presence of workers); and (3) wildlife injury or mortality (e.g., from collisions with the water tower, transmission line, buildings, or vehicles, and from the exposure to contaminants).

Habitat Disturbance

In general, the presence of the proposed GLE Facility (and associated maintenance) could result in areas that were once considered areas with a high probability of being used by wildlife becoming areas of lower habitat use. Maintenance of landscaped areas generally keeps wildlife diversity lower than surrounding habitats. Wildlife species occurring on sites within security areas are typically limited by low habitat quality and generally include common species adapted to industrial sites. The stormwater detention basin and associated drainage ditches could provide habitat capable of supporting some wildlife species (e.g., amphibians, waterfowl). Because the project area would be fenced, big game and other larger mammal species would be physically excluded from the proposed GLE Facility site.

Periodic maintenance of the transmission line ROW in forested areas would maintain the ROW in an early stage of plant community succession, which could benefit small mammals and their predators. Regrowth of trees following maintenance could benefit white-tailed deer that feed on the leaves, twigs, and young shoots of trees and shrubs. Conversely, habitat maintenance would have localized adverse effects on species that prefer late-successional or forested habitats. ROW vegetation maintenance would not be expected to occur more often than once every 3 years. This would lessen impacts on wildlife species that might use the ROW.
No distinct travel or migratory corridors for wildlife species occur on the Wilmington Site. Therefore, the presence of the proposed GLE Facility would not impact wildlife movement. As the proposed GLE Facility would not be located near stream corridors, species such as the American black bear (*Ursus americanus*) that tend to travel along densely vegetated stream banks would not be impacted. The edge habitat established between the existing forested areas and the proposed GLE Facility could attract species such as white-tailed deer and wild turkey (*Meleagris gallopavo*) (GLE, 2008).

Wildlife Disturbance

During operation and maintenance of the proposed GLE Facility, wildlife could be disturbed by noise and the presence of workers. The activities associated with operation of the proposed GLE Facility that could generate noise include transmission lines (corona), vehicles, maintenance equipment, and plant operations. The response of wildlife to these disturbances would be highly variable and depend on the species; distance; timing; and the type, intensity, and duration of the disturbance. Disturbance impacts on wildlife during operations and maintenance would be similar to those discussed for preconstruction and construction activities (Section 4.2.8.1). For example, some individual wildlife might temporarily or permanently move from the project area. Wildlife permanently moving from the area might incur high mortality rates if the surrounding habitats were at or near carrying capacity or if the surrounding areas lacked habitat capable of supporting the displaced individuals.

During operations and maintenance, vegetation maintenance would be required (e.g., regularly within the landscaped project area and along the access road and about every 3 years within the transmission line ROW). Because of the temporary nature of maintenance activities, disturbance from noise and human presence would be localized and of short duration. During vegetation-clearing operations, wildlife would be displaced to adjacent undisturbed habitats; however, less mobile individuals could be destroyed.

Night lighting could also disturb wildlife in the project area. Lights can directly attract migratory birds (particularly in inclement weather and during low-visibility conditions) and can indirectly attract birds and bats by attracting flying insects. Attraction to lights can increase the potential for birds to collide with structures.

Wildlife Injury or Mortality

Wildlife could be injured or killed by vehicle traffic along the access road to the proposed GLE Facility. Collisions with buildings, the water tower, and the transmission line also represent a potential hazard for birds. The relative abundance of a bird species does not predict the relative frequency of fatalities per species (Thelander and Rugge, 2000). However, resident birds may have a higher probability of collisions than migrants, given that residents tend to fly lower and spend more time in the area (Janss, 2000). Also, birds typically found within the operations area habitats of the Wilmington Site would be most likely to collide with structures due to their close proximity to them.

The potential for bird collisions with transmission lines depends on variables such as habitat, relation of the line to migratory flyways and feeding flight patterns, migratory and resident bird species, and structural characteristics of the lines (Beaulaurier et al., 1984). Birds that migrate at night, fly in flocks, and/or are large and heavy with limited maneuverability are at particular risk (BirdLife International, 2003). Waterfowl, wading birds, shorebirds, and passerines are most vulnerable to colliding with transmission lines near wetlands, while in habitats away from wetlands, raptors and passerines are most susceptible (Faanes, 1987). Young, inexperienced birds, as well as migrants in unfamiliar terrain, appear to be more vulnerable to wire strikes than resident breeders. Also, many species appear to be most highly susceptible to collisions when alarmed, pursued, searching for food while flying, engaged in courtship, taking off, landing, or otherwise preoccupied and not attentive to where they are going, and during the night and inclement weather (Thompson, 1978). Mortality resulting from birds colliding with transmission lines is considered unavoidable. However, mortality levels are not anticipated to result in long-term loss of population viability in any individual species or lead to a trend toward listing as a rare or endangered species, because it is expected that mortality levels would be low.

Except under unusual circumstances, no electrocution of raptors or other birds would be expected, because the spacing between the conductors or between a conductor and a ground wire or other grounding structure would exceed the wing span of the largest birds that occur in the region. Although a rare event, electrocution could occur during current arcing when flocks of small birds cross a line or when several roosting birds take off simultaneously. This is most likely to occur in humid weather conditions (Bevanger, 1995; BirdLife International, 2003). Arcing could also occur from the waste streamers of large birds roosting on the crossarms above insulators (BirdLife International, 2003). The electrocution of other wildlife from contact with electrical transmission lines is even less common. However, non-avian wildlife species that have been electrocuted include snakes, mice, squirrels, raccoons, bobcat (*Lynx rufus*), and

American black bear (*Ursus americanus*) (EEI, 1980; Williams, 1990). Among the mammals, squirrels are among the most commonly reported species to be electrocuted because of their proclivity for chewing on electrical wires. Because of the relatively rare nature of electrocutions, they are not expected to adversely affect populations of wildlife species in the vicinity of the proposed GLE Facility.

The potential effects of electromagnetic field (EMF) exposure on animal behavior, physiology, endocrine systems, reproduction, and immune functions have been found to be negative, very minor, or inconclusive (WHO, 2007). Generally, these results are for exposures much higher and longer than would be encountered by wildlife under actual field conditions. Also, there is no evidence that EMF exposure alone causes cancer in animals, and the evidence that EMF exposure in combination with known carcinogens can enhance cancer development is inadequate (WHO, 2007).

During operation and maintenance of the proposed GLE Facility and its ancillary components, wildlife might be exposed to herbicides, fuel, or other hazardous materials. Potential exposure to hazardous materials would be most likely from a spill. A spill could result in direct contamination of individual animals, contamination of habitats, and contamination of food resources. Acute (short-term) effects generally occur from direct contamination; chronic (long-term) effects usually occur from factors such as the accumulation of contaminants from food items and environmental media (Irons et al., 2000). Moderate to heavy contaminant contact is most often fatal to wildlife. Chronic exposure can reduce reproduction, hatching success, and growth and cause a variety of pathological conditions. Contaminant ingestion during preening or feeding might impair endocrine and liver functions, reduce breeding success, and reduce growth of offspring.

The impacts on wildlife from a spill would depend on factors such as the time of year, volume of the spill, type and extent of habitat affected, and home range and density of the wildlife species. A population-level adverse impact would be expected only if the spill was very large or if it contaminated a crucial habitat area where a large number of individual animals were concentrated. The potential for either event would be unlikely. Because the amounts of most fuels and other hazardous materials are expected to be small, an uncontained spill would affect only a limited area. Also, the avoidance of contaminated areas by wildlife during spill response activities (due to disturbance from human presence) would minimize the potential for wildlife exposure.

Most herbicides used within the transmission line ROW would pose little or no risk to wildlife unless the animals were exposed to accidental spills or direct spray or drift or unless they consumed herbicide-treated vegetation. Herbicide applications would be conducted by following label directions and in accordance with applicable permits and licenses. Thus, any adverse toxicological threat from herbicides on wildlife would be unlikely. The response of wildlife to herbicide use would be attributable primarily to habitat changes resulting from treatment rather than toxic effects of the applied herbicide. However, accidental spills or releases of these materials could affect exposed wildlife. Effects could include organ damage, growth decrease, decrease in reproductive output, adverse impacts on the condition of offspring, and death (BLM, 2007).

As previously discussed, no impacts on ecological resources from operation of the proposed GLE Facility due to radiological exposure are expected. The highest exposures to wildlife would

be to small animals occupying the UF_6 storage pads. However, periodic surveys and other activities within the UF_6 storage pads would discourage use of the storage pads by wildlife. Thus, the radiological exposures to local wildlife would be negligible.

Table 4-7 summarizes the significance levels of impact to wildlife that could occur from the proposed GLE Facility. Impacts on wildlife due to GLE Facility operations would be SMALL.

Aquatic Biota

No natural water bodies occur within the immediate area of the proposed GLE Facility. The stormwater detention basin could support aquatic biota similar to other onsite stormwater wet detention basins. However, it is not likely that a diverse fish community would occur in the detention basin. More diverse aquatic communities on the Wilmington Site occur in the tributaries to the Northeast Cape Fear River and Prince George Creek, the effluent channel, and process and water treatment lagoons. The Northeast Cape Fear River supports a diverse aquatic community.

During the operations and maintenance phase, aquatic habitats and aquatic biota could be affected by continued erosion and sedimentation and exposure to contaminants. The rates of erosion and the resulting levels of turbidity and sedimentation to aquatic habitats would likely be less than during the preconstruction and construction phases because of the established ground cover and functioning of the stormwater wet detention basin. However, increased discharges to Unnamed Tributary #1 to Northeast Cape Fear River could increase turbidity and sedimentation until the stream channel adjusts to increased flows (GLE, 2008). Wastewater generated during operations would be treated to meet NPDES permit requirements. Therefore, it is not expected that aquatic biota that inhabit Unnamed Tributary #1 to Northeast Cape Fear River, which would receive effluent from the proposed GLE Facility's operations, would be adversely impacted.

The potential exists for toxic materials (e.g., fuel, lubricants, and herbicides) to be accidentally introduced into aquatic habitats during operation and maintenance of the proposed GLE Facility, access road, and transmission line. The level of impacts from releases of toxicants would depend on the type and volume of chemicals entering the waterway, the location of the release, the nature of the water body (e.g., size, volume, and flow rates), and the types and life stages of organisms present in the waterway. Because the amounts of most fuels and other hazardous materials are expected to be small, an uncontained spill would probably affect only a limited area. In general, lubricants and fuel would not be expected to enter wetlands or waterways as long as heavy machinery is not used near waterways, fueling locations for maintenance equipment are situated away from waterways, and measures are taken to control potential spills. Mitigation measures for maintenance of transmission line corridors generally restrict the use of machinery near waterways. Similarly, there are restrictions placed on the application methods, quantities, and types of herbicides that are used in the vicinity of wetlands and waterways in order to limit the potential for impacts on aquatic ecosystems. For example, herbicides would not be used directly along streams, ditches, or the stormwater wet detention basin (GLE, 2008).

Only trace levels of radiological contamination would be released to surface waters from operation of the proposed GLE Facility, with the discharges being within NPDES-permitted levels (Section 4.2.6.2). Therefore, adverse radiological impacts on aquatic biota from the operation of the proposed GLE Facility would not be expected.

Table 4-8 summarizes the significance levels of impacts on aquatic biota that could occur from the proposed GLE Facility. Impacts on aquatic biota from GLE Facility operations would be SMALL.

Threatened, Endangered, and Other Special Status Species

No impacts on threatened, endangered, or other special status species would be expected from operation of the proposed GLE Facility because of the lack of suitable habitats within the immediate project area (in part due to habitat disturbance that would have occurred during preconstruction and construction activities [Section 4.2.8.1] and due to minimal contaminant releases to the environment). Therefore, impacts from GLE Facility operations to these species would be SMALL.

4.2.8.3 Mitigation Measures

This section presents mitigation measures to minimize impacts on ecological resources. Included are mitigation measures that GLE has committed to (GLE, 2008; GLE, 2009b) and mitigation measures identified during the NRC's review. The mitigation measures are grouped by phase of development. Many of the mitigation measures are general in nature, being applicable to all phases of the project. These general mitigation measures are presented first, with more phase-specific mitigation measures following. A number of the mitigation measures designed to minimize impacts on air quality (Section 4.2.4.3), soils (Section 4.2.5.3), surface waters (Section 4.2.6.3), noise (Section 4.2.9.3), and waste management (Section 4.2.12.3) would also minimize impacts on ecological resources, and are discussed in the referenced sections.

General Mitigation Measures

Mitigation Measures Identified by GLE

General mitigation measures that GLE has identified in order to minimize impacts on ecological resources include (GLE, 2008):

- Select a non-wetland, non-floodplain area for the proposed facility.
- Maintain the hydrological connectivity of wetlands to surface waters.
- Sod, seed, and/or landscape disturbed areas in accordance with the Sediment and Erosion Control Permit.
- Plant native plant species (i.e., not invasive species) to revegetate disturbed areas and for landscaping the proposed GLE Facility.
- Use nectar- and berry-producing plants for landscaping plants.
- Place bluebird boxes throughout the study area.
- Conduct site-stabilization practices to reduce the potential for erosion and sedimentation.

- Consider the recommendations made by appropriate Federal and State agencies, including the U.S. Fish and Wildlife Service (FWS) and the North Carolina Department of Environment and Natural Resources (NCDENR).

Additional Mitigation Measures Identified by NRC

- Reduce or prevent the collection, harassment, or disturbance of plants, wildlife, and their habitats (particularly threatened, endangered, and sensitive species) through employee and contractor education on applicable State and Federal laws. Additionally, implement the following measures: (1) instruct all personnel to avoid harassment and disturbance of local plants and wildlife; (2) make personnel aware of the potential for wildlife interactions around facility structures; and (3) ensure that food refuse and other garbage are not available to scavengers.

- Establish a trash abatement program focusing on containing trash and food in closed containers and removing them periodically to reduce their attractiveness to opportunistic species, such as bears, coyotes, and feral dogs.

- Minimize the number of areas where wildlife could hide or be trapped (e.g., open sheds, pits, uncovered basins, and laydown areas).

- Observe all trees greater than 61 centimeters (24 inches) in diameter identified during GLE's surveys for potential compensatory tree plantings for the potential presence of red-cockaded woodpecker cavities. If any cavities are observed, consult the FWS as required by Section 7 of the ESA and determine an appropriate course of action to avoid or mitigate impacts.

- Develop an integrated vegetation management plan for the control of noxious weeds and invasive plant species.

Mitigation Measures for Preconstruction and Construction Activities

Mitigation Measures Identified by GLE

Mitigation measures that the applicant has identified in order to minimize impacts on ecological resources during preconstruction and construction activities include (GLE, 2008):

- Minimize the construction footprint to the extent possible and limit habitat disruption.

- Limit cut/fill slopes to a horizontal-vertical ratio of 3:1 or less.

- Use existing service road routes and utility ROWs to the fullest extent practicable to minimize the need for additional wetlands crossings.

- Construct access road perpendicular to wetlands to minimize the area impacted.

- Avoid temporary storage of materials in wetlands.

- Place fencing/barriers and use signs around wetland areas.

- Use silt fencing and cover soil stockpiles to prevent sediment runoff.
- Restore disturbed areas to original surface elevations.
- Perform surveys of trees greater than 61 centimeters (24 inches) in diameter before beginning preconstruction and construction activities. The impacts on each tree would be mitigated by the planting of one 61-centimeter (24-inch) diameter tree, two 30.5-centimeter (12-inch) diameter trees, or three 20.3-centimeter (8-inch) diameter trees elsewhere on the Wilmington Site.
- Restrict preconstruction activities and the harvesting of trees to periods when the ground is dry.
- If trenches are necessary, ensure that they are closed overnight; inspect trenches that are left open overnight and remove animals prior to backfilling. In addition, place escape ramps at less than 45-degree angles in trenches to provide exit strategies for animals entering the trenches.
- Sod, seed, and/or landscape disturbed areas in accordance with the Sediment and Erosion Control Permit.
- Revegetate disturbed areas with native plant species.
- Install animal-friendly fencing around the proposed GLE Facility site so that wildlife cannot be injured by or entangled in the site's security fence.
- Establish food plots along roadways and under power lines.[13]

Additional Mitigation Measures Identified by NRC

- As an alternative to GLE's proposed tree-planting mitigation described above, the alternative tree mitigation program suggested by the FWS (FWS, 2010) should be adopted. The FWS proposes that compensation should be provided for all pine trees with a diameter at breast height (dbh) of 10.0 in. (25.4 cm) or more that would be cut down during preconstruction and construction activities. Mitigation would consist of planting longleaf pine seedling in appropriate habitat. One longleaf pine seedling should be planted for every 2.0 in. (5.1 cm) of dbh lost (e.g., five seedlings would be planted for the loss of a 10.0 in. [25.4 cm] dbh pine) with the diameter rounded up to the nearest 2.0 in. (5.1 cm). For example, a 10.5 in. (26.7 cm) dbh pine would be rounded up to 12.0 in. (30.5 cm) and require the planting of six longleaf pine seedlings. A professional forester could designate the suitable habitat and appropriate spacing for the longleaf pine seedling plantings. Habitat suitable for seedling planting should be areas identified in the forest management plan that would be excluded from all future development.

[13] The NRC does not recommend that food plots be established along roadways, as this could increase the potential for wildlife being run over or hit by vehicles.

- Minimize the area disturbed by preconstruction activities and the installation of facilities (pipelines, transmission towers, pump stations, substations, laydown areas, assembly areas) to retain native vegetation and minimize soil disturbance.

- Backfill open trenches as quickly as is reasonable.

- To the extent practicable, avoid the use of guy wires, as these pose a collision hazard for birds.

Mitigation Measures for Operations

Mitigation Measures Identified by GLE

No specific mitigation measures to protect ecological resources from the operation of the proposed GLE Facility were identified by GLE (GLE, 2008).

Mitigation Measures Identified by NRC

- Maintain areas left in a natural condition during construction (e.g., wildlife crossings) in as natural a condition as possible within safety and operational constraints.

- To minimize habitat loss and fragmentation, reestablish as much habitat as possible after construction is complete by maximizing the area reclaimed or vegetated during operations.

- Prevent the establishment and spread of invasive species and noxious weeds within the transmission line ROW, along the access road, and in associated areas of ground surface disturbance or vegetation cutting. Monitor the area regularly and eradicate invasive species immediately.

- Based on recommendations by the FWS (FWS, 2010), consider planting longleaf pine seedlings as landscaping around buildings and parking lots.

4.2.9 Noise Impacts

This section describes potential noise impacts of preconstruction activities, construction, and operation of the proposed GLE Facility on neighboring communities. In this analysis, noise impacts were organized into road construction, land clearing and grading, and operations activities. As explained further in Section 4.2.9.1, building construction would generate less noise than road construction, land clearing, and grading, thus it was not modeled separately.

In this analysis, noise level data for stationary and mobile sources such as heavy equipment, various types of vehicles, and facility operating units for the proposed GLE Facility are estimated using standard references and then noise levels at receptors are estimated using sound propagation computer software Cadna/A® developed by DataKustik. Potential impacts from road construction are presented in Section 4.2.9.1, and those from facility operations are discussed in Section 4.2.9.2. Mitigation measures for preconstruction and construction activities, as well as facility operations, are presented in Section 4.2.9.3.

4.2.9.1 Preconstruction and Construction Activities

The commuter and truck delivery vehicular traffic around the proposed GLE Facility and along the traffic routes nearby would generate intermittent noise. However, the contribution to noise from these intermittent sources would be limited to the immediate vicinity of the traffic routes and would be minor in comparison to the contribution from continuous noise sources such as compressors or bulldozers during preconstruction and construction activities. Sources of noise during preconstruction and construction activities for the proposed GLE Facility would include standard construction activities for moving earth and erecting concrete and steel structures. Noise levels from these activities would be comparable to those from other construction sites of similar size. The noise levels would be highest during land clearing, grading, and road construction, when a large fleet of heavy equipment would be used to clear the site over a short time period. This phase is expected to include two months of road construction followed by 1 year or more of land clearing and grading.

In general, the dominant noise source for most construction equipment is the diesel engine without sufficient muffling. Pile driving or pavement breaking would normally dominate noise at a construction site, but neither of these activities is planned. During construction, a variety of heavy equipment would be used. Average noise levels for typical construction equipment range from 74 A-weighted decibels (dBA) for a roller to 101 dBA for a pile driver (impact) at the distance of 15 meters (50 feet) from a source (Hanson et al., 2006). During construction at the Wilmington Site, the noise level for any heavy equipment or traffic vehicle would be less than 90 dBA at a 15-meter (50-foot) distance.

Projected sound-level contours including average daytime A-weighted decibels and day-night average sound levels (L_{dn}, dBA) are estimated for road construction and land clearing and grading. The assumed numbers of heavy equipment and vehicle trips for use in sound propagation modeling are presented in Table 4-9. Background and modeled sound levels at the fenceline nearest to the Wooden Shoe residential subdivision are presented in Table 4-10.

The proposed north access road would be constructed to connect the NC 133 (Castle Hayne Road) to the proposed GLE Facility. Road construction 2.6 kilometers (1.6 miles) in distance would last about two months and progress westward from the NC 133 along 2.6 kilometers (1.6 miles) in the proposed access road. Predicted noise levels of 68 dBA equivalent sound level (L_{eq}) and 66 dBA L_{dn} would temporarily exceed the daytime 65 dBA L_{eq} for the New Hanover County Noise Ordinance (New Hanover County, 2009b) and the EPA guideline of 55 dBA L_{dn} (EPA, 1974)[14] at the fenceline where the access road is the closest to the site boundary (not shown in the table). At the fenceline nearest to the Wooden Shoe residential subdivision, predicted noise levels of 61 dBA L_{eq} and 59 dBA L_{dn} would be lower than the daytime equivalent continuous sound level for the New Hanover County Noise Ordinance but exceed the EPA guideline, as shown in Table 4-10. Road construction activities would be of very short duration (assumed to last two months). Potential noise impacts on the surrounding community would be MODERATE but temporary in nature when the road construction activities would occur in the proximity of the site property line near the Wooden Shoe subdivision.

[14] This location is not a residence, and thus not subject to the New Hanover County Noise Ordinance or the EPA guideline. These noise levels are presented for informational purposes only.

Table 4-9 Assumed Number of Noise Sources for Use in Sound Propagation Modeling

Phase	Assumed Value	
Road construction	4	bulldozers
	2	graders
	4	loaders
	2	rollers
	1	excavator
	1	water truck
Land clearing and grading	4	Bulldozers
	2	graders
	4	loaders
	2	rollers
	1	excavator
	1	water truck
	375	passenger vehicles (trips/day)
	35	hauling vehicles (trips/day)
Operations	4	cylinder hauling vehicles dedicated to proposed GLE Facility
	2	hauling vehicles using the western connector to existing facility
	4	air handling units
	1	scrubber exhaust[a]
	2	cooling towers
	2	emergency diesel generators
	6	heat pumps (2 per service building)
	2	pump/lift stations (25 horsepower)
	1	electrical substation (60,000 kilovolt-amperes)
	375	passenger vehicles (trips/day)
	6	hauling vehicles (trips/day)

[a] Scrubber exhaust noise is included in sound propagation modeling, but the scrubber has been removed from the proposed GLE Facility design. Results can be viewed as a conservative estimate during facility operations.
Source: GLE, 2008.

Land clearing and grading activities, which are assumed in this analysis to last for 1 year or more, follow road construction activities. Most land clearing and grading activities would occur away from the fenceline and far from the nearest residential subdivision (about 1.3 kilometers [0.8 mile]). Noise levels from commuting, delivery, and support vehicles traveling the access road would be lower than those during road construction. Predicted noise levels of 61 dBA L_{eq} and 58 dBA L_{dn} at the fenceline nearest to the proposed GLE Facility would be lower than the daytime equivalent sound level for the New Hanover County Noise Ordinance but higher than the EPA guideline (not shown in the table). However, noise levels of 48 dBA L_{eq} and 49 dBA L_{dn} at the fenceline receptor closest to the subdivision are predicted to be below the daytime equivalent continuous sound level for the New Hanover County Noise Ordinance and the EPA guideline; thus, potential noise impacts on the surrounding community would be SMALL and temporary in nature.

During the building construction phase, major activities would include building erection and electrical and mechanical installation, and some activities would occur inside the buildings. Typically, heavy equipment with lower noise levels than those during road construction or land

Table 4-10 Estimated Cumulative Sound Levels (dBAs) at the Fenceline Receptor Nearest to the Wooden Shoe Residential Subdivision

		Average L_{eq} [a]		
Activity	**Item**	**Day**	**Night**	L_{dn} [b]
	Background (measured)	46	41	48
Road construction	Modeled	61	41[c]	58
	Background+ modeled	61	41	59
Land clearing and grading	Modeled	42	41[c]	40
	Background+ modeled	48	41	49
Operations	Modeled	38	34	42
	Background+ modeled	47	42	49
Applicable regulations	New Hanover County Ordinance (residential)[d]	65	50	NA[e]
	EPA guideline (residential)[f]	NA	NA	55

[a] L_{eq} = equivalent continuous sound level. The "day" time period is 15 hours from 7 a.m. to 10 p.m. and "night" time period is 9 hours from 10 p.m. to 7 a.m.
[b] L_{dn} = day-night average sound level.
[c] No modeling was performed because no activities would occur at night. This background value is used to calculate the L_{dn}.
[d] Source: New Hanover County, 2009b.
[e] NA = not applicable.
[f] Source: EPA, 1974.

clearing and grading would be employed. The start-up and final construction phase would include concurrent indoor construction activities along with staged testing and start-up of process units as completed. Traffic accessing the construction site might increase but the traffic would consist of smaller passenger vehicles, vans, and pickup trucks. Noise modeling was not performed for this building construction phase because noise levels would be expected to be lower than those for the road construction and land clearing and grading phase. Accordingly, potential noise impacts on the nearest Wooden Shoe subdivision would be anticipated to be SMALL during these phases.

In conclusion, road construction noise could temporarily exceed the EPA guideline at the nearest Wooden Shoe subdivision but not exceed the daytime New Hanover County Noise Ordinance level. During land clearing and grading, building construction, and start-up and final construction, noise levels at the nearest subdivision are well below the New Hanover County Noise Ordinance or the EPA guideline due to the distance (about 1.3 kilometers [0.8 mile]).

4.2.9.2 Facility Operations

During facility operations, noise sources would be primarily in enclosures within the main GLE operations buildings with limited rooftop equipment. Various outbuildings are planned with

exterior equipment, such as diesel generators, pumps, heat pumps, transformers, and cooling towers. Other noise sources would include vehicular traffic such as commuting and material delivery vehicles on the proposed north access road, as well as hauling vehicles around the proposed GLE Facility and to and from the cylinder yards and the existing FMO facility (GLE, 2008).

The assumed numbers of stationary noise sources and vehicle trips are presented in Table 4-9. It is also assumed that the proposed GLE Facility is operating 24 hours per day, seven days per week (GLE, 2008). Sound propagation modeling indicates that noise levels of 47 dBA L_{eq} (day), 42 dBA L_{eq} (night), and 49 dBA L_{dn} at the fenceline receptor closest to the Wooden Shoe residential subdivision are estimated to be below the day and night equivalent continuous sound level for the New Hanover County Noise Ordinance and the EPA guideline. These levels are only 1 decibel higher than existing ambient levels at this receptor, which is lower than a 3-decibel change that is considered a barely discernable difference (NWCC, 2002). Accordingly, potential noise impacts on the nearest Wooden Shoe subdivision during operations are anticipated to be SMALL.

4.2.9.3 Mitigation Measures

As discussed above, potentially MODERATE noise impacts during access road construction of short duration (assumed to be two months) and SMALL impacts during land clearing and grading, construction, and facility operations are anticipated. All project-related activities should comply with applicable laws, ordinances, regulations, and standards. Mitigation measures during the life of the project are recommended as a means to reduce potential noise impacts on the neighboring communities. Below are mitigation measures that GLE has proposed (GLE, 2008). The NRC has also identified additional measures that could potentially reduce impacts.

General Mitigation Measures

Mitigation Measures Identified by GLE

- When possible, use quiet equipment or methods to minimize noise emissions.
- For equipment with internal combustion engines, operate equipment at the lowest operating speed to minimize noise emissions, when possible and practical.
- Close engine-housing doors during operation of equipment to reduce noise emissions from the engine.
- Avoid equipment engine idling.

Additional Mitigation Measures Identified by NRC

- Operate all vehicles traveling within and around the project area in accordance with posted speed limits.
- Post warning signs in high-noise areas and implement a hearing protection program for work areas in excess of 85 dBA.

- Project operators should realize that complaints about noise may still occur, even when the noise levels from the facility do not exceed regulatory or guideline levels. Implement a noise complaint process and hotline for the surrounding communities, including documentation, investigation, evaluation, and resolution of all legitimate project-related noise complaints.

Mitigation Measures for Preconstruction Activities and Building Construction

Mitigation Measures Identified by GLE

- Prohibit heavy truck and earth-moving equipment usage after twilight and during early morning hours.

- Equip construction equipment with the manufacturer's noise-control devices, and maintain these devices in effective operating condition.

- Use quieter, less-tonal devices that comply with all applicable safety restrictions (e.g., Occupational Safety and Health Administration [OSHA] standards) on backup alarms for construction equipment.

Additional Mitigation Measures Identified by NRC

- When possible, schedule different noisy activities to occur at the same time, since additional sources of noise generally do not significantly increase noise levels at the site. That is, less-frequent but noisy activities would generally minimize overall noise disturbance than lower-level noise occurring more frequently.

- Implement noise control measures (e.g., erection of temporary wooden noise barriers) if noisy activities would be expected near sensitive receptors.

Mitigation Measures for Operations

Mitigation Measures Identified by GLE

- Use a quieter, high-efficiency transformer to mitigate noise from the proposed electrical substation.

Additional Mitigation Measures Identified by NRC

No additional mitigation measures to minimize potential noise impacts on neighboring communities from the operation of the proposed GLE Facility are proposed by NRC.

4.2.10 Transportation Impacts

This section addresses the potential impacts on the environment from transportation of workers and materials attributable to preconstruction activities, construction, and operation of the proposed GLE Facility. The main impact of these activities on transportation resources is expected to be increased traffic on nearby roads and highways. Impacts are expected to be SMALL to MODERATE on adjacent local roads, but regional impacts are expected to be SMALL. All incoming and outgoing shipments associated with the construction, operation, and

decommissioning of the proposed GLE Facility are anticipated to be transported by truck. All motor vehicle traffic to the facility will use a new entrance, an extension of the existing North Entrance (GLE, 2009e), to the Wilmington Site off of North Carolina Route 133 (Castle Hayne Road).

4.2.10.1 Preconstruction and Construction Activities

Preconstruction and construction activities involve the movement of personnel and equipment to and from the site, the delivery of materials and supplies, and the removal of construction debris and waste. The number and type of truck shipments will vary over the course of the initial 3-year preconstruction and construction period depending on the type and level of activity at the site. Truck types would vary from heavy haul tractor-trailer trucks and other heavy haul trucks, such as dump trucks and cement trucks, to light-duty delivery trucks. Site activities would include site clearing and grading, building construction (exterior and interior), installation of process equipment, and utility installation. Preconstruction and construction activities are estimated to add approximately 35 trucks per day to local traffic on average over the construction period (GLE, 2008). This additional traffic load would have only a SMALL impact on local traffic.

The number of construction workers and visitors (e.g., regulatory inspectors, GLE staff) at the construction site would also vary widely over the 3-year preconstruction and construction period, depending on progress at the site. During preconstruction and construction activities, prior to initial start-up of operations, an average increase of up to 1428 daily trips by construction personnel is anticipated (GLE, 2009e; GLE, 2011a) as shown in Table 4-11. Approximately 200 daily trips by workers are anticipated during preconstruction with an additional 1228 daily trips at the onset of construction activities. The heaviest local traffic occurs in the immediate vicinity of the site entrance on Castle Hayne Road near the I-140 on- and off-ramps. With an annual average daily traffic (AADT)[15] level ranging from about 10,000 to 12,000 on Castle Hayne Road, as discussed in Section 3.10.1, an additional 200 to 1228 or more trips during peak commuting periods could have a SMALL to MODERATE impact at the local level.

Impacts would be lessened if shift changes did not directly coincide with local peak road usage times, including shift changes at the existing Wilmington Site facilities. Because Castle Hayne Road is a major north-south thoroughfare and I-140 is in the immediate area to handle east-west traffic, traffic funnels to and from the site on these roads, keeping impacts limited to the local site vicinity, regional impacts are considered to be SMALL.

Approximately 200 daily trips by construction personnel are expected during preconstruction activities, which would result in SMALL to MODERATE impacts at the site entrance. During construction, approximately 1228 to 1428 daily trips by construction personnel are expected and would result in MODERATE impacts at the local level.

[15] Annual average daily traffic (AADT) is a measure of the daily average number of vehicles that pass through a given segment of roadway.

Table 4-11 Estimated Traffic Generated by Construction, Operation, and Decommissioning of the Proposed GLE Facility

Phase	Schedule[a]	Average Annual Number of Employees[b]	Total Vehicle Trips[c,d]	
			AM Peak Hour Trips	Average Daily Trips (ADT)[e]
Preconstruction and initial construction activities	2012–2013	680[f]	680[g]	1428[k]
Start-up operation (2014), overlapping with 5–6 years of final construction activities	2014–2020	590[h]	236	1239
Production operations	2020–2048	350	140	735
Production operations and initial decommissioning activities	2049-2050	400[i]	190[g,j]	840
Decommissioning	2051-2057	50[i]	50[g]	105

[a] As discussed in Section 4.1, additional schedule changes would be expected to cause slight changes in the transportation impact analysis but are not expected to change the overall impact conclusions.
[b] Average annual number of employees during the specified years using annual employment estimates for the proposed GLE Facility.
[c] Number of vehicle trips estimated using Institute of Transportation Engineers (ITE) standard trip generation rates for industrial manufacturing land use (ITE, 2004). The ITE defines manufacturing facilities as areas where the primary activity is the conversion of raw material or parts into finished products. The ITE trip generation rates are total vehicle rates that include trucks. Morning peak-hour trips = 0.4 per employee.
[d] Assumed ITE ADT trip generation rates for industrial manufacturing land use for all phases.
[e] ADT = 2.1 per employee.
[f] Actual total number of construction workers onsite on a given day would vary depending on the project's construction stage and required activities. On many days, fewer than 680 workers used for the ADT estimate are expected to be needed to perform the required daily construction activities.
[g] Assumed construction and decommissioning activities conducted only during daylight hours on a Monday through Friday schedule. Therefore, morning peak-hour trip estimates conservatively assume that all workers work the same schedule and arrive at the Wilmington Site at the same time.
[h] Start-up consists of a varying mix of onsite permanent operational workers and temporary engineering and construction workers.
[i] The 50 workers included in the ADT estimate is anticipated to be an upper limit. Actual total number of decommissioning workers on-site on a given day could vary depending on the specific decommissioning-phase activities.
[j] 140 morning peak-hour trips for production workers + 50 morning peak-hour trips for decommissioning workers.
[k] The number of vehicle trips associated with preconstruction and construction are estimated to be 200 and 1228, respectively (GLE, 2009e).
Source: Modified from GLE, 2008; and GLE, 2011a.

4.2.10.2 Facility Operations

The facility operations phase would overlap with the construction phase for 5–6 years (GLE, 2008; GLE, 2011a). During this time period, vehicular traffic from operations personnel commuting to and from the proposed GLE Facility would add to the increased local traffic from construction workers and shipments, as discussed in Section 4.2.10.1. The remaining years of operations would continue to see vehicular traffic from permanent operations personnel staff, occasional visitors (e.g., regulatory inspectors), and incoming truck shipments for materials and supplies as well as outgoing shipments of product materials and wastes.

Transportation of Personnel, Materials, and Supplies

In addition to the construction-related truck shipments, the natural uranium material used for feed to the enrichment process (i.e., UF_6 feed) would be shipped to the Wilmington Site and enriched UF_6 product, UF_6 tails, empty cylinders, and LLRW, would be shipped from the site. However, the enriched UF_6 product will be another source of material for the FMO facility, and thereby reduce the number of enriched UF_6 shipments coming to the Wilmington Site. A conservative estimate of the annual number of additional heavy-haul truck shipments to and from the Wilmington Site from operation of the proposed GLE Facility, which does not account for the reduced number of enriched UF_6 shipments arriving at the site, is 2100, approximately six trucks per day on average (GLE, 2008). Other supplies and equipment necessary for operations would also be delivered to the proposed GLE Facility on an as-needed basis.

Operations personnel would be expected to reside in the Wilmington Site regional area and commute from all directions, which is similar to current workers at the other site facilities and construction workers for the proposed GLE Facility. As shown in Table 4-11, the average number of workers (construction and operations personnel) at the proposed GLE Facility on a daily basis during operations start-up and construction completion would be approximately 590 (GLE, 2008; GLE, 2011a). About 350 permanent operations personnel would be employed over the 28-year remainder of the operations period. The proposed GLE Facility would operate on a 24-hour, multiple-shift schedule 7 days per week. Thus, not all employees would be arriving and departing at the same time in the morning and evening, respectively.

As noted in Table 4-11, the average number of additional daily vehicle trips at the Wilmington Site would increase by about 1428 during preconstruction and initial construction activities. Once preconstruction and construction activities have concluded, the average number of daily trips by operations personnel associated with the proposed GLE Facility is estimated to be approximately 735. The range of an additional 735 to 1428 daily trips would have a similar effect on the local road network as the increase due to construction traffic for the proposed GLE Facility discussed in Section 4.2.10.1. Traffic in the vicinity of Castle Hayne Road and I-140 near the site entrance may become more congested at times of peak travel associated with shift changes at the proposed GLE Facility resulting in a SMALL to MODERATE impact. Impacts would be lessened if shift changes did not directly coincide with local peak road usage times, including shift changes at the existing Wilmington Site facilities. The impact on regional traffic flow is expected to be SMALL.

Transportation of Radioactive Materials

Operations of the proposed GLE Facility would require the shipment of various radioactive materials to and from the facility:

- natural UF_6 (i.e., not enriched) feed to the facility
- enriched UF_6 product from the facility to a fuel fabrication facility
- depleted UF_6 to a conversion facility
- return of empty feed cylinders with residual contamination
- LLRW for disposal

All shipments are anticipated to occur via heavy-haul tractor trailer combination trucks.

A number of these shipments may have multiple origins or destinations. UF_6 feed may be obtained from a U.S. facility (Honeywell International, Metropolis, Illinois), a Canadian source (Cameco, Port Hope, Ontario, Canada) or overseas sources arriving at U.S. seaports (Portsmouth Marine Terminal [PMT], Portsmouth, Virginia; Dundalk Marine Terminal [DMT], Baltimore, Maryland). UF_6 product may be used at the Wilmington Site or sent to other fuel fabrication facilities in Columbia, South Carolina (Westinghouse Electric), and Richland, Washington (AREVA NP). The depleted UF_6 tails could be sent to facilities in either Paducah, Kentucky or Portsmouth, Ohio; both facilities completed operational testing and were fully operational in September 2011 for conversion of depleted UF_6 to uranium oxide for disposal. In the case of the LLRW generated at the proposed GLE Facility, only one destination is planned, the EnergySolutions disposal facility in Clive, Utah. Single-shipment and annual impacts are evaluated for all potential shipment routes. Annual impacts are assumed based on all shipments of one material type over the same route (e.g., all depleted UF_6 tails going to Paducah, Kentucky, or all going to Portsmouth, Ohio).

This assessment is based on the transportation assessment presented in NUREG-0170 (NRC, 1977). Since that assessment was conducted, computer models and basic assumptions have been refined, but the overall approach to estimating transportation impacts has remained the same. The technical approach for estimating transportation risks involves use of several computer models and databases. For assessment of normal transport, risks were calculated for the collective populations of all potentially exposed individuals, as well as for a maximally exposed individual (MEI)[16] receptor. Potentially exposed populations include those persons living and working along the transport route, those present at vehicle stops, and those on the road near the shipment. The accident assessment included consideration of the probabilities and consequences of a range of possible transportation-related accidents, including low-probability accidents that have high consequences and high-probability accidents that have low consequences. The details of the transportation analysis are provided in Appendix D.

For all shipments, risks were estimated for truck transport for both normal (incident-free) and accident conditions. In both cases, “vehicle-related” and “cargo-related” impacts were evaluated.

[16] A maximally exposed individual (MEI) is an individual that may be expected to receive the highest potential radiological dose for a given scenario.

Vehicle-related risks result simply from moving any material from one location to another, independent of the characteristics of the cargo. For example, increased levels of pollution from vehicular emissions during normal conditions may affect human health. Similarly, accidents during transportation may cause fatalities from physical trauma.

Cargo-related risk, on the other hand, refers to risk attributable to the characteristics of the cargo being shipped. The radiological cargo-related risks from the transportation of uranium feed and product materials, depleted uranium tails, empty cylinders with residual heels, and LLRW would be caused by exposure to ionizing radiation. Exposures to radiation occur during both normal transportation and during accident conditions. In the case of the uranium materials considered, cargo-related risks also include chemical hazards during accident conditions.

The risks from exposure to hazardous chemicals during transportation-related accidents, which include consideration of the formation of HF from the reaction of UF_6 with moisture in the air for this assessment, can be either acute (result in immediate injury or fatality) or latent (result in cancer that would present itself after a latency period of several years). However, none of the chemicals that might be released in any of the transportation accidents involving UF_6 is carcinogenic. As a result, no excess chemically induced latent cancers would be expected from accidental chemical releases. The acute health end point – potential irreversible adverse effects – was considered for the assessment of cargo-related population impacts from transportation accidents.

Routine Transportation

Radiological risks during routine transportation would result from the potential exposure of people to low levels of external radiation near a loaded shipment. U.S. Department of Transportation (DOT) and NRC regulations – 49 CFR 73.441 (Radiation Level Limitations) and 10 CFR 71.47 (External Radiation Standards for All Packages) – were set to maintain these external radiation levels at a value considered to be protective of the public. The maximum allowable external dose rate is 0.1 millisievert per hour (10 millirem per hour) at 2 meters (6.5 feet) from the outer lateral sides of the transport vehicle. In this analysis, the external dose rates range from approximately 0.0015 millisievert per hour (0.15 millirem per hour) to 0.02 millisievert per hour (2.0 millirem per hour) as shown in Table 4-12, depending on the shipment type. Since the regulatory maximum is approximately 0.14 millisievert per hour (14 millirem per hour) at a distance of 1 meter (3.3 feet), the external dose rates from the GLE Facility shipments are expected to be approximately 20 percent or less than the regulatory maximum.

Single-shipment radiological impacts are presented in Table 4-13 for transportation of the UF_6 feed material, the enriched uranium, the depleted UF_6 tails, empty cylinders, and LLRW. Impacts on an annual basis are presented in Table 4-14 for all shipment types. The most conservative annual impacts can be estimated if the shipment option for each type of shipment with the greatest impacts are selected (i.e., UF_6 feed material from Cameco in Port Hope, Ontario; enriched uranium sent to AREVA in Richland, Washington; depleted UF_6 tails sent to the Paducah conversion facility; empty cylinders sent to Honeywell; and LLRW sent to EnergySolutions).

In the most conservative case, combined total doses of 11 person-rem and 6.0 person-rem were estimated for the public and the transportation crews, respectively, from all shipments on

Table 4-12 Estimated External Dose Rates for Radioactive Material Shipments

Material	Shipment Configuration	Shipment External Dose Rate at 1 m (mrem/hr)
UF_6 feed	1-48Y cylinder	0.29
UF_6 product	5-30B cylinders	0.95
Depleted UF_6 tails	1-48Y cylinder	0.28
Empty cylinders	2-48Y cylinders with residual heels	2.0
LLRW	36-4 × 4 × 4 feet waste boxes	0.15

Sources: GLE, 2008; GLE, 2009b.

an annual basis. The resulting expected latent cancer fatalities (LCFs) are 0.007 and 0.004, respectively (see Table 4-14). These impacts on the public would be SMALL because the exposure would be spread out among all people along the transportation routes. For example, 50 annual shipments of the empty cylinders with tails to the Honeywell facility resulted in an estimated dose of 1.7 person-rem to 367,776 persons along the route, for an average individual dose of 0.0046 millirem. Thus, an average member of the public would receive only 0.002 percent or less of the value for exposure to natural background radiation in 1 year.

For an MEI member of the public (defined as being located 30 meters [98 feet] away from a shipment passing at a speed of 24 kilometers per hour [15 miles per hour] [NRC, 1977]), the greatest radiological risk would be from the empty cylinders with heels shipments, as shown in Table 4-15. The remaining heels in the cylinders contain a concentration of residual daughter radionuclides that pose a greater external radiation hazard than present in full UF_6 cylinders. In this case, a risk of 8×10^{-7} (a chance of less than 1 in 1.3 million) of contracting a fatal cancer is estimated and is 0.00004 percent of the value for an annual exposure to natural background radiation. However, the value for potential exposure to multiple shipments would be correspondingly higher. For example, if the same maximally exposed member of the public were present for three shipments of depleted UF_6, that individual would receive a dose of approximately 2.6×10^{-5} millirem.

For transportation crew members, the largest estimated single shipment dose to one transportation crew member would be 11 millirem for shipments of the enriched product from the proposed GLE Facility to the AREVA facility in Richland, Washington. In this case, the risk of contracting a fatal cancer is 1 in 160,000. The transportation crew member dose of 11 millirem is about 10 times lower than the estimated dose of 1.02 millisievert (102 millirem) if the dose rate in any normally occupied space in the vehicle was at the regulatory limit of 0.02 millisievert per hour (2 millirem per hour) [10 CFR 71.47(b)(4)].

No latent fatalities were estimated from vehicle emissions on an annual basis (risk < 0.5). In addition, the proposed action annual truck travel on U.S. highways for the most conservative case, 2,700,000 kilometers (1,700,000 miles) as shown in Table 4-14, is only 0.0012 percent of similar truck travel on an annual basis in the United States, 229,600,000,000 kilometers (142,706,000,000 miles) (BTS, 2009). Thus, impacts on the public from vehicle emissions are considered to be SMALL.

Table 4-13 Estimated Collective Population Proposed GLE Facility Single Shipment Transportation Risks

Shipment	Total Distance (km)	Cargo-Related[a] Radiological Impacts								Vehicle-Related Impacts[c]	
		Dose Risk (person-rem)[b]						Latent Cancer Fatalities[d]			
		Routine Crew	Routine Public				Accident[e]	Crew	Public	Latent Emission Fatalities	Physical Accident Fatalities
			Off-Link	On-Link	Stops	Total					
UF_6 feed coming from:											
Portsmouth Marine Terminal	463	8.3×10^{-4}	2.2×10^{-5}	8.5×10^{-5}	7.3×10^{-4}	8.3×10^{-4}	1.9×10^{-6}	5×10^{-7}	5×10^{-7}	3×10^{-5}	7.1×10^{-6}
Dundalk Marine Terminal	754	1.3×10^{-3}	6.2×10^{-5}	1.7×10^{-4}	1.1×10^{-3}	1.4×10^{-3}	7.6×10^{-6}	8×10^{-7}	2×10^{-7}	1×10^{-4}	1.1×10^{-5}
Honeywell International	1314	2.4×10^{-3}	9.8×10^{-5}	2.6×10^{-4}	2.1×10^{-3}	2.4×10^{-3}	5.8×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-4}	1.7×10^{-5}
Cameco	1397	2.5×10^{-3}	1.1×10^{-4}	3.0×10^{-4}	2.2×10^{-3}	2.6×10^{-3}	1.2×10^{-5}	2×10^{-6}	2×10^{-6}	2×10^{-4}	1.9×10^{-5}
UF_6 product going to:											
Westinghouse Electric	479	2.1×10^{-3}	2.5×10^{-4}	8.9×10^{-4}	7.3×10^{-3}	8.5×10^{-3}	6.6×10^{-6}	1×10^{-6}	5×10^{-6}	3×10^{-5}	9.3×10^{-6}
AREVA NP	4786	2.1×10^{-2}	2.0×10^{-3}	8.7×10^{-3}	$7.5E \times 10^{-2}$	8.6×10^{-2}	9.6×10^{-6}	1×10^{-5}	5×10^{-5}	3×10^{-4}	5.0×10^{-5}
Depleted UF_6 tails going to:											
Paducah conversion facility	1219	2.1×10^{-3}	8.4×10^{-5}	2.3×10^{-4}	1.8×10^{-3}	2.1×10^{-3}	5.0×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-4}	1.6×10^{-5}
Portsmouth conversion facility	989	1.7×10^{-3}	7.5×10^{-5}	1.9×10^{-4}	1.5×10^{-3}	1.8×10^{-3}	4.9×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-4}	1.5×10^{-5}
Empty 48Y cylinder return to:											
Honeywell International	1314	$1.6E \times 10^{-2}$	1.4×10^{-3}	3.6×10^{-3}	2.9×10^{-2}	3.4×10^{-2}	2.1×10^{-8}	1×10^{-5}	2×10^{-5}	1×10^{-4}	1.7×10^{-5}
LLRW going to:											
EnergySolutions	3947	6.9×10^{-3}	3.4×10^{-4}	1.4×10^{-3}	1.2×10^{-2}	1.3×10^{-2}	5.0×10^{-8}	4×10^{-6}	8×10^{-6}	3×10^{-4}	4.2×10^{-5}

[a] Cargo-related impacts are impacts attributable to the radioactive nature of the material being transported.
[b] To convert person-rems to person-sieverts, divide by 100.
[c] Vehicle-related impacts are impacts independent of the cargo in the shipment.
[d] Latent cancer fatalities were calculated by multiplying the dose by the FGR 13 health risk conversion factors of 6×10^{-4} fatal cancers per person-rem.
[e] Dose risk is a societal risk and is the product of accident probability and accident consequence.

Table 4-14 Estimated Annual Collective Population Proposed GLE Facility Transportation Risks

Shipment	Total Distance (km)	Cargo-Related[a] Radiological Impacts: Dose Risk (person-rem)[b]						Latent Cancer Fatalities[d]		Vehicle-Related Impacts[c]	
		Routine Crew[e]	Routine Public: Off-Link[f]	On-Link[g]	Stops[h]	Total	Accident[i]	Crew	Public	Latent Emission Fatalities	Physical Accident Fatalities
UF_6 feed coming from:											
Portsmouth Marine Terminal	416,707	7.5×10^{-1}	2.0×10^{-2}	7.6×10^{-2}	6.5×10^{-1}	7.5×10^{-1}	1.7×10^{-3}	4×10^{-4}	5×10^{-4}	3×10^{-2}	6.4×10^{-3}
Dundalk Marine Terminal	679,014	1.2	5.6×10^{-2}	1.5×10^{-1}	1.0	1.2	6.8×10^{-3}	7×10^{-4}	2×10^{-4}	1×10^{-1}	9.5×10^{-3}
Honeywell International	1,182,482	2.1	8.8×10^{-2}	2.3×10^{-1}	1.9	2.2	5.2×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-1}	1.5×10^{-2}
Cameco	1,257,364	2.3	9.8×10^{-2}	2.7×10^{-1}	2.0	2.3	1.1×10^{-2}	1×10^{-3}	1×10^{-3}	2×10^{-1}	1.7×10^{-2}
UF_6 product going to:											
Westinghouse Electric	23,971	1.0×10^{-1}	1.2×10^{-2}	4.5×10^{-2}	3.7×10^{-1}	4.2×10^{-1}	3.3×10^{-4}	6×10^{-5}	3×10^{-4}	2×10^{-3}	4.6×10^{-4}
AREVA NP	239,277	1.0	1.0×10^{-1}	4.4×10^{-1}	3.8	4.3	4.8×10^{-4}	6×10^{-4}	3×10^{-3}	2×10^{-2}	2.5×10^{-3}
Depleted UF_6 tails going to:											
Paducah conversion facility	975,262	1.7	6.7×10^{-2}	1.8×10^{-1}	1.4	1.7	4.0×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-1}	1.2×10^{-2}
Portsmouth conversion facility	791,411	1.4	6.0×10^{-2}	1.5×10^{-1}	1.2	1.4	3.9×10^{-3}	8×10^{-4}	8×10^{-4}	1×10^{-1}	1.2×10^{-2}
Empty 48Y cylinder return to:											
Honeywell International	65,693	8.1×10^{-1}	6.9×10^{-2}	1.8×10^{-1}	1.4	1.7	1.0×10^{-6}	5×10^{-4}	1×10^{-3}	7×10^{-3}	8.4×10^{-4}
LLRW going to:											
EnergySolutions	142,095	2.5×10^{-1}	1.2×10^{-2}	5.0×10^{-2}	4.2×10^{-1}	4.8×10^{-1}	1.8×10^{-6}	1×10^{-4}	3×10^{-4}	1×10^{-2}	1.5×10^{-3}

[a] Cargo-related impacts are impacts attributable to the radioactive nature of the material being transported.
[b] To convert person-rems to person-sieverts, divide by 100.
[c] Vehicle-related impacts are impacts independent of the cargo in the shipment.
[d] Latent cancer fatalities were calculated by multiplying the dose by the FGR 13 health risk conversion factors of 6×10^{-4} fatal cancers per person-rem.
[e] Collective doses were calculated for truck transportation crew members involved in the actual shipment of material. Workers involved in loading or unloading were not considered.
[f] Dose to persons living or working within 0.8 kilometer (0.5 mile) of each side of a transportation route.
[g] Dose to persons in all vehicles sharing the transportation route. This group includes persons traveling in the same or opposite directions as the shipment, as well as persons in vehicles passing the shipment.
[h] Dose to persons who might be exposed while a shipment was stopped en route. For truck transportation, these stops include those for refueling, food, and rest.
[i] Dose risk is a societal risk and is the product of accident probability and accident consequence.

Table 4-15 Maximally Exposed Individual Routine Dose from Radioactive Material Shipments[a]

Material	Single Shipment Exposure (mrem)[b]
UF_6 feed	9.1×10^{-6}
UF_6 product	9.2×10^{-5}
Depleted UF_6 tails	8.8×10^{-6}
Empty cylinders	1.3×10^{-4}
LLRW	1.7×10^{-5}

[a] Individual is located 30 m from the passing shipment. Shipment is traveling at 24 km/hr.
[b] To convert mrem to mSv, divide by 100.

Accident Impacts

Overall annual transportation accident impacts from the proposed action are considered to be SMALL. The total annual radiological collective population accident dose risk to the public from all shipments for the most conservative case was estimated to be 1.6×10^{-2} person-rem. The resulting estimated LCFs are 1×10^{-5} annually. These impacts on the public would be SMALL because the exposure would be spread out among all people along the transportation routes. For example, 50 annual shipments of the empty cylinders with tails to the Honeywell facility resulted in an estimated accident dose risk of 1×10^{-6} person-rem to 367,776 persons along the route, for an average individual dose of 2.7×10^{-9} millirem. Thus, an average member of the public would receive a negligible percentage of the value for exposure to natural background radiation in 1 year, which is approximately 310 mrem (NCRP, 2009).

Chemical impacts would be negligible; past analyses of depleted UF_6 shipments have shown that the estimates of irreversible adverse effects to be approximately 1 to 3 orders of magnitude lower than the estimates of public LCFs from radiological accident exposure (DOE, 2004a; DOE, 2004b; NRC, 2005a). In addition, only 1 percent or less of those persons experiencing irreversible adverse effects due to exposure to HF or uranium compounds actually results in fatality (Policastro, 1997).

Total fatalities from direct physical trauma as a result of accidents were estimated to be 0.034 per year. Thus, no fatalities are expected from accidents on an annual basis.

4.2.10.3 Mitigation Measures

The major impact identified in Sections 4.2.10.1 and 4.2.10.2 was related to traffic congestion near the Wilmington Site entrance, primarily as a result of commuting construction and operations workers. Measures identified by GLE that would lessen such impacts include (GLE, 2008):

- Locate the proposed facility near an interstate highway interchange to facilitate employee commuter traffic and minimize the distance that truck traffic must travel on local surface streets. Selecting the Wilmington Site for the proposed action achieves this measure because of its proximity to I-140 on Castle Hayne Road.

- Increase the number of entry gates to the Wilmington Site from NC 133, including one dedicated to workers. The design for the Wilmington Site achieves this measure through the addition of a new, separate entrance dedicated to traffic destined for the proposed GLE Facility, thereby distributing the traffic load and reducing the impact on a single point of entry and exit.

- Implement roadway improvements such as deceleration lanes, turn lanes, and traffic control devices (e.g., traffic lights) to NC 133 as required by the North Carolina Department of Transportation (NCDOT) for issuance of a driveway permit for connecting the new entrance.

- Work with the NCDOT to evaluate driveway- and roadway-improvement options to minimize impacts (and help regulate traffic flow in an orderly manner).

- Schedule/stagger worker shift changes for off-peak traffic periods, including those from shift changes for existing Wilmington Site facilities and other planned operations.

- Route truck shipments of radioactive materials around cities by using a U.S. Interstate Highway Systems bypass or beltway (when available).

- Schedule truck deliveries and shipments for off-peak traffic periods to reduce potential congestion on local roadways during peak worker commuting periods.

- Encourage carpooling for construction and operations workers.

4.2.11 Public and Occupational Health Impacts from Normal Operations

This section presents the environmental impacts on the surrounding public and on workers at the proposed GLE Facility from preconstruction activities, construction, and operation of the proposed facility for both radiological and non-radiological (i.e., hazardous chemical) exposures. For members of the public, this EIS considered the affected population within an 80-kilometer (50-mile) radius of the proposed GLE Facility, with the primary exposure pathway being from gaseous effluents. Workers at the proposed GLE Facility could similarly be exposed to airborne or gaseous releases in addition to direct chemical and radiation exposures from handling UF_6 cylinders, working near enrichment process equipment, or decontaminating cylinders and equipment. The analysis presented in this section is based on the assumptions that preconstruction and construction activities could start in 2012 and would continue until 2020, operations would start in 2014, and there would be 5–6 years of overlap between construction and operations of the proposed GLE Facility (GLE, 2011a). The NRC expects that a licensing decision will be made in 2012 and that construction would begin at that time, followed by initial operations (2014), and full operations (2020). Changes to the project schedule are assumed to have a minimal effect on the total number of worker-hours required for preconstruction and construction activities, and are therefore not expected to affect the analysis of public and occupational health from normal operations.

4.2.11.1 Preconstruction and Construction Activities

This section evaluates the potential for occupational injuries and illnesses associated with the proposed preconstruction and construction activities. It also evaluates the potential public and occupational health impacts from non-radiological and radiological releases during preconstruction and construction activities.

Occupational Injuries and Illnesses

The proposed action involves a major construction activity with the potential for industrial accidents related to construction vehicle accidents, material-handling accidents, and trips and falls. Resultant injuries could range from minor temporary injuries to long-term injuries and/or disabilities to fatalities. The proposed activities are not anticipated to be any more hazardous than those for a typical large industrial construction or demolition project.

Health impacts associated with preconstruction and construction activities were estimated using annual injury and illness data for heavy construction compiled by the U.S. Department of Labor, Bureau of Labor Statistics (BLS). This bureau compiles statistics by the North American Industry Classification System, which replaced Standard Industrial Classification Codes in 2002. Preconstruction and construction activities for the proposed GLE Facility are classified under North American Industry Classification System Code 237, *Heavy and Civil Engineering Construction*. The most recent data available for incident rates for total recordable cases and lost workday cases, in units of incidents per 100 full-time equivalents (FTEs), were obtained from the BLS publication “Table 1, Incident rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2009” (DOL, 2010a). Fatality incident rates for *Construction* for calendar year 2009 (the most recent data available), in units of incidents per 100,000 FTEs, were obtained from BLS publication “Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries for civilian workers by selected worker characteristics, occupations, and industries, 2009” (DOL, 2010b). The number of construction workers per year (FTEs) and the duration of preconstruction and construction activities were obtained from Table 4.3-10 of the Environmental Report (GLE, 2008; GLE 2011a). The incident rates for total recordable cases, lost workday cases, and fatalities were applied to the projected number of construction worker-years for the 10-year project to estimate the total number of incidents. The incident rates, total FTEs, and total incidents are summarized in Table 4-16.

Table 4-16 provides estimates of 89 total incidents and 52 lost work incidents of illness and injury to construction workers and less than one fatality over the approximately 10-year schedule. These totals include preconstruction impacts that are not part of the proposed action. Based on these estimates, impacts on occupational safety from preconstruction and construction activities would be SMALL. Assuming that preconstruction activities would be completed in the first year, about 4 percent of these impacts, as well as those for non-radiological and radiological exposures discussed below, would occur during preconstruction activities. In estimating the impact from preconstruction activities, it is assumed that 95 FTEs would be involved compared to 2346 FTEs involved in total construction activities (GLE, 2011a).

Table 4-16 Health and Safety Statistics for Estimating Industrial Safety Impacts Common to the Workplace and Total Incidents for Preconstruction and Construction Activities

FTE		Total Recordable Cases		Lost Workday Cases		Fatalities	
Average FTEs per year	Total FTEs[a]	Incidents per 100 FTEs[b]	Total Recordable Cases	Incidents per 100 FTEs[b]	Lost Workday Cases	Incidents per 100,000 FTEs[c]	Total Fatalities
235	2346	3.8	89	2.2	52	9.7	0.22

[a] FTEs (full-time equivalents) (GLE, 2008; GLE, 2011a).
[b] Source: DOL, 2010a.
[c] Source: DOL, 2010b.

Nonradiological Impacts

Occupational exposures during preconstruction and construction activities would include exposure of construction workers to airborne fugitive dusts generated from vehicle traffic and heavy equipment use, exposure to pollutants emitted from diesel and gasoline powered equipment (e.g., carbon monoxide, nitrogen oxides, sulfur oxides, and particulate matter), and exposure to vapors from any fuels, paints, or solvents used during construction. Any such exposures would be expected to be minor and would be minimized using work practices and personal protective equipment specified in a construction health and safety plan. Construction activities would be subject to OHSA construction regulations (29 CFR Part 1926, *Safety and Health Regulations for Construction*). Such exposures would be typical of construction projects of industrial facilities. Worker exposure to low-level background emissions of uranium and HF from the existing FMO plant and from the proposed GLE Facility during the overlap period of its construction and early operation is discussed under cumulative impacts in Section 4.3.8 and under facility operations in Section 4.2.11.2. As noted in these sections, such exposures would be minor.

The estimated levels of air pollutants emitted during road construction, land clearing, and building construction activities are presented in Section 4.2.4. As indicated there, impacts on air quality during these preconstruction and construction activities would be SMALL. Preconstruction and construction activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of minor exceedances of short-term criteria for particulate matter ($PM_{2.5}$ and PM_{10}) from fugitive dust emissions. Worker exposures would be limited through the use of dust masks or respirators, as appropriate.

Impacts on surface water and groundwater during preconstruction and construction activities have also been analyzed in this EIS in Sections 4.2.6 and 4.2.7, respectively. These analyses showed that surface water impacts would be minimized during these activities through the use of BMPs and engineering controls (see Section 4.2.5.3). Releases to surface water streams would be governed under an NPDES permit. Temporary increases in sedimentation and turbidity in streams may occur from stormwater runoff from soils disturbed by construction activities. As for surface waters, impacts on groundwater would be prevented using best practices and engineering controls to prevent or contain any spills of hazardous materials, including fuels for vehicles and equipment. Thus, incidental exposure to groundwater and surface water to members of the public would not be of concern. Drinking water for workers would be from an offsite source.

Radiological Impacts

Radiological impacts during preconstruction and construction activities would be received primarily by the construction workers. Exposures to the offsite public would not be expected due to the distance from construction emission sources. Construction workers would not be monitored for radiation exposure by the onsite radiation exposure control program. Thus, the applicable dose limits for the construction workers would be as for the general public listed in 10 CFR 20.1301(a)(1) (i.e., 0.1 sievert per year [100 millirem per year]).

Preconstruction and construction activities would not generate any radiological contamination, but these activities could disturb areas previously contaminated due to deposition of contaminated particulates on soil from air effluent releases of past FMO facility operations as well as to the current air emission from FMO facility operations. Preconstruction and construction workers would also be exposed to emissions from the proposed GLE Facility during the overlap period of construction and early operation.

The primary exposure pathways for construction personnel would be: (1) inhalation of contaminated dust resuspended by construction activities in contaminated soils; (2) inhalation of air effluent releases from FMO operations; (3) inhalation of air effluent releases from the proposed GLE operations after 2014; (4) external exposure from previously contaminated ground; and (5) external exposure from onsite sources, such as the cylinder storage yards. The construction workers were not assumed to consume food grown at the Wilmington Site or consume water impacted by site contamination. Therefore, potential exposure from ingestion of food and drinking water was not included. The external exposure from the air submersion pathway was also ignored, as it would be small compared to direct external exposure.

For calculating the doses to workers from the various existing soil contamination, the RESRAD code Version 6.5 (Yu et al., 2001) was used in conjunction with contamination data from site environmental reports (GNF-A, 2007) and the environmental assessment for the license renewal for the Global Nuclear Fuel-Americas (GNF-A) (FMO) facility (NRC, 2009b). A description of the modeling approach in RESRAD code for this analysis is provided in Appendix C. The CAP88-PC computer code was used in estimating the internal dose from FMO and GLE air emissions (see Section 4.2.11.2). For estimating the external dose from the cylinder storage yard, the RESRAD-BUILD code Version 3.5 (Yu et al., 2003) was used. A description of the modeling approach in RESRAD-BUILD code and the CAP88-PC code's modeling approach for this analysis are also provided in Appendix C.

The maximum estimated dose for each of the exposure pathways was calculated for an annual exposure period. These estimated doses are:

- internal dose from inhalation of resuspended contaminated soil: $<6 \times 10^{-5}$ millisievert per year (6×10^{-3} millirem per year)
- external dose from contaminated soil: $<3.2 \times 10^{-4}$ millisievert per year (3.2×10^{-2} millirem per year)
- internal dose from inhalation of air emissions from FMO operations: $<2.8 \times 10^{-5}$ millisievert per year (2.8×10^{-3} millirem per year)

- internal dose from inhalation of air emissions from the proposed GLE operations: $<3.2 \times 10^{-7}$ millisievert per year (3.2×10^{-5} millirem per year) (Section 4.2.11.2)
- external dose from the existing site sources: $<1.05 \times 10^{-1}$ millisievert per year (10.5 millirem per year)

The total maximum possible dose before and after the start of GLE operations is $<1.05 \times 10^{-1}$ millisievert per year (10.5 millirem per year). The dose is dominated by the external dose received from existing site sources.

The maximum dose to construction workers of 1.05×10^{-1} millisievert (10.5 millirem) is a very small fraction of background radiation exposure in the United States, which averages approximately 3.1 millisievert per year (311 millirem per year) (Section 3.11.1). The estimated maximum yearly dose applies to workers in both the preconstruction and construction phases.

The total maximum possible dose to construction workers from all pathways is less than the limit of 1 millisievert per year (100 millirem per year) in 10 CFR 20.1301(a)(1), even for estimates combining the most conservative analytical assumptions. This is a negligible dose, representing a lifetime excess cancer risk of less than 5×10^{-6} (less than a 5 in 1,000,000 chance of getting cancer) when using a risk coefficient of 5×10^{-2} risk per sievert (5×10^{-4} risk per rem) (ICRP, 1991). Based on this assessment, the impact on workers from radiological exposure during preconstruction and construction is SMALL.

The dose to the offsite public will be significantly smaller than that for construction workers, as there is no potential for measurable exposure from the existing site contamination. The impact on the offsite public from preconstruction and construction is therefore SMALL.

4.2.11.2 Facility Operations

This section evaluates potential occupational injuries and illnesses, as well as public and occupational health impacts associated with non-radiological and radiological releases, from operation of the proposed GLE Facility.

Occupational Injuries and Illnesses

The estimated rates and numbers of injuries to workers during operation of the proposed GLE Facility were determined from Bureau of Labor Statistics tables of rates and from numbers of expected workers in the same manner as for preconstruction and construction. For these estimates, operation of the proposed GLE Facility is classified under North American Industry Classification System Code 325, *Chemical Manufacturing*. Incident rates for total recordable cases and lost workday cases for calendar year 2009 (the most recent data available), in units of incidents per 100 FTEs, for North American Industry Classification System Code 325 were obtained from the BLS publication "Table 1, Incident rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2009" (DOL, 2010a). Fatality incident rates for *Chemical Manufacturing* (North American Industry Classification System Code 325) for calendar year 2009 (the most recent data available), in units of incidents per 100,000 FTEs, were obtained from the BLS publication "Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries for civilian workers by selected worker characteristics, occupations, and industries, 2009" (DOL, 2010b).

Incident rates for total recordable cases, lost workday cases, and fatalities were applied to the projected annual number of workers (GLE, 2008; GLE, 2011a) over the years of the projected operation schedule to estimate the total number of incidents. The estimated total incidents of each type are presented in Table 4-17. For the first 4 years of start-up and operations, 550 workers would be required, and 350 workers would be required for operation thereafter. A total of 14,100 FTEs were computed from a projected 38 years of operations.[17]

A total of 324 total recordable incidents and 197 lost workday incidents are projected for 38 years of operation of the proposed GLE Facility. Over the same period, less than one fatal injury is projected. According to the small number of projected non-fatal and fatal incidents, impacts on occupational health and safety during facility operations are expected to be SMALL.

Routine Non-Radiological Impacts

Since the proposed GLE Facility would be based on a new, laser-based, technology, no historical data are available on workplace concentrations of toxic chemicals of concern, UF_6 and HF. However, it is expected that the greatest potential for occupational exposures inside the GLE process building could be due to connecting and disconnecting of the UF_6 cylinders during operations and repair activities, which are the processes that produce the highest potential emissions of UF_6 at existing uranium enrichment facilities employing centrifuge technologies (GLE, 2008). GE-Hitachi experience in UF_6 cylinder handling at its FMO facility would be useful in limiting exposures. Any released UF_6 would react with ambient moisture to form HF and uranyl fluoride (UO_2F_2). Airborne concentrations of HF and UO_2F_2 inside facilities are expected to be insignificant with respect to general worker exposure. Workers would use ventilation equipment in the immediate vicinity of cylinder handling or similar operations with potential UF_6 releases to minimize exposures. An analysis performed for the proposed American Centrifuge Plant (ACP) in Piketon, Ohio, found that workplace HF concentrations from these operations would be, on average, less than 1 percent of the Occupational Safety and Health Administration's Permissible Exposure Limit of 2.5 milligrams per cubic meter of air over an 8-hour averaging time. The Piketon facility is assumed to be an appropriate model for such exposures at the proposed GLE Facility, as exposures would most likely occur during the same kind of operations associated with the connecting and disconnecting of cylinders to and from process lines. Concentrations in the immediate vicinity of the release point could be briefly as

Table 4-17 Health and Safety Statistics for Estimating Industrial Safety Impacts Common to the Workplace and Total Incidents for Facility Operations

FTE		Total Recordable Cases		Lost Workday Cases		Fatalities	
FTEs per Year	Total FTEs[a]	Incidents per 100 FTEs[b]	Total Recordable Cases	Incidents per 100 FTEs[b]	Lost Workday Cases	Incidents per 100,000 FTEs[c]	Fatalities
371	14,100	2.3	324	1.4	197	1.4	0.20

[a] Full-time equivalents (FTEs) (GLE, 2008; GLE, 2011b).
[b] Source: DOL, 2010a.
[c] Source: DOL, 2010b.

[17] The operational period of 38 years is based the assumption that operations would begin in 2014 and continue until 2051, with license termination occurring in 2052. Additional changes in the project schedule are not expected to affect any of the impacts conclusions.

high as 10 percent of the limit and would be limited by ventilation equipment. The corresponding analysis for UF_6 at ACP found that maximum expected levels of 0.7 milligrams per cubic meter would be well below the relevant workplace one-hour standard of 10 milligrams per cubic meter of uranium (NRC, 2006). Based on this analysis, the impacts associated with routine occupational exposures to HF and UF_6 in the workplace should be SMALL.

Large volumes of UF_6 would be present at the proposed GLE Facility as feed material and product material as a consequence of the primary function of the facility – uranium enrichment. This material, which is solid at ambient temperatures, would be stored in appropriate steel canisters in the feed storage and product storage areas. There would be no routine exposures to solid UF_6.

Worker health and safety would be the focus of the GLE Nuclear Safety Program and the Industrial Safety Program administered by the Industrial Health and Safety manager at the Wilmington Site. Work practices at the proposed GLE Facility would be evaluated to assure that workers were protected through the implementation of appropriate safety measures, including the use of safety equipment and personal protective equipment (GLE, 2008). Worker exposure to industrial chemicals would be limited to safe levels through a combination of minimizing airborne releases within and outside of the proposed GLE Facility and use of appropriate protective equipment, such as fume hoods, in situations where elevated air concentrations could exist. Hazardous chemicals would be handled under written procedures administered by the Industrial Safety Program. Industrial activities would be subject to OSHA's industrial regulations (29 Part CFR Part 1910, *Occupational Safety and Health Standards*), as well as site licenses and permits (GLE, 2008).

Because of the controls on chemical exposures that would be in place under an ongoing chemical safety program, non-radiological impacts on workers from routine operation of the proposed GLE Facility are expected to be SMALL.

The proposed GLE Facility would use banks of lasers to effect the enrichment of uranium. Thus, potential worker exposure to laser light would be a safety concern. Injuries to the eye would be the primary concern. Lasers would normally be operated within enclosures, while lasers would be equipped with interlocks to prevent inadvertent exposures from opening of enclosures. To ensure that protections are in place and to prevent any accidental exposures, a formal laser safety program would be implemented at the facility, headed by a Laser Safety Officer and employing a written laser safety protocol. The program would require laser safety training for all personnel working with or around laser equipment. Laser safety reviews would be conducted in advance of any maintenance, repair, or non-routine activity where exposures are possible. At the State level, laser safety would be regulated by the North Carolina Department of Labor, Occupational Safety and Health Division. Applicable regulations relevant to laser safety would include Federal standards for ionizing and non-ionizing radiation, 29 CFR 1910.133 (eye and face protection), and laser exposure limits under American National Standards Institute standard ANSI Z136.1. North Carolina Department of Labor General Industry Standards (under 13 N.C. Admin Code 07F) would apply as well. With laser protections in place, laser impacts on worker health would be SMALL.

With respect to public health impacts, non-radiological releases from operation of the proposed GLE Facility to surface water and groundwater, including liquid waste effluents from decontamination, cleaning, and laboratory processes and from cooling tower blowdown, should

be small and should not degrade existing water quality (Sections 4.2.6.2 and 4.2.7.2). Therefore, the public health impacts associated with such liquid releases would also be SMALL.

Potential long-term, low-level HF and uranium exposure to members of the public would be the primary offsite chemical exposures of concern. Public health impacts from such exposures are expected to be SMALL, however. The building housing the enrichment process would be operated under negative pressure. Any leaks, therefore, would exit the building only through the ventilation system, which would be equipped with a HEPA filter to remove particulate matter and with carbon beds to remove gaseous contaminants (GLE, 2008). Only minor quantities of UF_6 or HF would thus escape the system, as dictated by the efficiency of the filter devices.

As discussed in Section 4.2.4.2, carbon beds are expected to remove ≥99 percent of the HF in the gas vented through the operations building stack. The specific quantity of HF that would pass through the emissions control devices is not known at this time, but should be below levels established in a required air permit for the proposed GLE Facility and protective of public health (i.e., the facility would be assumed to meet its air permit requirements). Absent such estimates, onsite and offsite exposures were estimated using estimates for the National Enrichment Facility (NEF), a three million separative work unit (SWU) gas-centrifuge plant proposed to be built in New Mexico (NRC, 2005b). Most HF emissions would be expected to occur in feed and product ends of the operations at both types of plants, so similar emission levels would be expected for a given amount of UF_6 processed. Since the proposed GLE Facility would have twice the output of this facility, twice its estimated discharge point (ventilation stack) concentration of 3.9 micrograms per cubic meter, or 7.8 micrograms per cubic meter (0.0095 parts per million), was assumed to be the concentration at the proposed GLE Facility's stack. Table 4-18 shows modeled HF concentrations at various onsite and offsite locations after dispersion. A maximum HF concentration of only 3.7×10^{-4} micrograms per cubic meter (4.5×10^{-7} parts per million) is estimated at the location of an onsite member of the public or construction worker, which is far below the OSHA chronic (8-hour) exposure level of 2.5 milligrams per cubic meter (31 parts per million), while offsite locations would be far below public exposure standards discussed in Section 3.11.2. Given that the concentrations estimated for receptor locations would be far below levels of concern, the stated assumptions should be sufficiently accurate for the purposes of the analysis.

Uranium concentrations to which receptors could be exposed are shown in Table 4-18. These concentrations were based on GLE's estimated emission rate for uranium isotopes, (GLE, 2008; Table S-2) after converting uranium activity to mass. The maximum uranium concentration is estimated to be 1.9×10^{-7} micrograms per cubic meter at the location of the onsite member of the public.

Both the estimated HF and uranium concentrations at onsite exposure locations are many orders of magnitude below safe levels established by the OSHA (2.5 milligrams per cubic meter for HF and 50 micrograms per cubic meter for uranium, each averaged over eight hours, see Section 3.11.2). Modeled UF_6 and HF levels at the site boundary and at the location of the nearest resident given in Table 4-18 are even lower than onsite levels. HF concentrations at any exposure location, moreover, are far below the most stringent State or Federal ambient air quality standards for the general public, for example, Washington's standard of 8.7 micrograms per cubic meter (0.011 parts per million) (ATSDR, 2003). Since these estimates are based on a continuous release, they represent a continuous exposure. Such chronic exposure modes are considered in the formulation of the aforementioned air quality standards.

Table 4-18 Predicted Airborne Concentrations of Uranium and Hydrogen Fluoride from Proposed GLE Facility Stack Releases at Different Receptor Locations

Location	Direction	Distance (m)[a]	Total Uranium ($\mu g/m^3$)[b]	HF[c] ($\mu g/m^3$)
Site Boundary	North	399	1.1×10^{-7}	2.2×10^{-4}
Site Boundary	North-northwest	573	5.2×10^{-8}	1.0×10^{-4}
Site Boundary	Northwest	924	2.7×10^{-8}	5.3×10^{-5}
Site Boundary	West-northwest	1493	1.5×10^{-8}	2.9×10^{-5}
Site Boundary	West	1717	2.2×10^{-8}	4.4×10^{-5}
Site Boundary	West-southwest	2302	1.8×10^{-8}	3.5×10^{-5}
Site Boundary	Southwest	1806	3.0×10^{-8}	5.8×10^{-8}
Site Boundary	South-southwest	1892	2.9×10^{-8}	5.7×10^{-5}
Site Boundary	South	1416	5.1×10^{-8}	1.0×10^{-4}
Site Boundary	South-southeast	1708	1.9×10^{-8}	3.7×10^{-5}
Site Boundary	Southeast	2664	1.1×10^{-8}	2.1×10^{-5}
Site Boundary	East-southeast	1270	1.9×10^{-8}	3.8×10^{-5}
Site Boundary	East	671	6.5×10^{-8}	1.3×10^{-4}
Site Boundary	East-northeast	427	1.1×10^{-7}	2.1×10^{-4}
Site Boundary	Northeast	353	1.5×10^{-7}	3.0×10^{-4}
Site Boundary	North-northeast	346	1.2×10^{-7}	2.4×10^{-4}
Onsite Member of the Public	South	250	1.9×10^{-7}	3.7×10^{-4}
Nearest Resident	East-southeast	1352	1.8×10^{-8}	3.6×10^{-5}

[a] To convert meters to feet multiply by 3.28.
[b] 10^6 µg = 1 g.
[c] HF concentrations are based on dispersion of a release point concentration of 7.8 $\mu g/m^3$, or twice that estimated for the 3 million SWU proposed National Enrichment Facility (NRC, 2005b).

HF emissions would be monitored in vent stacks (as fluoride) and would be limited by an air quality permit required for the operation of the proposed GLE Facility that would be issued by the NCDAQ and would be protective of public health. This permit would consider GLE emissions in combination with those from the existing FMO facility, which would be substantially higher because of the nature of the chemical processes conducted there (GLE, 2008). No criteria air pollutants (e.g., CO, NO_x, SO_2, or VOCs) would be produced by the GLE process, as discussed in Section 4.2.4.2.

Routine Radiological Impacts

This section describes the potential routine radiological impacts on members of the public and workers from the proposed GLE Facility. Appendix C documents the methodology used in evaluating and reviewing project information and also includes the site-specific data used.

Public Health Impacts

Operation of the proposed GLE Facility could result in radiation exposure to the public via intake (ingestion or inhalation) of uranium released from the facility or from direct external exposure to radiation emitted by the uranium present at the facility. The two potential pathways of concern potentially leading to public intake of uranium would be airborne releases and liquid releases. With respect to releases to air, any UF_6 gas released inside the proposed GLE Facility's operations building during operations and repair activities would be sent through a ventilation system employing a high-efficiency, multi-stage, emissions control system that incorporates HEPA filters for removal of particulate matter and activated carbon beds for gas absorption, minimizing outside releases. Liquid releases could result from decontamination, cleaning, and maintenance of failed equipment or equipment being serviced and any associated releases of radioactive liquids to surface water. However, these liquids would be treated and sampled to limit releases via a permitted outfall. Exposure of members of the public to direct external radiation could occur from emission of radiation from uranium in process lines, in cylinders in storage areas, and during handling, temporary storage, and transportation within and outside of the site. The direct radiation emitted by the uranium in the facility would be significantly absorbed by the walls of the storage cylinder, and building walls, process lines and equipment within the proposed GLE Facility. Additionally, any direct radiation would diminish with distance as it traveled over 1300 meters (0.8 miles) to reach the current nearest member of the public. Any direct radiation and skyshine (radiation reflected from the atmosphere) from uranium released to the air would be expected to be undetectable at offsite areas due to the very low concentrations of such releases.

Public Dose from Airborne Releases of Radioactive Materials

The proposed GLE Facility's operations building would release small amounts of uranium to the atmosphere during operation through a single rooftop stack. The modeling performed by NRC for this analysis evaluated the impact of these releases to offsite populations and to onsite populations that are not included in the site's radiological dose monitoring program (e.g., construction workers). Exposures in both of these groups would be subject to the 1 millisievert per year (100 millirem per year) public exposure limits in 10 CFR 20.1301(a)(1) and the 0.1 millisievert per year (10 millirem per year) airborne dose limits in 40 CFR Part 61, Subpart H, the EPA's National Emissions Standards for Hazardous Air Pollutants (NESHAPs).

GLE laser-enrichment is a new technology and therefore, there are currently no test data to quantify the air emissions from the proposed GLE Facility. Monitoring data for the existing FMO facility vents that approximate the proposed GLE Facility's operations were used to approximate the proposed GLE Facility's emissions (GLE, 2008). Dispersion of uranium emitted at this estimated release rate was modeled from the design height of the rooftop vent of the proposed GLE Facility's main operations building. Table 4-19 shows the stack and vent characteristics, site-specific parameters, and annual release rates assumed in dose modeling. The stack could

Table 4-19 Proposed GLE Facility Stack/Vent Characteristics, Site Characteristics, and Stack Releases Used in Modeling

Input Parameter	Value
Stack Diameter (m)	1.2
Stack Release Height (m)[a]	15.24
Velocity (m/s)	12.3
Temperature	Ambient
Uranium-234 Emission Rate (Ci/sec)[b]	1.25×10^{-13}
Uranium-235 Emission Rate (Ci/sec)[b]	4.88×10^{-15}
Uranium-236 Emission Rate (Ci/sec)[b]	5.49×10^{-17}
Uranium-238 Emission Rate (Ci/sec)[b]	1.77×10^{-14}
Ambient Temperature (°C)	17.7
Annual Precipitation (cm)	144.96

[a] Stack could be higher (21–27 m [69–89 ft]) as reported by GLE in June 2009 (GLE, 2009a), but the lower value (GLE, 2008) is used because it is conservative and the doses are small.
[b] Emission rates are converted to Ci/yr by multiplying 3.15×10^{7} sec/yr conversion factor for input in the CAP-88 code.
Source: GLE, 2008 (Tables S-1 and S-2).

be higher (21–27 meters [69–89 feet]) as reported by GLE (GLE, 2009a), but the lower value of 15.24 meters (50 feet) (GLE, 2008) is used because it is conservative and the doses are small.

EPA air modeling code CAP88-PC (Version 3) was used to assess the impacts from the proposed GLE Facility's air emissions. This code is approved by the EPA for demonstrating compliance with NESHAPs. The code calculates radiation doses from a number of exposure pathways, including inhalation, submersion, groundshine, and ingestion of contaminated food following uranium deposition on the ground. A description of the modeling approach in the CAP88-PC code for this analysis is provided in Appendix C.

Data for wind speed and direction by stability classes were taken from the Wilmington International Airport meteorological station for the years 1988 through 1992 (Rosnick, 2007). The distances from the proposed GLE Facility stack to the receptor locations were measured to the Wilmington Site boundary in each of the 16 compass directions (GLE, 2009a). Receptor dose was also calculated at 250 meters (0.16 mile) to model the nearest onsite member of the public (e.g., a construction worker) and at 1350 meters (0.84 mile) to model the nearest resident. Separate runs for the onsite member of the public, site boundary, and nearest resident were made.

The onsite member of the public was assumed to consume foodstuff produced within an 80-kilometer (50-mile) radius surrounding the proposed GLE Facility but not produced onsite (regional food pattern in the code). The rural food consumption pattern was used to estimate the dose at the site boundary and the nearest resident. The rural food consumption pattern assumes a high percentage of the foodstuff is produced at home or at the point of exposure (70 percent vegetables, 40 percent milk, and 44 percent meat), and the remainder is produced within an 80-kilometer (50-mile) radius of the release point (proposed GLE Facility). These food assumptions are very conservative, because very few people actually consume 100 percent of their diet produced within 80 kilometers (50 miles) of their residence (Hill, 2008).

Table 4-20 shows the estimated dose to hypothetical receptors residing at the site boundary in each of the 16 directions modeled in CAP88-PC (Version 3). Information about doses from natural background radiation is provided in Section 3.11.1. Table 4-20 also includes the dose to the onsite member of the public and the nearest resident. The maximum dose to a hypothetical receptor at the Wilmington Site boundary is in the northeast direction (0.35 kilometers [0.22 miles]) of the proposed GLE Facility, estimated to be 1.1×10^{-6} millisievert per year (1.1×10^{-4} millirem per year). The estimated dose to the nearest resident located at 1.35 kilometers (0.84 miles) east-southeast of the proposed GLE Facility is 1.4×10^{-7} millisievert (1.4×10^{-5} millirem per year). The maximum estimated dose for the onsite member of the public assumed to be located 250 meters (0.16 mile) to the south of the GLE stack is 3.2×10^{-7} millisievert per year (3.2×10^{-5} millirem per year). For calculating the dose for the onsite member of the public it was assumed that the member of the public was on-site for 2000 hours in 1 year. All of these estimated doses are well below the 1 millisievert per year (100 millirem per year) public exposure limits in 10 CFR 20.1301(a)(1) and the 0.1 millisievert per year (10 millirem per year) airborne dose limits in 40 CFR Part 61, Subpart H (NESHAPs). Therefore, impacts on members of the public from the air emissions of the proposed GLE Facility would be SMALL.

The CAP-88 PC code also calculates airborne concentrations in picocuries per cubic meter for each radionuclide at the user-defined locations. These concentrations can be converted to micrograms per cubic meter for the purpose of evaluating the chemical toxicity of uranium. Uranium exerts heavy metal toxicity, primarily to the kidney (Section 3.11.3.3). Table 4-18 provides the calculated airborne uranium (and HF) concentrations at the same receptor locations as in Table 4-20.

In summary, airborne emission of uranium from the proposed GLE operations are predicted to cause radiation doses that are well below the 1 millisievert per year (100 millirem per year) public exposure limits in 10 CFR 20.1301(a)(1) and the 0.1 millisievert per year (10 millirem per year) airborne dose limits in 40 CFR Part 61, Subpart H, the EPA's NESHAPs. The airborne concentration of uranium from the proposed GLE operations are also well below the toxicity limits established by the National Institute for Occupational Safety and Health and the American Conference of Industrial Hygienists. Therefore, the impacts from proposed GLE Facility air emission are expected to be SMALL.

Table 4-20 Annual Effective Dose from Proposed GLE Facility Stack Releases at Different Receptor Locations

Location	Direction	Distance (m)[b]	Dose (mSv/yr)[c]
Site Boundary	North	399	8.5×10^{-7}
Site Boundary	North-northwest	573	6.2×10^{-7}
Site Boundary	Northwest	924	2.1×10^{-7}
Site Boundary	West-northwest	1493	4.7×10^{-8}
Site Boundary	West	1717	1.7×10^{-7}
Site Boundary	West-southwest	2302	1.4×10^{-7}
Site Boundary	Southwest	1806	2.3×10^{-7}
Site Boundary	South-southwest	1892	2.2×10^{-7}
Site Boundary	South	1416	3.9×10^{-7}
Site Boundary	South-southeast	1708	2.5×10^{-7}
Site Boundary	Southeast	2664	1.8×10^{-7}
Site Boundary	East-southeast	1270	1.5×10^{-7}
Site Boundary	East	671	4.9×10^{-7}
Site Boundary	East-northeast	427	8.3×10^{-7}
Site Boundary	Northeast	353	1.1×10^{-6}
Site Boundary	North-northeast	346	9.4×10^{-7}
Onsite Member of the Public[a]	South	250	3.2×10^{-7}
Nearest Resident	East–southeast	1352	1.4×10^{-7}

[a] Onsite member of the public in the south direction got the maximum dose. For calculating the dose for the onsite member of the public it was assumed that the member of the public was onsite for 2000 hours in 1 year.
[b] To convert m to ft multiply by 3.28.
[c] To convert mSv to mrem multiply by 100.

Public Dose from Direct Gamma Radiation

The presence of radioactive materials at the proposed GLE Facility would present the possibility for onsite members of the public to receive a radiation dose directly from gamma rays (photons) emitted from these materials. Isotopes of uranium could be present in quantities large enough to provide the potential for onsite members of the public to receive a measurable external radiation dose. Of the uranium onsite, only that being stored as depleted uranium would be continuously present in sufficient quantity to represent a potential source of direct radiation dose to the onsite member of the public. However, as noted above, gamma emissions would be attenuated to a large degree by container walls, structures, and through distance to receptors. There would be small amounts of other gamma emitters present onsite as sealed sources and laboratory standards, but these are not detectable at any large distance.

The measured radiation dose at various locations of interest from existing radiation sources at the Wilmington Site was used to gauge the public dose from direct gamma radiation from the proposed GLE Facility. The site conducts external gamma radiation monitoring using a network of thermoluminescent dosimeters (TLDs) positioned at various locations both on and off the Wilmington Site. The TLD readings are inclusive of any exposure caused by the presence of existing radiation sources on the Wilmington Site, including direct radiation and skyshine from the existing cylinder storage yards. None of the TLDs showed readings above the background exposure rate of 5 microentgens per hour (GLE, 2009b) at the site boundary. The distance to the nearest site boundary from the additional storage yards planned for the proposed GLE Facility is greater than 350 meters (1148 feet). Because of the shielding and the distance to the receptors, it is expected to have only a minor effect on the direct radiation exposure rate at the site boundary. Therefore, the impact from direct exposure to the public is expected to be SMALL.

Public Dose from Liquid Releases of Radioactive Material

The proposed GLE Facility would generate process and sanitary liquid effluent streams. Process wastewater generated at the proposed GLE Facility is a combination of 5000 gallons per day (18,900 liters per day) of liquid radiological waste generated from decontamination, cleaning, and laboratory activities and 30,000 gallons per day (113,600 liters per day) of cooling tower blowdown that circulates in a closed-loop system and does not come in direct contact with uranium materials. Radioactive wastewater is collected via a closed-drain system and discharged to an accumulator tank. The closed-drain system allows the liquid radioactive wastewater generated from different activities involving radioactive material to be collected at one place instead of being discharged. Liquid radioactive wastewater in the tank would be sampled on a regular basis before routing to a liquid effluent treatment system. The treated effluent would be discharged to the final process lagoon facility. Blowdown from the cooling water system would be piped directly to the final process lagoon facility (GLE, 2008). The water from the lagoon facility would be discharged through an NPDES-permitted outfall (Outfall 001) to the effluent channel. The 10,500 gallons per day (40,000 liters per day) sanitary wastewater generated would be treated in the existing sanitary wastewater treatment facility. The treated sanitary wastewater effluent would be used to replace blowdown from the cooling towers. The stormwater runoff from the proposed GLE Facility would drain to a stormwater wet detention basin before being discharged. In addition, a holding pond would be placed near the UF_6 storage pads to collect the stormwater runoff from these pads. Monitoring for gross alpha/beta activities, total uranium, and fluoride would be conducted at the holding pond before the water is discharged to the stormwater wet detention basin. If any unanticipated radioactivity is detected in the holding pond, radiological material would be allowed to settle and/or precipitate. The liquid then would be pumped from the holding pond and, if necessary, routed to the GLE liquid effluent treatment system. The effluent channel includes the discharges from all liquid effluent streams from the Wilmington Site and flows to the Northeast Cape Fear River through Unnamed Tributary #1.

For calculating the doses to the public from liquid effluent releases, the GENII code Version 2.06 (Napier, 2007; Napier et al., 2007) was used. The code has been developed by Pacific Northwest National Laboratory for the EPA for calculating dose and risk from radionuclide releases in the environment. GENII Version 2.06 incorporates internal dosimetry models recommended by the International Commission on Radiological Protection (ICRP), and the related risk factors published in Federal Guidance Report 13 (EPA, 1999). The GENII code

includes a set of programs for calculating radiation dose and risk from radionuclides released to the environment. GENII implements the NRC models in LADTAP code for surface water doses.

The Northeast Cape Fear River would receive the liquid effluent discharges from the proposed GLE Facility. There are no public water intakes on the river downstream of the discharge point, so only the fish ingestion and recreational water use-related exposure pathways were analyzed (GLE, 2009g).

The radionuclide concentration in surface water was calculated at three potential exposure locations from the uranium concentrations in liquid effluent releases from the proposed GLE Facility and the dilution factor in the receiving water body (GLE, 2009g). It was assumed that a member of the public was exposed to contaminated surface water from recreational activities and ingestion of fish grown in the contaminated surface water. The recreational activities considered were swimming, boating, and use of the shoreline. The following exposure pathways were included in the dose assessment:

- external exposure from swimming
- external exposure from boating
- external exposure from contaminated shoreline sediment
- inadvertent ingestion of contaminated surface water during swimming
- ingestion of fish grown in contaminated surface water

The surface water concentrations, estimated number of people involved, specific radiological parameters, and exposure parameters for different activities used in the GENII code for radiological impact assessment are provided in Appendix C. Table 4-21 provides the estimated dose for an exposed member of the public from different surface water exposure pathways, along with the estimated population doses. Information about doses from natural background radiation is provided in Section 3.11.1.

The maximum dose that a member of a public would receive from liquid effluent releases from the proposed GLE Facility would occur just south of the Wilmington Site boundary. The maximum estimated dose for the MEI from liquid effluent releases would be 7.3×10^{-7} millisievert per year (7.3×10^{-5} millirem per year). Total estimated population dose would be 2.7×10^{-3} person-millisievert per year (2.7×10^{-1} person-millirem per year). These doses are well below the 1 millisievert per year (100 millirem per year) public exposure limits in 10 CFR 20.1301(a)(1). Therefore, impacts on members of the public from liquid effluent releases from the proposed GLE Facility would be SMALL.

Summary of Public Dose

Based on these estimates, normal operations at the proposed GLE Facility would have SMALL impacts on public health. Results are based on conservative assumptions (see Appendix C), and it is anticipated that actual exposure levels would be less than presented here. The total

Table 4-21 Estimated Doses for Liquid Effluent Releases from the Proposed GLE Facility

Exposure location	Exposure Pathway	Dose (mrem/yr) to a Member of Public	Number of People Exposed	Collective Dose (person-mrem/yr)
Confluence with Unnamed Tributary #1 to Northeast Cape Fear River	Fish ingestion	5.26×10^{-5}	1414	7.44×10^{-2}
	Water ingestion during swimming	4.37×10^{-7}	1906	8.33×10^{-4}
	External exposure from swimming	1.03×10^{-8}	1906	1.96×10^{-5}
	External exposure from boating	5.15×10^{-9}	1244	6.41×10^{-6}
	External exposure from shoreline activities	2.01×10^{-5}	1231	2.47×10^{-2}
	Total for a member of public	7.32×10^{-5}	NA	NA
Just South of GE Wilmington Site Boundary	Fish ingestion	5.26×10^{-5}	1414	7.44×10^{-2}
	Water ingestion during swimming	4.37×10^{-7}	1906	8.33×10^{-4}
	External exposure from swimming	1.03×10^{-8}	1906	1.96×10^{-5}
	External exposure from boating	5.15×10^{-9}	1244	6.41×10^{-6}
	External exposure from shoreline activities	2.01×10^{-5}	1231	2.47×10^{-2}
	Total for a member of public	7.32×10^{-5}	NA	NA
NC 133 Bridge	Fish ingestion	5.06×10^{-5}	1414	7.15×10^{-2}
	Water ingestion during swimming	4.21×10^{-7}	1906	8.02×10^{-4}
	External exposure from swimming	9.95×10^{-9}	1906	1.90×10^{-5}
	External exposure from boating	4.98×10^{-9}	1244	6.20×10^{-6}
	External exposure from shoreline activities	1.93×10^{-5}	1231	2.38×10^{-2}
	Total for a member of public	7.03×10^{-5}	NA	NA
	Total population dose	NA	NA	2.72×10^{-1}

[a] To convert mrem to mSv, divide by 100.

[b] NA = not applicable.

annual dose from all exposure pathways would be far less than the limit of 1 millisievert per year (100 millirem per year) established in the NRC's regulations in 10 CFR 20.1301. All exposures are also expected to be significantly below the EPA limit of 0.25 millisievert per year (25 millirem per year) in 40 CFR Part 190 for dose to members of the public from uranium fuel-cycle facilities.

Occupational Exposure Impacts

Under the proposed action, the most significant contributor to occupational radiation exposure would be direct radiation from the UF_6. It is expected that the average occupational doses at the proposed GLE Facility would be similar to occupational doses at existing fuel cycle facilities in the United States. As is the case for such fuel cycle facilities, the most substantial sources of direct radiation would likely include both full Type 48Y cylinders containing either feed material or depleted UF_6 and empty Type 48Y cylinders with residual material (NRC, 2005b). Table 4-22 presents occupational doses at fuel cycle facilities within the United States for 2003–2007 (Burrows and Hagemeyer, 2005; Burrows and Hagemeyer, 2006; Lewis et al., 2008).

The existing nuclear and industrial safety program at the Wilmington Site would be expanded to include operation of the proposed GLE Facility (GLE, 2008). The program would monitor the occupational workers at the proposed GLE Facility for internal exposure from intake of uranium as well as dose from external exposure to radiation. GLE would also apply an annual administrative limit of 40 millisievert (4000 millirem), which is below the 10 CFR 20.1201 limit of 50 millisievert (5000 millirem) for occupational exposure.

GNF-A has implemented a comprehensive exposure control program at the Wilmington Site to manage occupational radiation exposure and dose. The program maintains exposures "As Low As Reasonably Achievable" (ALARA) through the use of radiation monitoring systems, personnel dosimetry, and mitigation systems to reduce environmental concentrations of uranium. The average TEDE to workers from existing GNF-A operations at the Wilmington Site for 2003–2007 varied from 0.5–0.75 millisievert (50–75 millirem) and the maximum TEDE during the same time period varied from 4.7–5.6 millisievert (470–560 millirem) (NRC, 2009b).

The occupational exposure analysis and the historical exposure data from the United States Enrichment Corporation facilities and the existing GNF-A operations at the Wilmington Site demonstrate that a properly administered radiation protection program at the proposed GLE Facility would maintain radiological occupational impacts below the regulatory limits of 10 CFR 20.1201. Therefore, the impacts from occupational exposure at the proposed GLE Facility are expected to be SMALL.

4.2.11.3 Mitigation Measures

Facility design features and process controls would be incorporated into the proposed GLE Facility to minimize gaseous and liquid effluent releases, and to maintain the impacts on workers and the surrounding population below regulatory limits. An ALARA program would be implemented in addition to routine radiological surveys and personnel monitoring. Minimum requirements associated with compliance with 29 CFR Part 1910 regarding OSHA standards would be implemented. Worker health and safety would be protected under an expansion

Table 4-22 Annual CEDE[a] and TEDE[b] for Fuel Cycle Facilities within the United States for 2003–2007

Year	Number of Monitored Individuals	Workers with Measured TEDE	Collective TEDE (person-rem[c])	Average Measured TEDE (rem)	Workers with Measured DDE	Collective DDE[d] (person-rem)	Average Measured DDE (rem)	Workers with Measured CEDE	Collective CEDE (person-rem)	Average Measured CEDE (rem)
2003	7738	3633	556	0.15	2815	258	0.09	2255	298	0.13
2004	7562	3814	514	0.13	2933	258	0.09	2327	256	0.11
2005	7699	3371	497	0.15	2385	238	0.10	2173	259	0.12
2006	7417	3413	522	0.15	2475	283	0.11	2131	238	0.11
2007	7536	3225	429	0.13	2254	230	0.10	1983	199	0.10

[a] Committed effective dose equivalent = total radiation dose received from ingestion or inhalation of radioactive material.
[b] Total effective dose equivalent = CEDE plus DDE (deep dose equivalent from external radiation).
[c] 1 rem = 1000 mrem.
[d] To convert rem to Sv, divide by 100.
Sources: Burrows and Hagemeyer, 2005; Burrows and Hagemeyer, 2006; Lewis, et al. 2008.

of the current GNF-A Nuclear Safety Program and the Industrial Safety Program that would comply with applicable State, NRC (10 CFR Part 20), and OSHA (29 CFR Part 1910) requirements. Appropriate safety controls would be implemented according to the nature of work and hazards presented to minimize exposure to chemicals and radionuclides.

Mitigation Measures Identified by GLE

- Install a building ventilation system and maintain the majority of the process building under sub-atmospheric pressure to prevent any air effluent release inside the building from being directly vented outside the building.
- Install alarms in the Emergency Control Center to detect, alarm, and/or activate the automatic safe shutdown of process equipment in case of operational problems.
- Install radiation monitors in effluent stacks to detect, alarm, and activate the automatic safe shutdown of process equipment, should contaminants be detected in the system exhaust.
- Isolate leaks and shut down process lines to prevent damage to equipment.
- Vent exhaust-gases from the emission control system to the atmosphere through a single rooftop stack. The emission control system would have a design control efficiency of at least 99 percent for uranium particulates and UF_6 and HF vapors.
- Employ fluoride monitors and radiation monitors in vent stacks to detect, alarm, and activate the automatic safe shutdown of process equipment.
- Perform environmental monitoring and sampling to ensure compliance with regulatory discharge limits.
- Route treated process wastewater effluents to the existing final process lagoon facility at the Wilmington Site for additional treatment. Treated sanitary wastewater effluent would be used to replace blowdown from the cooling towers.

The mitigation measures proposed by GLE for worker health and safety include:

- Comply with all applicable State, NRC, and OSHA regulations concerning worker health and safety, as well as the existing Wilmington Site Nuclear Safety Program and the Industrial Safety Program.
- Comply with the Site Radiation Protection Program, the Spill Prevention Control and Countermeasure Plan, and the GLE Environmental, Health, and Safety Program.
- Conduct routine facility radiation and radiological surveys to characterize and minimize potential radiological exposure.
- Monitor all operational workers via dosimeters and area air sampling to ensure that radiological doses remain within regulatory limits and ALARA practices.

- Conduct operations activities involving hazardous respirable effluents with ventilation control and/or respiratory protection, as required.

- Use personal protective equipment based on the nature of the work and chemical and/or radiological hazards present.

Additional Mitigation Measures Identified by NRC

- Move UF_6 cylinders only when cool and when UF_6 is in solid form, to minimize the risk of inadvertent release due to mishandling.

- Direct process off-gas from UF_6 purification and other operations through cold traps to solidify and reclaim as much UF_6 as possible. Pass remaining gases through high-efficiency filters and chemical absorbers to remove HF and uranic compounds.

- Separate uranic compounds and various other heavy metals in waste material generated by decontamination of equipment and systems.

4.2.12 Waste Management Impacts

This section evaluates the potential environmental impacts related to operation of the solid, hazardous, and radioactive waste management program at the proposed GLE Facility, including impacts resulting from temporary storage, conversion, and disposal of the depleted UF_6. No mixed waste (hazardous and radioactive) is expected to be generated at the proposed facility.

Due to the nature, design, and operation of a laser enrichment facility, the generation of waste materials can be categorized by three distinct facility operations: (1) preconstruction and construction, which generates typical construction wastes associated with an industrial facility; (2) enrichment process operations, which generate gaseous, liquid, and solid waste streams; and (3) generation and temporary storage of depleted UF_6 (Section 4.2.17.11 of this chapter discusses decommissioning wastes). Waste materials include radioactive waste (i.e., depleted UF_6 and material contaminated with UF_6), listed or characteristic hazardous materials (as defined in 40 CFR Part 261), and nonhazardous materials (any other wastes not identified as radioactive or hazardous). Hazardous materials include any fluids, equipment, and piping contaminated as defined in 40 CFR Part 261, such as cleaning solvents and pesticides, that would be generated due to the construction, operations, and maintenance programs.

The handling and disposing of waste materials is governed by various Federal and State regulations. To satisfy the Federal and State regulations, GLE has implemented waste minimization and pollution-prevention practices associated with the generation, collection, removal, and proper disposal of waste materials. GLE's waste management program is intended to minimize the generation of waste through reduction, reuse, or recycling (GLE, 2008). This program would assist in identifying methods to minimize the volume of regulated wastes through better segregation of materials and the substitution of nonhazardous materials as required under Resource Conservation and Recovery Act (RCRA) regulations. Using available information and waste data from similar facilities, the waste-management impacts at the proposed GLE Facility are assessed for preconstruction and construction, operations, and depleted UF_6 disposition activities.

4.2.12.1 Preconstruction and Construction Activities

Solid nonhazardous wastes generated during the preconstruction and construction phases would be typical of those for construction of industrial facilities. These wastes would be transported offsite to an approved local landfill. Approximately 3058 cubic meters (4000 cubic yards) per year of non-compacted waste is anticipated to be generated (GLE, 2009a) and would include paper, plastic, cardboard, packaging materials, wood scraps, metal building material scraps, roofing and insulation material scraps, masonry and ceramic materials, and empty paint and coatings containers. Small quantities of organic solvent-based residuals remaining from application of specialty paints, architectural coatings, sealants, and adhesives, as well as wastes from certain other materials that possibly could be used for ancillary building construction, which is one aspect of preconstruction, or construction, may be required to be managed as hazardous waste.

Nonhazardous wastes would be transported to the New Hanover County Landfill for disposal. This landfill receives approximately 151,000 tons (approximately 210,000 cubic yards [compacted]) annually (NCDENR, 2009a). Thus, proposed GLE Facility preconstruction and construction activities would generate approximately 2 percent of the waste that the New Hanover County Landfill receives annually from all other sources. The generation of hazardous wastes (i.e., waste oil, greases, excess paints, and other chemicals) associated with the preconstruction and construction activities for the proposed facility due to the maintenance of construction equipment and vehicles, painting, and cleaning, would be packaged and shipped offsite to licensed facilities in accordance with Federal and State environmental and occupational regulations. Table 4-23 shows the hazardous wastes that would be expected from construction of the proposed GLE Facility. The quantity of all preconstruction- and construction-generated hazardous and nonhazardous waste material would result in SMALL impacts that could be managed effectively.

Preconstruction activities such as land clearing, site grading and erosion control, installation of the stormwater system, utility placement, and parking lot and roadway construction, would account for less than 2 percent of the nonhazardous waste generated during preconstruction activities, with approximately 300 cubic meters (400 cubic yards) generated, compared to 3058 cubic meters per year (4000 cubic yards per year) generated during each of the following 6 years of building construction (GLE, 2009f). Similarly, hazardous waste generated during preconstruction activities would be expected to account for approximately two percent of the hazardous waste generated during the ensuing 6 years of construction. These estimates are based on GLE’s assumption that construction of ancillary buildings, although authorized by the exemption allowing GLE to perform certain preconstruction activities prior to the NRC licensing decision, would not occur until after the NRC licensing decision (GLE, 2009f). Thus, the estimated volume of waste from ancillary building construction is included here in the estimated volumes of building construction waste.

4.2.12.2 Facility Operations

Normal operation of the proposed GLE Facility would result in the generation of wastewaters that would be treated onsite before discharge and solid wastes that would be treated onsite or offsite and shipped for disposal offsite. The systems used to manage the wastes generated during operations onsite are described in Section 2.1.2.4.

Table 4-23 Estimated Construction Hazardous Wastes for the Proposed GLE Facility

Waste	Annual Quantity
Paints, solvents, thinners, organics	3000 gal (11,360 L)
Petroleum products, oils, lubricants	3000 gal (11,360 L)
Sulfuric acid (battery)	100 gal (379 L)
Adhesives, resins, sealers, caulking	2000 lb (910 kg)
Lead (batteries)	200 lb (91 kg)
Pesticides	100 gal (379 L)

Source: GLE, 2009a.

Wastewater

Wastewater management systems are in place at the proposed GLE Facility site to handle sanitary wastewater, facility cooling tower water, stormwater, and process wastewater. The first three systems deal with nonradioactive effluents, while the last system is in place to remove any uranium or other metals left in the water as a result of the uranium enrichment process. Stormwater management is discussed in Sections 3.7.1 and 4.2.6.2. Table 4-24 summarizes the estimated quantities generated by the different systems.

Sanitary Wastewater

Sanitary wastewater at the proposed GLE Facility would be collected by a sewer system connected to the existing Wilmington Site sanitary wastewater treatment facility discussed in Section 3.12.2.1. Approximately 39,747 liters per day (10,500 gallons per day) are estimated to be generated by the proposed GLE Facility, increasing the load on the existing treatment system by about one-third (GLE, 2008). Because the Wilmington Site has secured a reuse permit for treated sanitary wastewater effluent as makeup water in cooling towers onsite, the additional 39,747 liters per day (10,500 gallons per day) discharged could be used in the proposed GLE Facility cooling tower, which is estimated to have a blowdown of about 113,562 liters per day (30,000 gallons per day) (GLE, 2008). Should discharges to surface waters be necessary in the future, the existing NPDES discharge permit of 283,906 liters per day (75,000 gallons per day) as discussed in Section 3.12.2.1 would be adequate to cover the additional volume of effluent. The NPDES discharge permit is half of the capacity of the existing treatment system. Therefore, impacts from sanitary wastewater from the proposed GLE Facility would be SMALL.

Cooling Tower Blowdown

The water removed from a cooling tower loop is referred to as “blowdown.” Water in a cooling tower loop does not come in direct contact with wastes or hazardous materials, but a portion of the cooling water in a tower’s loop is replaced periodically to maintain the concentration of dissolved solids and other impurities within specific water quality limits. At the proposed

Table 4-24 Wastewater Volume Estimates for the Proposed GLE Facility

Wastewater Type	Wastewater Source	Estimated Average Daily Quantity Generated
Process liquid radwaste	Wastewaters from proposed GLE Facility's main operations building decontamination room; process area floor drains, sinks, sumps, and mop water; laboratory area floor drains, sinks, sumps, and mop water; change room showers and sink; and aqueous process liquids that have the potential to contain uranium	18,927 lpd (5000 gpd)
Cooling tower blowdown	Proposed GLE Facility's main operations building HVAC cooling tower	113,562 lpd (30,000 gpd)
Sanitary waste	Sanitary waste from building areas used by proposed GLE Facility workers (e.g., restrooms, break rooms)	39,746 lpd (10,500 gpd)
Stormwater runoff	Stormwater runoff from proposed GLE Facility impervious surfaces (e.g., building roofs, parking lots, service roads, outdoor storage pads, and other maintained areas)	Variable depending on local precipitation

Source: GLE, 2008.

GLE Facility, approximately 113,562 liters per day (30,000 gallons per day) of blowdown would be sent directly to the Wilmington Site's final process lagoons (GLE, 2008). This volume of water represents a 6 percent increase handled by the process lagoons in 2006, but is only 2 percent of the existing NPDES permit for treated process wastewater. The impacts from cooling tower blowdown are therefore expected to be SMALL.

Process Wastewater

Daily operations at the proposed GLE Facility are estimated to generate approximately 18,927 liters per day (5000 gallons per day) of radioactive wastewater from decontamination, cleaning, and laboratory activities within the proposed GLE Facility's main operations building (GLE, 2008). This process wastewater would be collected in an accumulator tank. Uranium and other metals would be precipitated out of solution in the accumulator tank through a pH adjustment. The resulting precipitate slurry at the bottom of the tank would be isolated and disposed of as solid LLRW as discussed in the following section on Nonhazardous Solid Wastes. The resulting fluoride solution at the top of the tank would be treated to remove the fluoride also resulting in a solid waste form. The treated process wastewater effluent would then be discharged to the Wilmington Site process wastewater aeration basin and Final Process Lagoon Treatment Facility (FPLTF). Because the additional 18,927 liters per day (5000 gallons per day) from operation of the proposed GLE Facility would only be about an additional 1 percent over the volume treated by the FPLTF in 2006 (the latest data available) and less than 0.3 percent of the NPDES permit, the impacts from GLE process wastewater would be SMALL.

Nonhazardous/Nonradioactive Solid Wastes

Operations at the proposed GLE Facility would generate approximately 345 metric tons per year (380 tons per year) of municipal solid waste (MSW) and an additional 97 metric tons per year (107 tons per year) of other nonhazardous industrial solid wastes. Table 4-25 provides a summary of the types of wastes anticipated. The MSW would be collected on a regular basis and sent to the local New Hanover Municipal Landfill, which receives about 137,000 metric tons per year (151,000 tons per year) (NCDENR, 2009a). Impacts on the landfill operations would be SMALL, as the MSW waste would contribute approximately an additional 0.3 percent to its current receipt rate. The other nonhazardous industrial waste would either be packaged and shipped directly to Heritage Environmental Services in Indianapolis, Indiana, or routed through Heritage Environmental Services for reuse, reclamation, or treatment. Impacts are considered to be SMALL because 97 metric tons per year (107 tons per year) represents less than 0.1 percent of the waste received at Heritage Environmental in 2007 (the latest data available) (IDEM, 2008).

Hazardous Wastes

As shown in Table 4-25, approximately 11 metric tons per year (12 tons per year) of RCRA hazardous waste would be expected to be generated by the proposed GLE Facility. The waste would be packaged and shipped to Heritage Environmental Services in Indianapolis, Indiana, a RCRA-permitted Subtitle C facility, for treatment, storage, and disposal. The impact would be expected to be SMALL because disposal of 11 metric tons per year (12 tons per year) represents approximately 0.01 percent of the amount of hazardous waste, 122,091 metric tons (134,610 tons), received by Heritage Environmental Services in 2007 (the latest data available) (IDEM, 2008).

Low-Level Radioactive Waste

A variety of uranium-contaminated wastes would be expected to be generated from operation of the proposed GLE Facility, as shown in Table 4-25. With the exception of the depleted UF_6 tails, the majority of the LLRW (312 metric tons per year [344 tons per year]) would be the combustible and non-combustible portions of contaminated used items, with an additional 953 kilograms per year (2100 pounds per year) of sludge from the process wastewater treatment discussed in Section 4.2.12.2, followed by waste from feed sampling and analysis (44 kilograms per year [97 pounds per year]) (GLE, 2008). This LLRW would be packaged per DOT standards and shipped to Energy*Solutions*' Clive, Utah, facility for disposal. The impact would be considered SMALL because approximately 312 metric tons per year (344 tons per year) of waste is less than 0.08 percent of the 500,000 metric tons per year (453,600 tons per year) permitted maximum of the disposal facility (UDRC, 2009).

Depleted UF_6 Management

As discussed in Chapter 2 of this EIS, depleted UF_6-filled Type 48Y or 48G cylinders (depleted UF_6 cylinders) would be temporarily stored on an outdoor cylinder storage pad on the facility grounds. Storage of depleted UF_6 cylinders at the proposed GLE Facility would occur during the facility's 40-year operating lifetime, with eventual removal of depleted UF_6 from the site through one of the disposition options considered. The U.S. Department of Energy (DOE) is required by Section 3113 of the Atomic Energy Act, 42 U.S.C. § 2297h11, to take title to and possession of the depleted uranium if requested. Furthermore, DOE provided GLE with a

Table 4-25 Operations Waste Estimates for the Proposed GLE Facility

Waste Type	Waste Source	Estimated Average Annual Quantity Generated
Municipal solid waste (MSW)	General worker operations, maintenance, and administrative activities not involving the handling of or exposure to uranium	345 Mt/yr (380 tons/yr)
Nonhazardous industrial wastes	Nonhazardous wastes from proposed GLE Facility equipment cleaning and maintenance activities (e.g., used coolant, non-hazardous caustic, and filter media) that are recyclable or not accepted by municipal solid waste (MSW) landfill	97 Mt/yr (107 tons/yr)
RCRA hazardous waste	Wastes designated as RCRA hazardous wastes from proposed GLE Facility equipment and maintenance activities (e.g., used cleaning solvents, used solvent-contaminated rags)	11 Mt/yr (12 tons/yr)
Low–level radioactive waste (LLRW)	Laboratory waste from UF_6 feed cylinder sampling and analysis	44 kg/yr (97 lbs/yr)
	Combustible, uranium-contaminated used items (e.g., worker personal protection equipment, swipes, step off pads)	93 Mt/yr (103 tons/yr)
	Noncombustible, uranium-contaminated used items (e.g., spent filters from HVAC systems, liquid effluent treatment system, and area monitors) and corrective maintenance items (e.g., defective pigtails, valves, other safety equipment that need replacement)	219 Mt/yr (241 tons/yr)
	Liquid effluent treatment system filtrate/sludge	953 kg/yr (2100 lbs/yr)
	Depleted UF_6 (UF_6 tails)	11,250 Mt/yr (12,400 tons/yr)

Source: GLE, 2008.

cost estimate for disposition of the depleted uranium and indicated that DOE would extend the operational period of its conversion plants to accommodate the additional material (GLE, 2008).

The current storage pad design is large enough (465,000 square feet) to accommodate up to 9000 cylinders, the expected inventory from 10 years of operation. Additional area is available nearby for expansion, if room for more cylinders is required. If further expansion of the pad is necessary in the future, GLE would be required to prepare a license amendment and prepare the requisite safety and environmental analyses at that time.

Temporary Onsite Storage Impacts

Proper and active cylinder management, which includes routine inspections and maintaining the anti-corrosion layer on the cylinder surface, has been shown to limit exterior corrosion or mechanical damage to the degree necessary for the safe storage of depleted UF_6 (DNFSB, 1995a; DNFSB, 1995b; DNFSB, 1999). DOE has stored depleted UF_6 in Type 48Y or similar cylinders at the Paducah and Portsmouth Gaseous Diffusion Plants since approximately 1956. Cylinders were also stored at the East Tennessee Technical Park in Oak Ridge, Tennessee,.until 2007 (DOE, 2010). Cylinder leaks due to corrosion led DOE to implement a cylinder management program. Past evaluations and monitoring by the Defense Nuclear Facility Safety Board (DNFSB) of DOE's cylinder maintenance program confirmed that DOE met all of the commitments in its cylinder maintenance implementation plan (DOE, 1995), particularly through the use of a systems engineering process to develop a workable and technically justifiable cylinder management program (DNFSB, 1999). Thus, similar active cylinder maintenance program by GLE would assure the integrity of the depleted UF_6 cylinders for the period of time of temporary onsite storage of depleted UF_6 on the cylinder storage pad.

The principal impacts from cylinder storage would be the radiological exposure resulting from depleted UF_6 temporarily stored in 9000 depleted UF_6 cylinders (the design capacity of the GLE full tails cylinder storage pad) under normal conditions and the potential release (slow or rapid) of depleted UF_6 from the cylinders due to an off-normal event or accidents (operational, external, or natural hazard phenomena events). These radiation exposure pathways are analyzed in Sections 4.2.11.2 and 4.2.15.2, and based on these results, the impacts from temporary storage would be SMALL. The annual impacts from temporary storage would continue until the depleted UF_6 cylinders are removed from the proposed GLE Facility site.

Offsite Disposal Impacts

For the disposal of the depleted UF_6, GLE has proposed that the Type 48Y cylinders would be transported from the proposed GLE Facility to either of the DOE's conversion facilities at Paducah, Kentucky, or Portsmouth, Ohio, for conversion to triuranium octaoxide (U_3O_8). After being converted to uranium oxide (primarily dry U_3O_8), the waste would be further transported to a licensed disposal facility. The transportation of the Type 48Y cylinders from the proposed GLE Facility to either of the conversion facilities would have environmental impacts that are included in the transportation analysis presented in Section 4.2.10.2.

If the DOE conversion facility could not immediately process the depleted UF_6 upon arrival, potential impacts would include radiological impacts proportional to the time of temporary storage at the conversion facility. DOE has previously assessed the impacts of depleted UF_6 storage during the operation of a depleted UF_6 conversion facility (DOE, 2004a; DOE, 2004b). At the Paducah and Portsmouth conversion facilities, the maximum collective dose to workers (i.e., workers at the cylinder yards) would be 0.055 person-sievert (5.5 person-rem) per year and 0.03 person-sievert (3 person-rem) per year, respectively, considering the existing stored inventories of depleted UF_6. There would be negligible exposure to noninvolved workers or the public because of their distance from the cylinder yards and air emissions from the cylinder preparation and maintenance activities would be negligible (DOE, 2004a; DOE, 2004b).

The dose calculations presented throughout this EIS are based on the estimated composition of depleted UF_6 generated by the proposed laser-based facility. The doses from external exposure to containers of depleted uranium from the proposed facility (either as UF_6 or U_3O_8)

are expected to be very similar to the doses calculated by DOE (DOE, 2004a; DOE, 2004b) (i.e., within 1 percent). However, under accident conditions at a potential DOE facility that converts UF_6 to U_3O_8, if the depleted uranium is aerosolized and inhalation becomes the dominant pathway for exposure, the doses from depleted uranium from the proposed GLE Facility could be up to twice as large as doses calculated by DOE. Based on a comparison to doses from accidents considered by DOE (DOE, 2004a; DOE, 2004b), the resulting doses would still be well below levels that could cause acute fatalities from radiation exposure and below the levels that could cause acute radiation sickness. The lifetime increase in the probability of developing a fatal latent cancer would be less than 0.05 for the maximally exposed member of public or maximally exposed non-involved worker. For involved workers, DOE indicated that impacts under accident conditions would likely be dominated by physical forces from the accident itself. This conclusion would be the same for a potential accident with depleted uranium from the proposed GLE Facility at a potential DOE facility that converts UF_6 to U_3O_8.

To assess the impacts of depleted UF_6 generated by the proposed GLE Facility on DOE's conversion facilities, one must understand the relative amount of additional material as compared to DOE's existing depleted UF_6 inventory. The Paducah conversion facility would operate for approximately 25 years to process 436,400 metric tons (481,000 tons) that were in storage prior to the anticipated facility start-up in 2006 (DOE, 2004a). The Portsmouth conversion facility would operate for 18 years to process 243,000 metric tons (268,000 tons) (DOE, 2004b). The projected maximum amount of depleted UF_6 generated by the proposed GLE Facility (450,000 metric tons [496,000 tons]) would represent approximately 185 percent of the Portsmouth and approximately 103 percent of the Paducah starting inventories. The proposed GLE Facility would produce approximately 11,250 metric tons (12,401 tons) of depleted UF_6 per year at full production capacity (GLE, 2008), which represents approximately 62 percent of the annual conversion capacity of the Paducah facility (18,000 metric tons [20,000 tons]) and approximately 83 percent of the Portsmouth facility annual conversion capacity (13,500 metric tons [15,000 tons]). The proposed GLE Facility maximum depleted UF_6 inventory could extend the time of operation by approximately 25 years for the Paducah conversion facility or 33 years for the Portsmouth conversion facility.

With routine facility and equipment maintenance, and periodic equipment replacements or upgrades, DOE indicated that the conversion facilities could be operated safely beyond their proposed operational lifetimes to process the depleted UF_6 such as that originating at the proposed GLE Facility. In addition, DOE indicated that the estimated impacts that would occur from prior conversion facility operations would remain the same when processing depleted UF_6 such as the proposed GLE Facility's wastes. The overall cumulative impacts from the operation of the conversion facility would increase proportionately with the increased life of the facility (DOE, 2004a; DOE, 2004b).

Additional conversion processing capacity could also be achieved through increased efficiency of the Paducah and Portsmouth conversion plants and the possibility of a commercial conversion plant being constructed. International Isotopes, Inc., submitted a license application to the NRC on December 31, 2009, to construct and operate a depleted UF_6 conversion facility near Hobbs, New Mexico; the NRC is currently conducting environmental and safety reviews of the application (NRC, 2010). In either case, impacts are expected to be comparable to those estimated for construction and operation of the Paducah and Portsmouth plants (DOE, 2004a; DOE, 2004b).

In order to keep up with increased demand for enriched uranium as discussed in Chapter 1, other uranium enrichment facilities are in the planning process or already under construction. These facilities would also generate depleted UF_6, in addition to the currently operating gaseous diffusion enrichment plant at Paducah that would require conversion and disposal. Should all such facilities (NEF, ACP, and Eagle Rock Enrichment Facility [EREF]) become fully operational, extended storage times for the depleted UF_6 cylinders would be necessary and could result in the need for an additional conversion facility.

The above assumptions and data indicate that environmental impacts from the conversion of the depleted UF_6 from the proposed GLE Facility at an offsite location such as Portsmouth or Paducah would be SMALL.

Impacts from the transportation of the converted depleted uranium oxide from the conversion facilities to potential disposal sites at locations such as a commercial facility, Energy*Solutions* in Utah, or a DOE facility, the Nevada Test Site in Nevada, have been previously evaluated for the depleted uranium stored at the Portsmouth and Paducah sites (DOE, 2004a; DOE, 2004b). Transportation impacts for shipment of depleted uranium oxide from the Paducah or Portsmouth conversion facility to either potential disposal site for similar volumes with origins traced back to the proposed GLE Facility discussed above would be SMALL.

Depleted uranium remains source material after it ceases to possess any value for uranium enrichment purposes. Thus, if no beneficial reuse can be identified, the depleted uranium could be considered as radioactive waste for disposal. Under the current provisions of 10 CFR Part 61, depleted uranium can be considered as Class A low-level radioactive waste. The NRC is currently in the process of amending its regulations to establish new requirements for the disposal of some low-level radioactive wastes, including large quantities of depleted uranium. Considering the steps that are involved in this rulemaking, the NRC plans to publish a final rule in late 2012 (NRC, 2009c). While this rulemaking may result in additional requirements in the future, along with further restrictions that could be imposed by Agreement States, the disposal of depleted uranium, for the purpose of preparing this EIS, is assumed to remain within the current regulatory framework until such rulemaking actions have been finalized and the revised rules promulgated. As such, it is assumed that the DOE will transport the entire depleted uranium oxide inventory to a low-level waste disposal facility, such as EnergySolutions at Clive, Utah, for disposal as Class A low-level waste.

4.2.12.3 Mitigation Measures

<u>Mitigation Measures Identified by GLE</u>

Impacts from waste generation and management at the proposed GLE Facility would be minimized or eliminated by implementing a number of mitigation measures as proposed by GLE, which include (GLE, 2008):

- Select the laser enrichment process over current gaseous diffusion and gas centrifuge technologies, which would reduce the amount of waste generated for production of the same amount of enriched product.

- Minimize the quantities of waste generated by the proposed facility by implementing a Waste Minimization Plan that considers all facility processes, entails input and responsibility

at the worker level on up through all levels of management, and involves recurring review cycles to measure performance and investigate new reduction measures. The plan should include potential reuse and recycling, where possible.

- Perform an integrated safety analysis (ISA) for each onsite waste storage area to identify and prevent accidental releases to the environment.
- Pre-treat radioactive liquid wastewaters in a treatment system planned for the proposed facility before the wastewater effluent is pumped to the existing NPDES-permitted final process lagoon facility for further treatment.
- Conduct onsite treatment of process and sanitary wastewaters to NPDES permit limits before discharge to receiving waters.
- Ship each waste generated by the proposed facility that requires offsite storage, treatment, or disposal to a licensed facility (as appropriate for the waste type) in compliance with EPA and NRC requirements.
- Avoid and minimize potential hazardous and radiological waste impacts from the UF_6 storage pads by implementing design elements and safety procedures during operations, including:
  - use of a storage array that permits easy visual inspection (stacked no more than two cylinders high)
  - segregation of storage pad areas from the rest of the enrichment facility by barriers (e.g., vehicle guardrails)
  - inspection of cylinders for external contamination (i.e., a “wipe test”) prior to placing on the storage pads or transporting them offsite
  - ensuring that UF_6 cylinders are not equipped with defective valves
  - allowing only designated vehicles with a limited amount of fuel in the storage pad area
  - allowing only trained and qualified personnel to operate vehicles in the storage pad area
  - monitoring the holding pond that collects stormwater runoff from the cylinder pads
- Inspect cylinders of UF_6 initially prior to placing a filled cylinder on a storage pad and, thereafter, inspect periodically for damage or surface coating defects. Inspection criteria would include ensuring that:
  - lifting points are free from distortion and cracking
  - cylinder skirts and stiffener rings are free from distortion and cracking
  - cylinder surfaces are free from bulges, dents, gouges, cracks, or significant corrosion

- cylinder valves are fitted with the correct protector and cap
- cylinder valves are straight and not distorted, two to six threads are visible, and the square head of the valve stem is undamaged
- cylinder plugs are undamaged and not leaking

- If inspections of a cylinder reveal significant deterioration or other conditions that may affect its safe use, transfer the contents of the cylinder to another cylinder and discard the defective cylinder. Investigate the cause of any significant deterioration, and if necessary, perform additional inspection of cylinders.
- Minimize onsite storage volumes and times and shipping waste destined for offsite treatment and disposal facilities as soon as practicable.
- Monitor and inspect onsite liquid waste storage tanks and containers on a periodic schedule to detect leaks or releases to the environment due to equipment malfunctions so that actions identified in the SPCC plan or other appropriate corrective action can be taken promptly.
- Conduct continuous or periodic monitoring of waste management processes and storage facilities for the detection of non-intentional releases to the environment, so that corrective actions would be taken to minimize adverse impacts on the environment. For example, directing stormwater runoff from the UF_6 storage pads to a holding pond, where it would be monitored to ensure that unexpected radioactive material releases to the wet detention basin did not occur.
- Use the existing Wilmington Site onsite wastewater treatment facilities within current regulatory permit limits to avoid the need to add new onsite waste treatment and disposal facilities for the proposed facility.

4.2.13 Socioeconomic Impacts

This section provides an analysis of the socioeconomic impacts of preconstruction and construction, start-up, operations, and decommissioning of the proposed GLE Facility. Each phase would generate income and employment and State and local tax revenue, while the influx of workers and their families into local communities would affect housing demand and availability and local public services. The impacts are evaluated for the socioeconomic region surrounding the proposed GLE Facility.

As discussed in Section 3.13, the socioeconomic region of influence (ROI) is defined by the area where GLE workers and their families are expected to live and spend their income, thereby affecting the economic conditions of the region. The socioeconomic ROI corresponds to the Wilmington Metropolitan Statistical Area (MSA), a three-county area comprising Brunswick, New Hanover, and Pender Counties. These three counties cover an area that extends up to approximately 80 kilometers (50 miles) from the Wilmington Site.

This analysis of socioeconomic impacts includes impacts on employment, income, State and local tax revenues, population, housing community, and social services.

Employment impacts are evaluated by estimating direct and indirect employment associated with the proposed GLE Facility; direct employment is created at the Wilmington Site during preconstruction, construction, start-up, facility operations, and decommissioning, while indirect employment is created in the ROI, to support the needs of the workers employed by the proposed GLE Facility and jobs created to support site purchase and non-payroll expenditures. The number of direct jobs created is estimated based on anticipated labor inputs for various engineering and construction activities. Impacts of preconstruction are separated from GLE construction impacts using payroll expenditure data provided by GLE (GLE, 2009g). Indirect employment is estimated using economic multipliers from the IMPLAN input-output model (MIG, 2009), which account for inter-industry relationships within regions (see Appendix F).

State income tax revenue impacts are estimated by applying State income tax rates to GLE project-related construction and operations earnings. State and local sales tax revenues are estimated by applying appropriate State and local sales tax rates to after-tax income generated by construction and operations employees, spent within the ROI. Impacts of the proposed GLE Facility on State corporate income taxes were estimated by applying current State tax rates to projected annual facility operating revenues.

Impacts on population characteristics are evaluated by estimating the fraction of direct and indirect jobs that will be filled by workers relocating to the area from outside the ROI. The average family size and age profiles of migrating families are estimated using U.S. Census Bureau statistics. Impacts on area housing resources are estimated by comparing rental and owner-occupied vacancy statistics with estimated population in-migration into the ROI during the construction and operations phases of the project.

In addition to State income and sales taxes, tax incentives were provided to GE by the State of North Carolina and by New Hanover County. It is anticipated that these would amount to up to $26.6 million from the State, most of which would be payable over a 12-year period, and up to $10 million from the county, payable over a 10-year period. Both incentives are contingent on GE reaching specified investment and employment levels at the plant (GLE, 2009f).

Impacts on community and social services are assessed by estimating the number of additional local community service employees that would be required to maintain existing levels of service or education, law enforcement, and fire services, given the number of in-migrating workers expected into the ROI. Although the ROI corresponds to the Wilmington Metropolitan Statistical Area (MSA), which is expected to be the primary source of labor for the proposed GLE Facility, some labor in-migration is expected during each phase of the proposed project. The number of in-migrating workers was based on interviews with local economic development officials, with estimates used in the analysis assumed to be a range. Sixty-five percent of in-migrating workers were assumed to be accompanied by their families, which would consist of an additional adult and one school-age child (GLE, 2009a).

There are large differences between the indirect (offsite) impact of the proposed GLE Facility during the construction phase and during other phases of the project. These differences are due to the relative magnitude of expenditures during the construction phase compared to the other phases of the project, and the important role in the economy of the ROI of suppliers of capital equipment and other materials and services provided to the project during the construction phase.

4.2.13.1 Preconstruction and Construction Activities

Preconstruction and construction activities combined during the peak year (2012)[19] would employ 680 construction workers at the proposed GLE Facility site. An additional 3131 indirect jobs could be created in the ROI from the procurement of material and equipment and the spending of worker income (see Table 4-26 and Appendix F for more information on the methods used to estimate impacts). Facility construction would generate $139.8 million in income in the ROI in 2012.[20] Construction would generate $1.7 million and $1.2 million in direct State income and sales taxes, respectively. Peak year construction activities would constitute approximately 2.5 percent of total ROI employment in 2012; the economic impact of constructing the proposed GLE Facility would, therefore, be SMALL.

Although a large proportion of construction workers are expected to come from within the three-county region, given the scale of construction activities and the likelihood of local worker availability in the required occupational categories, construction of the proposed GLE Facility could cause some workers and their families to relocate from outside the ROI, with between 299 and 598 persons in-migrating into the ROI during the peak year of construction. Although in-migration may potentially impact local housing markets, the relatively small number of people relocating to the ROI and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility construction on the number of vacant rental housing units would be small, with between 87 and 173 rental units expected to be occupied in the ROI during construction. These occupancy rates would represent less than 1 percent of the vacant rental units expected to be available in the ROI in 2012; the impact from construction of the proposed GLE Facility on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local-community and educational services. With between 299 and 598 in-migrants expected in the ROI during preconstruction and construction activities, and existing levels of service (see Section 3.13), approximately one additional police officer and firefighter would be required to maintain the existing levels of service during the peak construction year. Assuming that a certain number of workers are accompanied by their families during construction, between 84 and 169 school-age children could be expected in the ROI in 2012, meaning approximately one additional teacher would be required to maintain existing student-teacher ratios in the local school system. These increases would represent less than 1 percent of community service employment expected in the ROI in 2012; the impact of construction of the proposed GLE Facility on community services would, therefore, be SMALL.

Based on expenditure data for the project, preconstruction activities would contribute 5 percent of the socioeconomic impacts, and construction activities (2012 to 2020) would contribute 95 percent (GLE, 2009g).

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[19] The socioeconomic impacts analysis is based on the assumption that the peak construction year will be 2012, if a license is granted. Any changes in the licensing and construction schedule could cause slight changes to socioeconomic analysis but would not affect the overall impact conclusion.

[20] All direct income and direct sales tax impact estimates are provided in 2008 dollars.

Table 4-26 Effects of the Proposed GLE Facility on ROI Socioeconomics[a]

Parameter	Preconstruction and Construction	Start-up	Operations	Decom-missioning
Employment (number of jobs)				
Direct	680	200	350	50
Indirect	3131	218	382	33
Total	3811	418	732	83
Income ($m 2007)				
Direct	26.0	19.2	33.3	5.1
Indirect	113.8	8.7	15.1	1.0
Total	139.8	28.0	51.5	6.1
Direct tax revenues				
Income taxes ($m 2007)	1.7	1.3	2.3	0.3
Sales taxes ($m 2007)	1.2	0.9	1.7	0.2
Population (number of new residents)	299–598	92–120	161–210	115–120
Housing (number of units required)	87–173	27–47	47–61	33–35
Community service employment (number of individuals)				
Police officers	1	<1	<1	<1
Firefighters	1	<1	<1	<1
Education (number of individuals)				
School-age children	84–169	26–40	46–70	38–40
Teachers	1	<1	<1	<1

[a] Impacts are shown for the peak year of construction (2012), the first year of start-up activities (2014), the first complete year of full operations (2020), and the first year of decommissioning (2051).
Source: Modified from GLE, 2008.

4.2.13.2 Facility Operations

Start-up

Start-up activities in 2014 would employ 200 workers at the proposed GLE Facility. An additional 218 indirect jobs could be created in the ROI from the procurement of material and equipment and the spending of worker income (Table 4-26) (see Appendix F for more information on the methods used to estimate impacts). Facility start-up would generate approximately $28.0 million in income in the ROI in 2014, and approximately $1.3 million in

income taxes paid by GLE employees and approximately $0.92 million in sales taxes. Start-up activities would constitute less than 1 percent of total ROI employment in 2014; the economic impact of start-up of the proposed GLE Facility would, therefore, be SMALL.

Given the scale of start-up activities and the availability of local workers, start-up of the proposed GLE Facility could cause some workers and their families to relocate from outside the ROI, with between 92 and 120 persons migrating into the ROI during the peak year of start-up (Table 4-26). Although in-migration may potentially impact local housing markets, the relatively small number of people relocating to the ROI and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility start-up on the number of vacant rental housing units would be small, with between 27 and 47 rental units expected to be occupied in the ROI during start-up. These occupancy rates would represent less than 0.1 percent of the vacant rental units expected to be available in the ROI in 2014; the impact of the proposed GLE Facility's start-up on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local-community and educational services. With between 92 and 120 in-migrants expected in the ROI during start-up activities and existing levels of service (see Section 3.13), less than one police officer and firefighter would be required to maintain existing levels of service during the peak start-up year, 2014. Assuming that a certain number of workers are accompanied by their families during start-up, between 26 and 40 school-age children could be expected in the ROI in 2014, meaning one additional teacher would be required to maintain existing student-teacher ratios in the local school system (Table 4-26). These increases would represent less than 0.1 percent of community service employment expected in the ROI in 2014; the impact of the proposed GLE Facility's start-up on community services would, therefore, be SMALL.

Operations

Operations activities in 2020 would employ 350 workers at the proposed GLE Facility. An additional 382 indirect jobs could be created in the ROI from the procurement of material and equipment and the spending of worker income (Table 4-26) (see Appendix F for more information on the methods used to estimate impacts). Facility operations would generate approximately $51.5 million in income in the ROI in 2020. Operations would also generate approximately $2.3 million in income taxes paid by GLE employees and approximately $1.7 million in sales taxes. Corporate income tax payments would total approximately $52.7 million annually. Operations activities would constitute less than 1 percent of total ROI employment in 2020; the economic impact of operating the proposed GLE Facility would, therefore, be SMALL.

Given the scale of operations activities and the availability of local workers, operation of the proposed GLE Facility could cause some workers and their families to relocate from outside the ROI, with between 161 and 210 persons in-migrating into the ROI during the first year of operation. Although in-migration may potentially impact local housing markets, the relatively small number of people relocating to the ROI and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility operations on the number of vacant owner-occupied housing units would be small, with between 47 and 61 rental units expected to be occupied in the ROI during operations. These occupancy rates would represent less than 0.1 percent of the vacant owner-occupied units expected to be available in

the ROI in 2020; the impact of the proposed GLE Facility's operations on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local-community and educational services. With between 161 and 210 in-migrants expected in the ROI during operations and existing levels of service (see Section 3.13), less than one police officer and less than one firefighter would be required to maintain existing levels of service during the peak operations year. Assuming that a certain number of workers are accompanied by their families during operations, between 46 and 70 school age children could be expected in the ROI in 2020, meaning less than one additional teacher would be required to maintain existing student-teacher ratios in the local school system. These increases would represent less than 0.1 percent of community service employment expected in the ROI in 2020; the impact of the proposed GLE Facility's operation on community services would, therefore, be SMALL.

4.2.13.3 Mitigation Measures

Since the socioeconomic impacts of constructing and operating the proposed GLE Facility would be SMALL and mostly beneficial, mitigation would not be required.

4.2.14 Environmental Justice Impacts

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the construction and operation of the proposed GLE Facility at the Wilmington Site. Adverse human health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionately high environmental effects refer to impacts or risk of impact on the natural or physical environment in a minority or low-income community that are significant and appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts. Some of these potential effects have been identified in resource areas discussed in this EIS. For example, increased demand for rental housing during construction could disproportionately affect low-income populations. Minority and low-income populations are subsets of the general public residing in the vicinity of the Wilmington Site, and all are exposed to the same health and environmental effects generated from activities at the proposed GLE Facility.

As described in Sections 4.2.1 through 4.2.13, the impacts of preconstruction activities and the proposed action, including the construction and operation of the proposed GLE Facility, would be SMALL for most of the resource areas evaluated. Impacts ranging from SMALL to MODERATE in other resource areas could potentially affect environmental justice populations. However, in each of these resources areas, the impacts would not be disproportionately high and adverse for minority or low-income populations. A brief summary of potential impacts to the general population follows:

- Land Use. As described in Section 4.2.1, the Wilmington Site is owned by GE and is zoned for heavy industrial use. Preconstruction activities would remove the undeveloped forest. Construction of the proposed GLE Facility is consistent with current zoning.

Preconstruction, construction, and operations of the proposed GLE Facility would not alter current land use or zoning of the Wilmington Site or surrounding properties. Impacts would be SMALL during all phases.

- Historic and Cultural Resources. As described in Section 4.2.2, no construction activities would occur in the portion of the Wilmington Site where historic and cultural resources are known to exist. While GLE has no plans to alter the site during operations, there is a high potential for additional historic and cultural resources to be discovered during routine maintenance activities. The Wilmington Site is located within a region containing high concentrations of historic and cultural resources. Operational impacts would depend largely on procedures employed to protect historic and cultural resources. The NRC proposed a license condition that would require GLE to consider the potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed areas of the proposed GLE Facility site. GLE also developed Common Procedure CP-24-201 to address the unanticipated discovery of human remains or artifacts. Based on this information, the NRC determined that the impact level is SMALL to MODERATE given the close proximity of significant historic and cultural resources and high potential for additional historic and cultural resource materials to be discovered during preconstruction, construction, and facility operations.

- Visual and Scenic Resources. As described in Section 4.2.3, the proposed GLE Facility project area has low scenic quality and would be located adjacent to existing GE industrial facilities. Temporary visual impacts would result from increased truck and worker traffic and the use of construction cranes during preconstruction and construction activities. The proposed project area would be surrounded by a vegetation barrier, so preconstruction and construction activities would largely be screened; therefore, the impacts would be SMALL. During operations, the two most visible features would be the water tower and a portion of the operations building. These features would not represent a major alteration of the existing visual environment; therefore, the impacts would be SMALL.

- Air Quality. As described in Section 4.2.4, air quality impacts from the proposed GLE Facility would be highest during preconstruction activities and during the initial 2 years of construction. Criteria pollutants, volatile organic compounds (VOCs), greenhouse gases, hazardous air pollutants (HAPs), fugitive dust emissions, and engine exhaust emissions would be released during these activities. Emissions of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) would have a SMALL impact on ambient air quality (well below applicable standards). Road construction, land-clearing, and building construction activities are projected to cause a temporary increase in the concentrations of particulate matter in the ambient air, which would exceed the air quality standard. These impacts would be MODERATE, but temporary. The proposed GLE Facility would not employ any continuous combustion activities during operation; criteria pollutant and HAPs emission rates would be SMALL. Uranium-related and hydrogen fluoride (HF) stack emissions would be minimal, and emissions from diesel fuel handling would be very low; therefore, these impacts would be SMALL.

- Geology and Soils. As described in Section 4.2.5, approximately 91 hectares (226 acres) of land would be disturbed on the Wilmington Site, including approximately 40 hectares (100 acres) for the proposed GLE Facility site in the North-Central Site Sector, plus about 5 hectares (13 acres) for support structures to the east and about 13 hectares (33 acres)

associated with the North access road. Soil disturbance during facility operations would continue at reduced levels, as some construction projects are ongoing, while others would be completed. Impervious surfaces such as roads, parking lots, and roofs would increase stormwater runoff, increasing the erosion potential. Although terrain changes would be minimal, a short-term increase in soil erosion would occur. Foundations, roads, and utility lines would likely be undisturbed during decommissioning. Erosion may increase, as portions of the site are disturbed by heavy equipment. Impacts on soils and geology during construction and operations are expected to be SMALL.

- Surface Water Resources. As described in Section 4.2.6, construction excavation could affect surface water quality. Access road construction could lead to erosion and increased sediment load, and erosion may increase as portions of the site are disturbed by heavy equipment. Leaks or spills of fuel, oil, or grease from construction vehicles and equipment could affect nearby surface water, but infiltration into soil would likely eliminate or reduce the potential for runoff. Impacts on surface water quality during preconstruction and construction are expected to be SMALL due to the nature of the work activities, the site soil characteristics and slopes, and the use of best management practices (BMPs). Process wastewater effluent would be discharged at an existing outfall during operations, increasing the site's wastewater volume. Treatment of liquid radioactive waste would produce an effluent similar to process wastewaters currently produced at the Wilmington Site. No consumption of surface water would occur during operations. Stormwater runoff would collect in a State-permitted wet detention basin before regulated discharge, and stormwater runoff from the UF_6 cylinder storage pads would collect in a lined holding pond for radioactivity monitoring prior to discharge to the wet detention basin. Oil, grease, metals, and other automotive-related contaminants would be present in limited quantities due to vehicular traffic; herbicides used in landscaped areas would also be present. Impacts on surface water during operations are expected to be SMALL due to planned systems for runoff, treatment, and monitoring, as well as experience with existing Wilmington Site facilities.

- Groundwater Resources. As described in Section 4.2.7, implementation of BMPs during preconstruction and construction activities for the proposed GLE Facility would reduce the potential for leaks of fuel, oil, and grease to soil and groundwater. The use of portable toilets during construction would eliminate sanitary system impacts on groundwater. Tanker trucks would provide potable and nonpotable water necessary for construction. The impact of preconstruction and construction activities on groundwater use and quality would be SMALL. Groundwater used for facility operations would come from existing groundwater supplies at the site and would be offset by the industrial reuse of treated sanitary wastewater effluent as process water. A small increase in drawdown is expected, without significant effect on flow directions, water quality, or availability for offsite users. Stormwater runoff collected from the UF_6 cylinder storage pads is expected to have no more than trace amounts of radiological contaminants, and the lined holding pond would limit infiltration to groundwater. A portion of discharged effluents may potentially infiltrate the Peedee sand aquifer, but treatment and monitoring are expected to result in no significant contaminant concentrations in the effluent channel. Diesel tanks at the facility would have appropriate leak detection equipment, and a groundwater monitoring plan would be developed after the facility is constructed. Impacts on groundwater during operations are expected to be SMALL.

- Ecological Resources. As described in Section 4.2.8, preconstruction impacts on wildlife and vegetation from clearing, habitat fragmentation, alteration of topography, changes in drainage patterns, and soil compaction would be MODERATE; remaining construction impacts (e.g., decline or mortality of trees near the construction boundary, erosion, dust and other particulate matter, invasive plant species, habitat fragmentation, noise, and accidental releases of hazardous materials) would be SMALL. Impacts on wetlands associated with preconstruction and construction activities would be SMALL. Preconstruction and construction activities would result in SMALL impacts on aquatic biota. Impacts on any Federally listed threatened, endangered, or other special status species from preconstruction and construction activities would be SMALL; impacts on any State-listed species would also be SMALL. Impacts on vegetation during operation would be SMALL and would include mowing, cutting, and chemical control of vegetation around facilities, utility corridors, and access roads. Impacts on wetlands during operation would be SMALL. No environmentally sensitive areas would be affected by operations, so impacts would be SMALL. Impacts on wildlife, aquatic biota, and threatened, endangered, and other special status species due to operations would also be SMALL.

- Noise. As described in Section 4.2.9, vehicular traffic to and from the proposed GLE Facility would generate intermittent noise along local roadways during preconstruction and construction activities. Noise would be limited to the immediate vicinity of the Wilmington Site. Potential noise impacts on the nearest subdivision would be MODERATE but temporary during road construction (preconstruction). Most land-clearing and grading activities would occur away from the fenceline and far from the nearest residential subdivision and would be below day and night ambient sound levels that correspond to the New Hanover County Noise Ordinance and EPA guidelines; therefore, noise impacts on the surrounding community would be temporary and SMALL. During facility operations, exterior equipment, such as pumps, heat pumps, transformers, and cooling towers would generate noise. Other sources of noise would include commuter vehicular and delivery truck traffic. Noise levels from facility operations at the fenceline nearest to the Wooden Shoe residential subdivision would be below day and night ambient sound levels that correspond to local and EPA guidelines; therefore, impacts would be SMALL.

- Public and Occupational Health. As described in Section 4.2.11, members of the public around the Wilmington Site and the workers who will be involved in the construction and operation of the proposed GLE Facility (and employees at existing GE facilities on the Wilmington Site) are likely to be exposed to radiation from uranium used and stored at the proposed GLE Facility and other existing operations at the Wilmington Site. They could also be exposed to certain quantities of radioactive materials (primarily UF_6) and chemicals (primarily HF) that are likely to be released to the environment during normal operations of the proposed GLE Facility. All radiological doses and chemical exposures received by members of the public and workers due to the proposed action would be well below all applicable regulatory limits and standards. In addition, GLE would implement an As Low As Reasonably Achievable (ALARA) program and use best management practices to keep all public and occupational exposures low. As a result, the public and occupational health impacts from normal operations are expected to be SMALL.

- Waste Management. As described in Section 4.2.12, solid nonhazardous wastes generated during construction would be similar to wastes from other industrial construction sites and transported offsite to an approved local landfill. Construction activities would generate less

than 2 percent of the waste that the New Hanover County Landfill receives annually from all other sources. Hazardous wastes from construction would be packaged and shipped offsite to licensed facilities. The quantity of all waste materials generated during preconstruction and construction activities could be managed effectively and would result in SMALL impacts. Facility operations would generate wastewaters that would be treated onsite prior to discharge, and solid wastes that would be treated (onsite or offsite) and shipped offsite for disposal. Radioactive process wastewater from facility operations would be collected and treated to remove uranium, other metals, and fluoride. The treated effluent would be discharged to the process wastewater aeration basin and final process lagoon facility. Should discharges to surface waters be necessary, the existing National Pollutant Discharge Elimination System discharge permit would be adequate to cover additional effluent volume. Impacts from sanitary wastewater, cooling tower blowdown, and process wastewater would be SMALL. Impacts of nonhazardous/nonradioactive waste, hazardous waste, and low-level radioactive waste generation would be SMALL due to treatment processes and the availability of disposal pathways. Impacts from radiological exposure to depleted UF_6 in the cylinder storage pads would be SMALL, and impacts from the conversion of depleted UF_6 would be SMALL.

- Socioeconomics. As described in Section 4.2.13, there would be increases in regional employment, income, and tax revenue during preconstruction, construction, and operation of the proposed GLE Facility. Workers and their families could relocate into the ROI in support of GLE Facility operations (over the 40-year license period), which would result in long-term socioeconomic impacts, including increased demand for housing resources and public services. However, these impacts are estimated to be SMALL. All other socioeconomic effects from preconstruction, construction, and decommissioning would be short-term and limited.

- Accidents. As described in Section 4.2.15, five accident scenarios were evaluated in this EIS as a representative selection of the types of accidents that are possible during operation of the proposed GLE Facility. The representative accident scenarios vary in severity from intermediate- to high-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. Two of the accidents involve criticality and the other three involve the release of UF_6. If the higher-consequence-criticality accident were to occur, the consequence for a worker in close proximity would be high (fatality), but GLE has committed to various preventive and mitigating measures to significantly reduce these consequences. A maximally exposed individual at the Controlled Area Boundary would receive a radiation dose of 5.7 millisievert (0.57 rem) total effective dose equivalent, which represents a low consequence to an individual (<0.05 sievert [<5 rem]). For the accidents involving a UF_6 release, worker health consequences would be low for radiological exposures (<0.25 sievert [25 rem]); for accidents involving uranium chemical exposure, worker health consequences would be intermediate for one (Node 4200) and high for two (Nodes 4100 and 4800) of the accidents. Consequences to the collective offsite public are less than one lifetime cancer fatality for all accident scenarios. Through a combination of facility design, passive and active engineered controls, and administrative controls, all processes would be maintained non-critical, and accidents at the proposed GLE Facility pose an acceptably low risk to workers, the environment, and the public. Therefore, the probability weighted consequence (risk) from accidents would be SMALL. No facility accidents would occur after the cessation of operations, so there would be no potential for facility accidents during decommissioning.

Potential impacts to minority and low-income populations would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Radiation doses from facility operations after construction are expected to remain below regulatory limits.

Noise and dust impacts would be short-term and limited to onsite activities. Minority and low-income populations residing along site access and the primary commuter roads could experience increased commuter vehicle traffic during shift changes. Increased demand for rental housing during construction could disproportionately affect low-income populations. However, due to the short duration of construction work and the availability of rental housing, impacts to minority and low-income populations would be short-term and limited.

Based on this information and the analysis of human health and environmental impacts presented in this EIS, the construction and operation of the proposed GLE Facility would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the Wilmington Site.

Even where environmental impacts would be SMALL for the general population, some population subgroups, such as individuals participating in outdoor recreation, home gardening, or subsistence hunting and fishing, could be disproportionately affected through the inhalation or ingestion of radionuclides. One Census block group, which has a high percentage of low-income and minority residents, is located downstream of the proposed GLE Facility on the Northeast Cape Fear River. Residents of this Census block group could face increased risk of exposure due to fish-consumption; however, releases of total uranium and UF_6 are projected to be extremely low (see Section 4.2.11.2), and exposure through fish consumption would be even lower. Therefore, any impacts the minority and low-income populations from the preconstruction, construction, operation, and eventual decommissioning of the proposed GLE Facility are not expected to be disproportionately high and adverse.

Soil and vegetation samples from the existing site and from 1.6 kilometers (1 mile) away show no impact from current GE operations at the Wilmington Site. As discussed in Section 4.2.11.2, the radiological doses to the nearest residents resulting from operation of the proposed GLE Facility and current GE operations are projected to be well below the EPA 10 millirem (0.1 millisievert) per year standard (20 CFR Part 190) and the NRC total effective dose equivalent (TEDE) limit of 1 millisievert (100 millirem) per year (10 CFR Part 20).

Resource Dependencies and Vulnerabilities of Minority and Low-Income Populations

Section 4-4 of Executive Order 12898 directs Federal agencies, whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations that rely principally on fish and/or wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this EIS, the NRC considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts to American Indian, migrant workers, and other traditional lifestyle special pathway receptors. Special pathways that took into account the levels of contaminants in native vegetation, crops, soils and sediments, groundwater, surface water, fish, and game animals on or near the Wilmington Site were considered.

As part of addressing environmental justice concerns associated with the construction, operations, and eventual decommissioning of the proposed GLE Facility, the NRC considers the potential radiological risk to special population groups (such as migrant workers or American Indians) from exposure to radioactive material received through their unique consumption and interaction with the environment patterns including subsistence consumption of fish, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of airborne radioactive material released from the facility during routine operation.

Potential resource dependencies were sought in the course of public meetings and other information supplied by the Hispanic/Latino and African American/Black communities in meetings with the NRC. Letters were also sent to local Federally recognized American Indian tribes to determine any potential resource dependencies. These letters described the construction, operation, and decommissioning of the proposed GLE Facility, solicited their concerns on the project, and inquired about whether the American Indian tribes desired to participate in the Section 106 consultation process (see Appendix B). The Coharie Indian Tribe indicated that there are no historic properties in the area of potential effects that could have cultural or religious significance to them. Currently, very few American Indians live in the vicinity of the Wilmington Site.

In addition, the NRC examined data provided by the State of North Carolina concerning the health status of the general population in Brunswick County, New Hanover County, and Pender County (Table 4-27). No exceptional health problems were found among residents in the Wilmington area. It was not possible to identify any unusual incidences of birth defects, chronic diseases, or cancer clusters at the county level, the smallest area for which published health information is available. Age-adjusted incidence of cancer is slightly lower in Pender County than elsewhere in the three-county area; rates in each county are lower than in North Carolina as a whole. The income and ethnicity of individuals with chronic diseases are not available.

Table 4-27 Selected Health Statistics for Counties near the Proposed GLE Facility

	Brunswick County	New Hanover County	Pender County	North Carolina
Age-adjusted cancer Incidence rates (per 100,000 population), 2005	474.0	491.4	432.0	511.8
Age-adjusted cancer death rates, (per 10,000 population), 2002-2006	196.8	197.6	217.5	195.8
Age-adjusted major causes of death (per 100,000 population), 2006				
Heart disease	194.0	203.0	215.8	198.7
Trachea, bronchus, or lung cancer	58.8	65.0	62.3	60.4
Cerebrovascular disease	56.8	40.8	46.1	53.2
Chronic lower respiratory diseases	66.4	37.1	35.7	46.4

Source: NCSCHS, 2009.

4.2.15 Accident Impacts

The operation of the proposed GLE Facility would involve impacts to workers, the public, and the environment from potential accidents. The regulations in 10 CFR Part 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material," require that each applicant or licensee evaluate, in an Integrated Safety Analysis (ISA), its compliance with certain performance requirements. The Safety Evaluation Report (SER) for the proposed GLE Facility will include a more detailed analysis of the potential accidents identified in the GLE license application (GLE, 2011b). The accidents evaluated in the SER are a representative selection of the types of accidents that are possible at the proposed GLE Facility.

The analytical methods used in this consequence assessment are based on NRC guidance for analysis of nuclear fuel-cycle facility accidents (NRC, 1990; NRC, 1991; NRC, 1998; NRC, 2001). With the exception of the criticality accident, the hazards evaluated involve the release of UF_6 from process systems that are designed to confine UF_6 during normal operations. As described below, UF_6 poses a chemical and radiological risk to workers, the public, and the environment. GLE has committed to various preventive and mitigative measures to significantly reduce these impacts.

4.2.15.1 Accidents Considered

The GLE License Application (GLE, 2011b) describes potential accidents that could occur at the proposed GLE Facility. GLE provided accident descriptions according to facility node (operational unit), and further subdivided them by consequence, according to the severity of the accident.

The NRC selected, for detailed evaluation, a subset of the potential accident scenarios that is intended to encompass the range of possible accidents. The representative accident scenarios selected vary in severity from intermediate- to high-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. The accident scenarios evaluated are as follows:

- nuclear criticality
- liquid fuel fire outside (Node 4100 cylinder storage and handling)
- system breach inside a solid feed station (Node 4200 feed and vaporization)
- system breach inside an autoclave (Node 4800 sampling system)
- criticality due to uranium accumulated in decontamination and maintenance equipment (Node 5200 decontamination/maintenance)

The accident analysis does not include an estimate of the probability of occurrence of accidents. Instead, the analyzed accidents are assumed to occur and the consequences are evaluated.

4.2.15.2 Accident Consequences

Accidents involving release of UF_6 liquids or vapors were analyzed, in general, by identifying the quantity of a containerized material at risk inside the facility, the amount of material released into a room as vapor or particulates under the accident scenario, the fraction of released material that is of respirable size, and the fraction of material exhausted to the atmosphere through an available pathway, typically a building ventilation system. The dispersion of released material in the atmosphere and transport to onsite and offsite locations was then analyzed using the GENII code (Napier, 2007; Napier et al., 2007) with conservative inputs for release and atmospheric transport factors. The model estimated direct exposures to members of the public from an airborne plume, as well as exposures over a year's time from deposited uranium materials, to determine accident consequences to the public. The analysis also included impacts on the public from exposure to radionuclides that would be released from a criticality event in a vessel inside the facility, including gaseous fission products and radioiodine.

The NRC performance requirements in Part 70, Subpart H (10 CFR 70.61), require that the applicant limit the risks of credible high-consequence and intermediate-consequence events by applying engineering controls, administrative controls, or both, to reduce the likelihood and consequences of these types of accidents, and ensure that under normal and credible abnormal conditions, all nuclear processes are subcritical. Threshold consequence values that define the high- and intermediate-consequence events, except for criticality events, are indicated in Table 4-27. The values in Table 4-27 are based on the requirements of 10 CFR 70.61 and the EPA's Acute Exposure Guideline Levels for chemical exposure to HF (EPA, 2009e; EPA, 2009f).

Receptors located at the Restricted Area Boundary within the site and at the Controlled Area Boundary represent worst-case exposures to non-radiological workers at the facility and members of the public, respectively. The NRC also evaluated accident consequences for releases of UF_6 for the general public offsite of the facility.

Table 4-28 summarizes the NRC's evaluation of consequences from the hypothetical accidents. Consequences were evaluated against the above criteria. For the generic criticality accident, previous experience with this type of criticality accident indicates that a worker in close proximity (less than 4.5 meters [15 feet]) is unlikely to survive. With increasing distance from the accident, the radiation dose would be lower. Therefore, the NRC has qualitatively evaluated the accident as a high-consequence event for the worker. However, GLE has committed to various preventive and mitigative measures to significantly reduce these consequences (GLE, 2008). A maximally exposed individual at the Controlled Area Boundary (CAB) would receive a radiation dose of 5.7 millisievert (0.57 roentgen equivalent man [rem]) total effective dose equivalent, which represents a low consequence to an individual (<0.05 sievert [<5 rem]). The collective dose to the offsite population in the east–southeast direction, as determined using GENII (Napier, 2007; Napier et al., 2007), is estimated to be 3.87 person-sievert (387 person-rem). This population dose would cause an estimated 0.28 latent cancer fatalities (LCFs). The specific criticality accident at Node 5200, Decontamination and Maintenance, would likewise have high consequences for a nearby worker and roughly one half the estimated concentrations of uranium and HF at the site boundary of those for the generic criticality. It is estimated to similarly result in one half the offsite dose and cancer risk.

Table 4-28 Definition of High- and Intermediate-Consequence Events

Receptor	Intermediate Consequence	High Consequence
Worker – Radiological	>25 rem (0.25 Sv)	>100 rem (1 Sv)
Worker – Chemical (10-minute exposure)	>19 mg U/m^3 >78 mg HF/m^3 (95 ppm) (>AEGL-2 values[a])	>147 mg U/m^3 >139 mg HF/m^3 (170 ppm) (>AEGL-3 values)
Individual at the Controlled Area Boundary - Radiological	> 5 rem (0.05 Sv)	> 25 rem (0.25 Sv) 30 mg soluble uranium intake
Individual at the Controlled Area Boundary – Chemical (30 minute)	>2.4 mg U/m^3 >0.8 mg HF/m^3 (0.98 ppm) (>AEGL-1 values)	>13 mg U/m^3 >28 mg HF/m^3 (34 ppm) (>AEGL-2 values)
Environment at the Restricted Area Boundary	>24-hour average release greater than 5000 times the values in Table 2 of Appendix B of 10 CFR Part 20 (1.5 × 10^{-8} uCi/mL)	N/A

[a] AEGL: Acute Exposure Guideline Levels are public and private sector derived consensus values intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals.
Sources: EPA, 2009e; EPA, 2009f.

The consequences of the accident scenarios involving a release of UF_6 vary widely, as shown in Table 4-28. Worker radiological consequences are low (<25 rem [<0.25 sievert]) for all analyzed scenarios involving a UF_6 release. Worker health consequences from HF exposure are low for the accident scenario at Node 4200 and are high for scenarios at Nodes 4100 and 4800. Worker health consequences from uranium chemical exposure would be intermediate for the scenario at Node 4200 and high for scenarios at Nodes 4100 and 4800.

Radiological consequences (30-minute exposure) to the maximally exposed individual at the CAB would be low for all UF_6 release scenarios and for the criticality accidents (<0.05 sievert [<5 rem]).

Uranium chemical exposure consequences (30-minute exposure) would be low (<2.4 milligrams uranium per cubic meter [<1.5 × 10^{-7} pounds uranium per cubic foot]) for the accident scenario at Node 4200 and intermediate (>2.4 and <13 milligrams uranium per cubic meter [>1.5 and <8.1 × 10^{-7} pounds uranium per cubic foot]) for the scenarios at Nodes 4100 and 4800. HF exposure consequences (30-minute exposure) would be low (<0.8 milligrams HF per cubic meter [0.98 parts per million]) for the accident scenario at Node 4200 and intermediate (>0.8 and <28 milligrams HF per cubic meter [>0.98 and <34 parts per million]) for scenarios at Nodes 4100 and 4800.

Total consequences to the public in terms of radiation dose to the population in the ESE direction and resultant total LCFs are provided in Table 4-29. Accident scenarios at all nodes predict less than one LCF in this population.

Of the accident scenarios analyzed by the NRC, the accident consequences to a worker great than low would be those from scenarios involving nuclear criticality, a liquid fuel fire outside

Table 4-29 Summary of Health Effects Resulting from Accidents

Accident (Node)	Worker[a] [U], mg/m³ (rem)[b]	Worker[a] [HF], mg/m³ (ppm)	Environment at RAB uCi/mL	Individual at CAB [U], mg/m³ (rem)	Individual at CAB [HF], mg/m³ (ppm)	Collective Dose and LCFs Direction	Collective Dose and LCFs Person-rem	Collective Dose and LCFs LCFs
Generic Criticality	(High[c])	NA	2.64[d]	(0.57)[e]	NA	ESE	387	0.28
Liquid Fuel Fire Outside[f] (4100)	5.6E+3 (3.91)	1.8E+3 2.2E+3)	3.2E-9	2.79 (0.02)	1.06 (1.3)	ESE	41.2	3.0E-2
Breach Inside a Solid Feed Station (4200)	66 (0.46)	22 (27)	2.64E-11	3.2E-2 (<0.001)	1.1E-2 (1.3E-2)	ESE	0.032	7.6E-4
System Breach Inside an Autoclave (4800)	1.8E+4 (13.0)	6.25E+3 (7.6E+3)	2.7E-9	9.12 (3.8E-2)	3.45 (4.2)	ESE	67.8	5.0E-2
Decontamination and Maintenance Criticality (5200)	(High[c])	NA	1.32	(0.28)	NA	ESE	190	0.14

[a] Worker exits after 5 minutes in all cases.
[b] To convert rem to sievert, multiply by 0.01.
[c] High consequence could lead to a fatality.
[d] Pursuant to 10 CFR 70.61(c)(3), this value is the sum of the fractions of individual fission product radionuclide concentrations over 5000 times the concentration limits that appear in 10 CFR Part 20, Appendix B, Table 2.
[e] The dose to the individual at the CAB is the sum of internal and external doses from fission products released from the criticality.
RAB – Restricted Area Boundary; CAB – Controlled Area Boundary; HF – hydrogen fluoride; LCF – latent cancer fatalities; mg/m³ – milligrams per cubic meter; ppm – parts per million.

resulting in a cylinder rupture and UF_6 release (Node 4100), a breach inside a solid feed station (Node 4200), and a system breach inside an autoclave (Node 4800). The accident scenarios with potential consequences to the public greater than low would be a system breach inside an autoclave (Node 4800) and a liquid fuel fire outside resulting in a cylinder rupture and UF_6 release (Node 4100). The potential consequences to the public from both of these accidents would be potentially intermediate due to exposure to both uranium and HF.

The NRC selected and evaluated a representative subset of the potential accidents that could occur at the proposed facility. The accident consequences vary in magnitude, and demonstrate that both UF_6 and HF release can be of concern if these accidents were to occur. However, the design of the proposed facility minimizes the likelihood of accidents occurring, while the facility Emergency Plan addresses all identified potential low- to high-consequence events. Therefore, the NRC concludes that, through the combination of plant design, passive and active engineered controls (items relied on for safety, or IROFS), and administrative controls, all processes would be maintained non-critical, and accidents at the proposed facility pose an acceptably low risk to workers, the environment, and the public. Thus, the probability weighted consequence (or risk) from accidents is expected to be SMALL.

4.2.15.3 Mitigation Measures

NRC regulations (10 CFR Part 70, Subpart H) and GLE's operating procedures (GLE, 2008) for the proposed GLE Facility are designed to ensure that the high- and intermediate-consequence accident scenarios would be highly unlikely. The NRC's SER assesses the safety features and operating procedures required to reduce the risks from accidents. The combination of responses by IROFS that mitigate or prevent emergency conditions, and the implementation of emergency procedures and protective actions in accordance with the proposed GLE Emergency Plan, would limit the consequences and reduce the likelihood of accidents that could otherwise extend beyond the proposed GLE boundaries.

Specifically, preventive and mitigative measures within the proposed facility relevant to a fire/explosion scenario would include (GLE, 2008):

- fire alarm and detection systems, possibly including a fire suppression system
- fire barriers preventing propagation of fires into and out of areas holding quantities of uranium materials
- system features that isolate combustible (process) materials and/or shut down processes to prevent or mitigate a fire
- continuous detection of a flammable gas in the laser system, with automatic isolation of process piping exceeding set limits
- structures designed to ensure that peak explosive blast loads would minimize intrusion of structural materials into UF_6 process or handling areas
- limiting combustibles in outside areas where cylinders are stored

Mitigative measures proposed by GLE relevant to radiological accidents would include (GLE, 2008):

- radiation detection and criticality monitoring systems to alert workers and isolate systems when parameters exceed set limits
- physical separation of areas within the facility designed to prevent or reduce exposure
- controlled positive or negative air pressures within designated areas to control air flow and prevent or maintain leakage between facility areas
- carbon absorbers, HEPA filters, and automatic trips on ventilation systems to prevent releases outside of affected areas
- limited building leakage paths to the outside environment through appropriate door and building design

These features are designed to contain UF_6 vapors within specified building areas and attenuate any release to the environment. Preventive controls for a nuclear criticality accident

would include maintaining a safe geometry of all vessels, containers, and equipment that contain fissile material, and ensuring that the amount of such material in these vessels does not exceed set limits. Mitigative controls would include criticality monitoring and alarm systems and emergency response training (GLE, 2008).

4.2.16 Separation of Preconstruction and Construction Impacts

As described in Section 4.2, the NRC has granted an exemption (NRC, 2009a) for GLE to conduct certain preconstruction activities, and Sections 4.2.1 through 4.2.14 have provided estimates of the fraction of impacts that are attributable to preconstruction activities (conducted as part of the exemption granted by the NRC) and the fraction attributable to NRC-licensed construction activities. Table 4-30 provides a summary of the anticipated impacts for each resource area, along with the fractions of these impacts that would be attributable to preconstruction and construction activities, respectively.

4.2.17 Impacts from Decontamination and Decommissioning

This section summarizes the potential environmental impacts of decontamination and decommissioning of the site through comparison with facility construction and normal operational impacts. Decontamination and decommissioning (under a separate NRC action) would involve the removal and disposal of all operating equipment while leaving the structures and most support equipment decontaminated to free-release levels in accordance with 10 CFR Part 20 (since GLE does not plan to demolish the buildings). These activities would include the cleaning and removal of materials, equipment, and structures that are contaminated with radioactive and/or hazardous wastes. As discussed in Chapter 2 of this EIS, decommissioning activities are estimated to require 3.5 years, shorter than construction (6 years) or operations activities (40 years).

Decommissioning activities anticipated to be conducted for the proposed GLE Facility include purging and draining of process systems, dismantling and removal of equipment, decontamination of equipment and structures, waste disposal, and final radiological surveys (GLE, 2009c). GLE has also indicated that it plans to sell salvaged materials (GLE, 2009c). However, a complete description of actions taken to decommission the proposed GLE Facility at the expiration of its NRC license period cannot be determined fully at this time. In accordance with 10 CFR 70.38, GLE must prepare and submit a Decommissioning Plan to the NRC at least 12 months prior to the expiration of the NRC license for the proposed GLE Facility. GLE would submit a final decommissioning plan to the NRC prior to the start of decommissioning (GLE, 2008). This plan would be the subject of further NEPA review, as appropriate, at the time the Decommissioning Plan is submitted to the NRC. Decontamination and decommissioning activities would be conducted to comply with all applicable Federal and State regulations in effect at the time of these activities.

Depleted UF_6 (tails) that remains after the operational phase would be sold, sent to a DOE depleted UF_6 conversion facility, and/or sent to other licensed facilities for conversion. These facilities would convert the tails into a stable, non-volatile uranium compound for disposal in accordance with regulatory requirements. Low-level radioactive wastes produced during the decontamination and decommissioning process would be disposed of in a licensed low-level waste disposal facility. Hazardous wastes generated during the decontamination and decommissioning process would be treated or disposed of in permitted hazardous waste

Table 4-30 Summary of Anticipated Impacts from Preconstruction and Construction Activities

Resource Area	Impact	Preconstruction (%)	Construction (%)
Land Use	SMALL	50	50
Historic and Cultural	SMALL to MODERATE[a]	95	5
Visual and Scenic	SMALL	25	75
Air Quality	SMALL to MODERATE[b]	75	25
Geology and Soil	SMALL	75	25
Surface Water	SMALL	75	25
Groundwater	SMALL	50	50
Ecology	SMALL to MODERATE[a]	75	25
Noise	SMALL to MODERATE[b]	75	25
Transportation	SMALL to MODERATE	NA[c]	NA[c]
Occupational and Public Health	SMALL	15	85
Waste Management	SMALL	2	98
Accidents	SMALL	NA[c]	NA[c]
Socioeconomic	SMALL	5	95
Environmental Justice	No disproportionately high and adverse impact	NA[c]	NA[c]

[a] The majority of impacts on this resource occur during preconstruction. Therefore, the anticipated impacts from preconstruction activities are SMALL to MODERATE, and the anticipated impacts from construction activities are SMALL.
[b] Although the majority of overall impacts on this resource occur during preconstruction activities, the impacts vary on a daily basis, depending on the types of activities performed. Therefore, the anticipated impacts are SMALL to MODERATE for both preconstruction and construction activities.
[c] Quantitative separation of preconstruction and construction impacts is either not applicable or not appropriate for this resource.

facilities. Releases to the atmosphere would be expected to be minimal. The final step in the decontamination and decommissioning process, the radiation survey, does not involve adverse environmental impacts. The proposed GLE Facility would be released for unrestricted use as defined in 10 CFR 20.1402.

The primary environmental impacts of the decontamination and decommissioning of the proposed GLE Facility include changes in releases to the atmosphere and surrounding environment, and disposal of industrial trash and decontaminated equipment. The types of impacts that may occur during decontamination and decommissioning would be similar to many of those that would occur during the initial construction of the proposed facility. Some impacts, such as water usage and the number of truck trips, could increase during the decontamination and disposal phase of the decommissioning, but would be less than the construction phase. The impacts on different resource areas from decontamination and decommissioning are discussed in detail in the following subsections.

4.2.17.1 Land Use

The location of the proposed GLE Facility is zoned for heavy industrial uses. The decontamination and decommissioning of the proposed GLE Facility would not alter the use or the zoning of the property or adjacent properties. Impacts on land use from decontamination and decommissioning would be SMALL.

4.2.17.2 Historic and Cultural Resources

It is unlikely that decontamination and decommissioning of the proposed GLE Facility would have an effect on historic and cultural resources. Impacts on historic and cultural resources occur primarily during ground-disturbing activities; if decontamination and decommissioning activities require the disturbance of previously undisturbed land, then impacts could result. The need to clear previously undisturbed land is not expected as part of decontamination and decommissioning activities. The NHPA can also consider project effects on items of unique engineering. If, at the time of decommissioning, the technologies employed at the facility are considered significant to the nation for understanding nuclear technologies, some record of the facility may be required to mitigate the removal of the facility. Therefore, the impacts on historic and cultural resources resulting from decontamination and decommissioning are expected to be SMALL.

4.2.17.3 Visual and Scenic Resources

Decontamination and decommissioning activities have the potential to impact visual and scenic resources, however, all impacts would be minimal and of short duration. Visual and scenic impacts associated with decontamination and decommissioning would result from the use of heavy equipment to dismantle the facilities and the increase in worker traffic. Once the decommissioning was complete, most of the visual impacts would cease. The vegetation screen surrounding the facility would remain, making changes to the plant imperceptible to all but the closest residences. Visual and scenic impacts from decontamination and decommissioning would be SMALL.

4.2.17.4 Air Quality

Large-scale soil disturbances are not anticipated during decontamination and decommissioning. Most decontamination activities would occur inside the proposed GLE Facility buildings, where emission controls would minimize atmospheric releases of radioactive materials. If decommissioning activities include demolition of buildings, structures, and hard surface areas; heavy construction equipment, such as bulldozers, scabblers, or front-end loaders, would be used for demolishing and loading debris onto trucks. For these activities, fugitive dust emissions, potentially contaminated, would be a primary concern. Standard dust suppression techniques could be employed during these activities to control dust emissions (e.g., water spraying). By employing dust suppression techniques, demolition activities would be unlikely to violate the permit conditions. If necessary, work areas would be monitored for airborne dust, and respiratory protection may be used or a small, temporary shelter or tent with portable HEPA filtration may be used to minimize potential contaminated dust emissions. Salvaged materials for sale and wastes and debris for disposal would be hauled offsite. The number of workers during this phase would be fewer than those during construction or operations, but hauling truck traffic on the North access road would be comparable to that experienced during construction.

The GLE license, if issued, would terminate in 2052. Around 2051, when decommissioning is expected to begin, more stringent exhaust standards may be applied to onroad and offroad engines, and zero-emission cars (e.g., electric or hydrogen fuel cell cars) may be more common. Air emission rates and associated air quality impacts of decontamination and decommissioning activities at the proposed GLE Facility would be comparable to or less than those experienced during construction. Therefore, potential impacts of decontamination and decommissioning activities on ambient air quality would be SMALL.

4.2.17.5 Geology and Soils

During decontamination and decommissioning of the proposed GLE Facility, the foundations, roads, and utility lines would likely be undisturbed. Erosion may increase, as portions of the site are disturbed by heavy equipment. BMPs would reduce the impact of the erosion, as discussed in Section 4.2.6.3 related to mitigation measures for surface water. Impacts on geology or soil during decontamination and decommissioning are expected to be SMALL.

4.2.17.6 Water Resources

During decontamination and decommissioning, the process wastewater flow would cease, but decontamination effluent would be generated. If sanitary discharge from the proposed GLE Facility could not be received by the Wilmington treatment and industrial reuse facility, then presumably, portable toilets would be required for the decommissioning workers. The collection, treatment, monitoring, and discharge of decontamination water would be designed to avoid significant environmental impact.

Erosion may increase, as portions of the site are disturbed by heavy equipment. BMPs would reduce the impact of the erosion, as discussed in Section 4.2.6.3 related to mitigation measures for surface water. Stormwater would continue to be gathered in a State-permitted wet detention basin.

The impact of decontamination and decommissioning (including removal of structures, utilities, materials, and products) on water resources is expected to be SMALL.

4.2.17.7 Ecological Resources

Large-scale ecological resource impacts would not be likely, as most decontamination activities would occur inside the buildings. If decommissioning activities include demolition of buildings, structures, or hard surface areas (e.g., cylinder storage pads and parking lots), the activities that could affect ecological resources include:

- the dismantling process
- generation of waste materials
- regrading of project areas

- revegetation activities
- accidental releases (spills) of potentially hazardous materials

Vegetation

Removal of facilities could impact vegetation adjacent to the facilities and cause offsite erosion and sedimentation. Landscaped areas used for staging of equipment or temporary storage of materials could also be impacted. Fill may be required following the removal of facilities. If Wilmington Site areas are used to supply the fill, any vegetation established at the source area would be destroyed. Following decontamination and decommissioning, affected areas would be revegetated (GLE, 2008). The plant community established where facilities are removed would depend on subsequent use of the project area.

Accidental spills of hazardous materials during decontamination and decommissioning could impact plant communities in the vicinity of the spill. Impacts would be similar to those discussed for preconstruction and construction (Section 4.2.8.1).

Wetlands

As no wetlands occur within the proposed GLE Facility area, decontamination and decommissioning activities would not directly impact wetlands.

Environmentally Sensitive Areas

As no environmentally sensitive areas occur within the proposed GLE Facility area, decontamination and decommissioning activities would not directly impact environmentally sensitive areas.

Wildlife

As decontamination and decommissioning activities would be restricted primarily to within the proposed GLE Facility, only landscaped areas and maintained lawn areas adjacent to the impervious storage pad areas would be impacted. During decontamination and decommissioning, there would be a temporary increase in noise and visual disturbance to wildlife associated with vehicle, equipment, and worker activities.

Other potential environmental concerns resulting from decontamination and decommissioning would include the disposal of solid wastes and hazardous materials and the remediation of any contaminated soils. Some fuel and chemical spills could also occur, but these would be generally confined to the access road and project site area. The probability that wildlife would be exposed to such spills would be small and limited to a few individuals. After decontamination and decommissioning activities were complete, there would be no fuel or chemical spills associated with the proposed GLE Facility.

Impacts on wildlife from decontamination and decommissioning activities would be similar to those that occurred during the construction phase, but the extent of impacts would be less, as the operations building is not expected to be demolished. Minimal wildlife habitat would exist on the storage pads. If the minimal existing habitat were removed as part of decontamination and

decommissioning, their removal would have negligible direct impacts on wildlife. There would be a temporary increase in noise and visual disturbance associated with the removal and subsequent restoration of facilities. Most wildlife would avoid the area while decontamination and decommissioning activities were taking place. Increased traffic levels during decommissioning could result in increased roadkills, but injury and mortality rates of wildlife would probably be lower than they would be during construction.

Revegetation of the removed facility areas could increase wildlife habitat diversity. Revegetation of the pad areas would probably result in habitat similar to that on other operational areas of the Wilmington Site (i.e., landscaped lawns). Wildlife species that would inhabit these areas would be the same as those that occur on other developed locations of the Wilmington Site (Section 3.8.4).

Aquatic Biota

Removal of the impervious areas, coupled with the cessation of the proposed GLE Facility's operations, would lower the amount of runoff and discharge to the stormwater wet detention basin and water treatment facilities. Therefore, what minimal impacts occur to water quality and thus, aquatic biota during operations, would cease. The potential would exist for fuel and chemical spills to occur. These would be confined to the access road and the proposed GLE Facility area and would not be expected to enter waterways. Once decontamination and decommissioning activities were completed, there would be no spills associated with the proposed GLE Facility.

Threatened, Endangered, and Other Special Status Species

As no threatened, endangered, or other special status species would be expected to inhabit the proposed GLE Facility, decontamination and decommissioning activities would not directly impact listed species.

Summary

In the long-term, decommissioning and reclamation would increase species diversity and habitat quality within the project area compared to that which would exist during operations. The impact of decommissioning on ecological resources is expected to be SMALL.

4.2.17.8 Noise

Most decontamination activities would occur inside the proposed GLE Facility buildings. If decommissioning activities include demolition, heavy construction equipment (such as bulldozers, scabblers, or front-end loaders) would be used for demolishing and loading debris onto trucks. Salvaged materials for sale and wastes and debris for disposal would be hauled offsite by truck. There would be fewer workers during decommissioning than during construction or operations, which would result in a reduction in commuter traffic. Noise from truck traffic on the North access road would be comparable to that during construction and could impact the Wooden Shoe residential subdivision. As discussed in Section 4.2.9, potential noise impacts on the Wooden Shoe subdivision during construction would be SMALL. Even though cylinder pads would be removed and heavy equipment would be used, noise levels at the Wooden Shoe subdivision would be below the New Hanover County Noise Ordinance and EPA

guideline. Therefore, noise impacts from decontamination and decommissioning activities on the nearest residential subdivision are expected to be SMALL.

4.2.17.9 Transportation

Initial decontamination and decommissioning activities during the last year of operations would increase the total number of workers at the proposed GLE Facility to approximately 400, a level similar to that during the construction period, with similar impacts. Approximately 50 workers are estimated to support decommissioning activities (GLE, 2008; GLE, 2011) as shown in Table 4-11. An upper limit of 50 workers is expected, though day-to-day numbers would vary depending on the scheduled activities as decontamination and removal of equipment and other materials progresses. The number of truck shipments to offsite locations during this time period is anticipated to be approximately the same as during construction, an average of about 35 trucks per day (GLE, 2008). Local and regional transportation impacts would be SMALL after operations cease due to the decrease in workers from approximately 680 during construction, 350 during operations, 400 during operations and initial decontamination and decommissioning, to 50 during decommissioning.

Radioactive waste from decontamination and decommissioning would be transported to the appropriate storage, treatment, and disposal facilities as authorized by the NRC. Suitable disposal facilities would be identified at the time of decommissioning. All shipments would comply with existing NRC and DOT regulations. Impacts from radioactive waste shipments would be SMALL because of the low levels of external radiation and the low number of shipments. Overall, transportation impacts from decontamination and decommissioning would be SMALL.

4.2.17.10 Public and Occupational Health

The anticipated decontamination and decommissioning plans call for cleaning structures and selected facilities to free-release levels and allowing them to remain in place for future use. Allowing the buildings to remain in place would minimize the potential number of workers required for decontamination and decommissioning, which would reduce the number of injured workers compared to building removal. Occupational injuries would be of similar nature to those incurred during construction of the facility (Section 4.2.11.1), but would be reduced in number in accordance with the reduced effort required for decontamination and decommissioning. According to current estimates, such efforts would require less than 20 percent of the worker level for construction: 450 FTEs versus 2346 FTEs for construction (GLE, 2008; GLE, 2011a; Table 4.10-3). If residual contamination is discovered, it would be decontaminated to free-release levels or removed from the site and disposed of in a low-level radioactive waste facility.

The annual occupational dose during decontamination and dismantling activities is estimated to be in the range of 0.05–1.5 millisievert (5–150 millirem) (GLE, 2009a). The dose estimate is based on the time spent at different work locations and the dose rates in the non-affected and major processing areas. The dose rate assumed in the non-affected areas was 0.0001 millisievert (0.01 millirem) per hour, and in the major processing areas it was up to 0.5 millirem per hour (GLE, 2009a). The highest dose is comparable to the average dose from the operating fuel facilities of 1.3-1.5 millisievert (130-150 millirem) (Table 4-22). Therefore, the occupational dose during decontamination and decommissioning is expected to be bounded by potential exposures during operations. Similar uranium handling would be involved (i.e., UF_6 in Type 48Y

cylinders and UF_6 in the laser-enrichment lines) during the portion of operations that purges the laser-enrichment lines. Although purging operation is different from the normal operation, the number of UF_6 workers would be exposed in the laser-enrichment lines would not be much different. Once this decontamination operation is completed, the remaining quantity of UF_6 would be residual and significantly less than handled during operations. Because systems containing residual UF_6 would be opened, decontaminated (with the removed radioactive material processed and packaged for disposal), and dismantled, an active environmental monitoring and dosimetry (external and internal) program would be conducted to maintain ALARA doses to workers and to individual members of the public as required by 10 CFR Part 20. Chemical exposures would be similarly limited. Therefore, the public and occupational health impacts from decontamination and decommissioning would be SMALL.

4.2.17.11 Waste Management

The waste management facilities used during operations would also be used during decontamination and decommissioning. With the decrease in workers from operations to decommissioning, the sanitary wastewater treatment volumes would decline. Materials and equipment eligible for recycling or nonhazardous disposal would be sampled or surveyed to ensure that contaminant levels are below release limits. Buildings and other structures would be decontaminated and the debris shipped offsite for disposal. Radioactive material from decontamination and contaminated equipment would be packaged and shipped offsite to an appropriately licensed facility. Staging and laydown areas would be segregated and managed to prevent contamination of the environment and creation of additional wastes. Waste management impacts from decontamination and decommissioning would be SMALL.

4.2.17.12 Socioeconomics

Decontamination and decommissioning activities in the first year would employ 50 workers at the proposed GLE Facility. Based on data provided by GLE (GLE, 2008), an additional 23 indirect jobs could be created in the ROI from the procurement of material and equipment and the spending of worker income (Table 4-26). Decontamination and decommissioning of the proposed GLE Facility would generate $6.1 million in income in the ROI in the first year of decommissioning. Facility decommissioning would also generate less than $0.3 million in income taxes and less than $0.2 million in sales taxes. With decommissioning activities constituting less than 1 percent of total ROI employment in the first year, the economic impact of decommissioning the proposed GLE Facility would be SMALL.

Given the scale of decommissioning activities and the availability of local workers, decontamination and decommissioning of the proposed GLE Facility could cause some workers and their families to relocate from outside the ROI, with between 115 and 120 persons migrating into the ROI during the first year of decommissioning. Although in-migration may potentially impact local housing markets, the relatively small number of people relocating to the ROI and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility decommissioning on the number of vacant rental housing units would be small, with between 33 and 35 rental units expected to be occupied in the ROI during decommissioning. These occupancy rates would represent less than 1 percent of the vacant rental units expected to be available in the ROI; the impact of the proposed GLE Facility's decontamination and decommissioning on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local community and education services. Accordingly, less than one police officer and firefighter would be required to maintain existing levels of service during the peak decommissioning year. Assuming that a certain number of workers are accompanied by their families during decommissioning, between 38 and 40 school-age children could be expected in the ROI, meaning less than one additional teacher would be required to maintain existing student-teacher ratios in the local school system. These increases would represent less than 1 percent of community service employment expected in the ROI; therefore, the impact of decontamination and decommissioning on community services would be SMALL.

4.2.17.13 Environmental Justice

As described in Sections 4.2.17.1 through 4.2.17.12, the potential impacts of the proposed action during decontamination and decommissioning are expected to be SMALL for all of the resource areas evaluated. Impacts could affect minority and low-income residents living in the immediate vicinity of the proposed GLE Facility. Since impacts to the general population are expected to be SMALL and of short duration, overall impacts to minority and low-income populations would not be disproportionately high or adverse.

Even where environmental impacts are SMALL for the general population, some population subgroups, such as individuals participating in outdoor recreation, home gardening, or subsistence hunting and fishing, could be disproportionately affected through inhalation or ingestion of radionuclides and other environmental contaminants. One Census block group, which has a high percentage of low-income and minority residents, is located downstream of the proposed GLE Facility on the Northeast Cape Fear River. Residents of this Census block group could face increased risk of exposure due to fish consumption; however, the releases of total uranium and UF_6 are projected to be extremely low (see Section 4.2.11.2), and indirect exposure through fish consumption would be even lower.

Soil and vegetation samples from the existing site and from a mile away show no impact from current GE operations at the Wilmington Site. As discussed in Section 4.2.11, the radiological doses to the nearest residents resulting from operations of the proposed GLE Facility and the current GE operations are projected to be well below the EPA 10 millirem (0.1 millisievert) per year standard (20 CFR Part 190) and the NRC total effective dose equivalent (TEDE) 100-millirem (1-millisievert) per year limit (10 CFR Part 20).

Overall, impacts to minority and low-income populations from the decontamination and decommissioning of the proposed GLE Facility would not be disproportionately high or adverse.

4.2.17.14 Summary

For most resource areas, the adverse environmental impacts of decontamination and decommissioning of the proposed GLE Facility could be SMALL to MODERATE; similar to the construction impacts. The notable exception would be cultural resources, where the impacts of preconstruction and construction activities would be significant in comparison to those of decontamination and decommissioning. The facilities and land could be released for restricted or unrestricted use, and releases to the environment from the proposed GLE Facility would cease. In addition, depending on the future use of the site, consumption of water and electricity and vehicular traffic to and from the site could be reduced. Decommissioning impacts would be

localized in the immediate proposed GLE Facility-developed site. No disposal of waste, including radioactive waste, would occur at the proposed GLE Facility site.

4.2.18 Carbon Dioxide and Other Greenhouse Gas Impacts

This section presents an assessment of the effect construction, operations, and decommissioning activities for the proposed GLE Facility would be expected to have on carbon dioxide and greenhouse gas emissions.

4.2.18.1 Greenhouse Gases

Greenhouse gases include those gases, such as water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), that are transparent to incoming short-wave radiation from the sun but opaque to outgoing long-wave (infrared) radiation from the earth's surface. The net effect over time is a trapping of absorbed radiation and a tendency to warm the planet's surface and the boundary layer of the earth's atmosphere, which constitute the "greenhouse effect." Some direct GHGs (CO_2, CH_4, and N_2O) are both naturally occurring and the product of industrial activities, while others such as the hydrofluorocarbons are created and are present in the atmosphere exclusively due to human activities. Each GHG has a different radiative forcing potential (the amount of thermal energy [in watts] trapped by the gas per square meter of the earth's surface). The radiative efficiency of a GHG is directly related to its concentration in the atmosphere. As a way to compare the radiative forcing potentials of various GHGs without directly calculating changes in their atmospheric concentrations, an index known as the Global Warming Potential (GWP) has been established with CO_2, the most abundant of GHGs released to the atmosphere (after water vapor),[21] established as the reference point.

GWPs are calculated as the ratio of the radiative forcing that would result from the emission of 1 kilogram (2.2 pounds) of a GHG to that which would result from the emission of 1 kilogram (2.2 pounds) of CO_2 over a fixed period of time. GWPs represent the combined effect of the amount of time each GHG remains in the atmosphere and its ability to absorb outgoing thermal infrared radiation. As the reference point in this index, CO_2 has a GWP of 1. On the basis of 100-year time horizon, GWPs for other key GHGs are as follows: 21 for CH_4, 310 for N_2O, 11,700 for trifluoromethane (HFC-23), and 23,900 for SF_6 (IPCC, 2007).

Indirect GHGs, including CO, NO_x, nonmethane volatile organic compounds (NMVOCs), and SO_2, indirectly affect terrestrial solar radiation absorption by influencing the formation and destruction of tropospheric and stratospheric ozone or, in the case of SO_2, by affecting the absorptive characteristics of the atmosphere.

[21] Water vapor is the most abundant and most dominant greenhouse gas in the atmosphere. However, it is neither long-lived nor well mixed in the atmosphere, varying spatially from 0 to 4 percent by volume. Compared to natural processes, human activities are not believed to have a significant direct effect on the average global concentration of water vapor; however, increased concentrations of other greenhouse gases released, in part, through human activities may indirectly affect the hydrologic cycle. Despite its substantial radiative forcing potential (primarily through the formation of clouds which can both absorb and reflect solar and terrestrial radiation), water vapor is not typically included in GHG inventories.

4.2.18.2 Greenhouse Gas Emissions and Sinks in the United States

The EPA is responsible for preparation and maintenance of the official U.S. Inventory of Greenhouse Gas Emissions and Sinks to comply with existing commitments under the United Nations Framework Convention on Climate Change (UNFCCC). GHG emissions are reported in sectors, using the GWPs established in the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).[22]

In 2007, total GHG emissions in United States were 7150.1 teragrams CO_2 equivalent,[23] an increase of 17 percent from 1990 (EPA, 2009c). In 2007, CO_2 emissions in U.S. were about 20 percent of worldwide emissions (EIA, 2009). However, net emissions (considering sources and sinks) were estimated to be 6087.5 teragrams CO_2 equivalent. The primary GHG sinks functional in 2007 included carbon sequestration in forests, trees in urban areas, agricultural soils, and landfilled yard trimmings and food scraps, all of which, in aggregate, offset 14.9 percent of the total GHG emissions in 2007. The primary GHG emitted by human activities in the United States was CO_2, representing approximately 85.4 percent of the total GHG emissions (6103.4 teragrams CO_2 equivalent). The largest source of CO_2 for 2007 was the result of fossil fuel combustion (80.2 percent of total GHG emissions), primarily electricity generation (33.5 percent), transportation (26.4 percent), industrial applications (11.8 percent), residential heating (4.8 percent), and commercial applications (3.0 percent). Methane emissions in 2007, which declined from 1990 levels, were about 585.3 teragrams CO_2 equivalent, which represented about 8.2 percent of total GHG emissions. Major contributors to CH_4 emissions included enteric fermentation associated with domestic livestock, decomposition of wastes in landfills, and natural gas systems. Emissions of N_2O in 2007 were about 311.9 teragrams CO_2 equivalent (4.4 percent of total GHG emissions), for which agricultural soil management accounts for two-thirds of total N_2O emissions, followed by mobile fuel combustion (about 10 percent of total N_2O emissions). Emissions of HFCs in 2007 were 125.5 teragrams CO_2 equivalent (about 1.8 percent of total GHG emissions), most of which was associated with substitution of ozone-depleting substances. PFC and SF_6 emissions in 2007 were a small fraction of total GHG emissions (about 0.1 and 0.2 percent, respectively). Contributions to PFC emissions were comparable between aluminum production and semiconductor manufacturing, while three-quarters of SF_6 emissions in 2007 resulted from electrical transmission and distribution.[24] Albeit small emissions relative to other principal GHG emissions, emissions of HFCs, PFCs, and SF_6 were significant because many have extremely high GWPs and, in the case of PFCs and SF_6, have long atmospheric lifetimes (e.g., PFC-14 with about 50,000 years).

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[22] IPCC assessment reports are a compilation of separate reports of the various working groups that are established by the Panel. IPCC periodically updates assessment reports to incorporate newly established data, including revisions to GWPs and radiative forcing potentials of GHGs. The latest is the Fourth Assessment Report, published in 2007. Revised GWPs are contained in the report of Working Group I (IPCC, 2007). However, to provide for the analysis of trends of GHG emissions and sinks over time, nations responsible for GHG inventories continue to use the GHG GWPs established in the Second Assessment Report published in 1996.

[23] GHG emissions are expressed as CO_2 equivalent (or CO_2 Eq.), which is the product of the mass of a gas and its associated GWP. One teragram is equal to 10^{12} grams, or one million metric tons (1.12 million tons).

[24] SF_6 is a gas at standard conditions and is used as a dielectric medium in high-voltage electrical equipment.

Emissions of indirect GHGs in 2007 included about 14.25 teragrams for NO_x, 63.88 teragrams for CO, 13.75 teragrams for NMVOCs, and 11.73 teragrams for SO_2. Mobile fossil fuel combustion accounted for half of total NO_x emissions, followed by stationary fossil fuel combustion. CO emissions resulted primarily from mobile fossil fuel combustion, while SO_2 emissions resulted primarily from stationary fossil fuel combustion (e.g., coal-fired power plants). Mobile fossil fuel combustion and solvent use accounted for about 41 and 28 percent of NMVOCs emissions, respectively.

4.2.18.3 Greenhouse Gas Emissions and Sinks in North Carolina

Among States, North Carolina ranks 12th with respect to emissions of GHGs and 11th in population (based on 2003 data) (NextGenerationEarth, 2009). In 2005, North Carolina produced about 192 teragrams CO_2 equivalent gross emissions, an amount equal to 2.7 percent of total gross U.S. GHG emissions (Peterson et al., 2007). The principal source of North Carolina's GHG emissions is consumption-based electricity use (electricity production netting out electricity exports), accounting for 39.5 percent of total State gross GHG emissions in 2005. The next largest contributors to total gross GHG emissions are the transportation sector (30.9 percent) and residential, commercial, and industrial fossil fuel combustion (16.6 percent). Note that electricity production is predominated by coal, which accounted for over one-third of State gross GHG emissions in 2005. Typically, coal-fired power plants produce as much as twice the CO_2 emissions per kilowatt-hour of electricity as natural gas-fired power plants. As a result of these factors, North Carolina's power plants are the greatest single source of GHG emissions in the State. Agricultural activities, industrial processes, and waste management account for the remainder of State GHG emissions (about 13 percent). Considering carbon sequestered and released from biomass throughout the State, net emissions would be about 169 teragrams CO_2 equivalent, an amount equal to 2.8 percent of total net U.S. GHG emissions. During the period 1990 to 2005, gross and net GHG emissions in North Carolina increased by about 42 and 57 percent, respectively, while gross and net national GHG emissions increased by only 17 and 16 percent, respectively.

4.2.18.4 Projected Impacts from the Construction, Operation, and Decommissioning of the Proposed GLE Facility on Carbon Dioxide and Other GHG Emissions

Construction, operation, and decommissioning of the proposed GLE Facility would contribute to CO_2 and other GHG emissions through various mechanisms, primarily from combustion of fossil fuels in both mobile and stationary sources during construction, operations, and decommissioning. Individual contributions are discussed below. Regional transportation volumes used in the analysis below were established in Section 4.2.10 and Appendix E.

Gasoline combustion is expected to occur at 99 percent efficiency, each gallon releasing 8.8 kilograms (19.4 pounds) of CO_2 (EPA, 2005). Likewise, diesel fuel burned at the same combustion efficiency would release 10.1 kilograms (22.2 pounds) of CO_2 per gallon. In this analysis, only CO_2 emissions were estimated. Gasoline and diesel engine combustion also generate small amounts of other GHG emissions, such as CH_4, N_2O, and HFCs. However, CO_2 emissions account for about 93–94 percent of total GHG emissions for automobiles and about 99 percent for heavy-duty trucks on a CO_2 equivalent basis (EPA, 2009c). Accordingly, estimation of CO_2 emissions only could underestimate total GHG emissions by a few percent.

CO_2 emissions source categories are similar during access road construction, land clearing, and building construction activities. The final start-up and final construction phase would include

concurrent indoor construction activities with staged testing and start-up of process units as completed. Accordingly, CO_2 emission source categories during this phase are similar to those during operations. This discussion addresses these two phases together.

Impacts During Access Road Construction, Land Clearing, and Building Construction

Access road construction and land clearing activities were assumed in the air quality analysis (Section 4.2.4) to include road construction for two months, followed by 1 year or more of land clearing, and building construction for 2 years. During these activities, GHG emission sources would include heavy construction equipment, as well as commuting to and from the site by the construction workforce, and locally by delivery vehicles bringing materials and equipment to the site and removing construction-related non-radiological wastes from the site to area landfills and treatment/disposal facilities. Annual total fuel consumption for offroad heavy construction equipment is estimated using a fuel consumption rate of 0.065 gallons per horsepower-hour (SME, 1992). During access road construction and land clearing activities, a daily average of 95 workers would work onsite, while during the building construction phase, a daily average of 858 workers would work onsite. For onroad vehicles, an average of 200 daily local trips for access road construction and land clearing activities and 1801 daily local trips for building construction activities are assumed, 90 percent of which are from gasoline engine automobiles and 10 percent of which are from heavy-duty diesel trucks. Average vehicle miles traveled (VMT) offsite per trip by automobiles and trucks are assumed 10 and 100 miles, respectively. In addition, these vehicles would travel another 1.64 miles onsite from the gate to the proposed GLE Facility. Fuel economy factors of 24.1 and 7.2 miles per gallon were assumed for automobiles and trucks, respectively.

Annual total fuel consumption and CO_2 emissions are estimated, as shown in Table 4-31. During access road construction and land clearing activities, annual total CO_2 emissions would be around 729 metric tons (804 tons) and 4436 metric tons (4890 tons), respectively. These emissions would account for about 0.0004 and 0.0023 percent of North Carolina GHG emissions in 2005, and about 0.00001 and 0.00006 percent of U.S. GHG emissions in 2007 (the most recent publically reviewed data). During the building construction phase, annual total emissions are estimated to be about 12,939 metric tons (14,262 tons), about 0.0067 percent of North Carolina GHG emissions and 0.00018 percent of U.S. GHG emissions. CO_2 emissions during this period are about three times more than those for access road construction and land clearing activities due to increased workforce and delivery activities.

Impacts During Start-up and Final Construction, and Operations

Start-up and final construction activities would occur for 5–6 years from 2014 to 2020, and operations would continue until 2051. During start-up and final construction, an estimated 590 workers would work onsite, while during the operations phase, an estimated 350 workers would work onsite. For onroad vehicles, a total of 1239 daily local trips for start-up and final construction and 735 daily local trips for operations are assumed. Compared with the previous two phases, auxiliary diesel generators, onsite transfer vehicles (OSTVs), possibly diesel-powered forklifts, and onsite diesel trucks used for cylinder transfer are added instead of offroad heavy construction equipment. To support facility operations, regional deliveries would be anticipated: UF_6 feedstock coming to the proposed GLE Facility and UF_6 product, depleted UF_6 tails, empty 48Y cylinders, and LLRW leaving the facility. Detailed discussion including the destination and total distance traveled by delivery trucks is available in Section 4.2.10. It is

Table 4-31 Annual CO_2 Emissions from Access Road Construction, Land Clearing, Building Construction, Start-up and Final Construction, and Operation of the Proposed GLE Facility

Phase	Air Emission Source	Fuel		CO_2 Emission Factor (lbs/gal)[b]	CO_2 Emissions	
		Type	Consumption rate (gals/yr)[a]		(tons/yr)	(MTs/yr)[c]
Access road construction	Offroad construction equipment	Diesel		22.2	565.8	513.3
	Automobiles (local)	Gasoline		19.4	50.4	45.7
	Diesel trucks (local)	Diesel		22.2	187.7	170.2
	Total				803.8	729.2
Land clearing	Offroad construction equipment	Diesel	229,249	22.2	3441.8	3122.4
	Automobiles (local)	Gasoline	23,415	19.4	306.4	277.9
	Diesel trucks (local)	Diesel	76,039	22.2	1141.6	1035.7
	Total				4889.7	4436.0
Building construction	Offroad construction equipment	Diesel	126,744	22.2	1407.6	1277.0
	Automobiles (local)	Gasoline	281,013	19.4	2719.8	2467.4
	Diesel trucks (local)	Diesel	912,559	22.2	10,135.1	9194.5
	Total				14,262.4	12,938.9
Start-up and final construction	Auxiliary diesel generator units[d]	Diesel	–	–	10.4	9.4
	OSTVs used for cylinder transfer	Diesel	6299	22.2	70.0	63.5
	Onsite diesel truck used for cylinder transfer	Diesel	29	22.2	0.3	0.3
	Automobiles (local)	Gasoline	196,581	19.4	1902.6	1726.0
	Diesel trucks (local)	Diesel	638,405	22.2	7090.0	6432.0
	Diesel trucks (regional)[e]	Diesel	249,175	22.2	2767.3	2510.5
	Total				11,840.5	10,741.7
Operations	Auxiliary diesel generator units[d]	Diesel	–	–	10.4	9.4
	OSTVs used for cylinder transfer	Diesel	6299	22.2	70.0	63.5
	Onsite diesel truck used for cylinder transfer	Diesel	29	22.2	0.3	0.3
	Automobiles (local)	Gasoline	116,616	19.4	1128.7	1023.9
	Diesel trucks (local)	Diesel	378,715	22.2	4205.9	3815.6
	Diesel trucks (regional)[e]	Diesel	498,349	22.2	5534.5	5020.9
	Total				10,949.8	9933.6

Foonotes on following page.

Table 4-31 Annual CO_2 Emissions from Access Road Construction, Land Clearing, Building Construction, Start-up and Final Construction, and Operation of the Proposed GLE Facility (Cont.)

[a] See Appendix E for detailed information on underlying assumptions.
[b] Source: EPA, 2005.
[c] MTs/yr = metric tons/year. To convert to tons/year, divide by 0.9072.
[d] Emissions are estimated using the NCDENR calculator spreadsheet (NCDENR, 2010).
[e] Includes UF_6 feed coming to proposed GLE Facility and UF_6 product, depleted UF_6 tails, empty 48Y cylinders, and LLRW leaving the facility.

assumed that separate shipments would be initiated to return empty cylinders and waste containers to their points of origin. It is further assumed that, during start-up and final construction, the production level on average would be 50 percent of that during operations.

During start-up and final construction, the proposed GLE Facility is estimated to release an annual total of 10,742 metric tons (11,841 tons) of CO_2, which is equivalent to 0.0056 percent of North Carolina GHG emissions in 2005 and 0.00015 percent to U.S. GHG emissions in 2007. During operations, annual total CO_2 emissions are projected to be 9934 metric tons (10,950 tons), which is approximately 0.0052 percent of North Carolina statewide emissions in 2005 and 0.00014 percent of nationwide emissions in 2007. The building construction phase would release the highest CO_2 emissions during the lifespan of the GLE project, followed by the start-up and final construction phase and operations. During start-up and final construction, CO_2 emissions from local traffic are predicted to be greater than from regional traffic. However, during operations, CO_2 emissions from local and regional traffic would be comparable.

Impacts During Decommissioning

As discussed in Section 4.1, because decommissioning will take place well in the future, detailed plans for decommissioning the proposed GLE Facility are not known at this time. Consequently, the impacts of decommissioning are discussed qualitatively in this document.

The main sources of CO_2 and other GHG emissions during the decommissioning phase are expected to be shipment of waste (LLRW and nonhazardous/nonradioactive waste) to appropriate disposal facilities and shipment of any remaining depleted UF_6 on site to a conversion facility. In addition, heavy equipment use at the site and travel to and from the site by the decommissioning workers would contribute to CO_2 and other GHG emissions during decontamination and decommissioning.

The emissions from shipments of waste and depleted UF_6 would depend on the locations of selected disposal and conversion facilities. Because GLE does not plan to demolish buildings during decommissioning (see Section 4.2.17), the quantity of nonhazardous/nonradioactive waste generated during this phase of the project would be relatively small as compared to the quantity generated during operations. With respect to LLRW, GLE estimates that it would generate approximately 18,800 cubic meters (664,000 cubic feet) of LLRW during the entire decommissioning period (GLE, 2009c). Assuming that LLRW generated during decommissioning has a density of 2 kilograms per liter (125 pounds per cubic foot), GLE would generate approximately three times more LLRW, by mass, during decommissioning than it would during operations. Assuming LLRW is disposed of in the same facility during decommissioning as it is during operations, this difference would represent approximately

3000 more shipments of approximately 3940 kilometers (2450 miles) during the entire decommissioning period as compared to the operations period. However, the emissions from these LLRW shipments would be less than the emissions from other shipments that would occur during operations but not during decommissioning, including approximately 900 shipments per year of unenriched UF_6 feed to the facility (470 to 1400 kilometers [290 to 870 miles]), 50 shipments per year of enriched UF_6 product (480 to 4780 kilometers [300 to 2970 miles]), and 50 shipments per year to return empty depleted UF_6 cylinders (1320 kilometers [820 miles]).

Available storage space on the cylinder storage pads would limit the number of depleted UF_6 cylinders that could be stored on site at any one time to 9000. Upon cessation of facility operations, it is likely that less than 9000 cylinders would be stored on-site. However, assuming 9000 cylinders would be stored on site and awaiting shipment to a conversion facility during decommissioning, there would be approximately three times as much depleted UF_6 shipped to a conversion facility during operations as there would be during decommissioning.

As a result, CO_2 emissions associated with shipments of materials, including LLRW, nonhazardous/nonradioactive waste, and depleted UF_6, during decontamination and decommissioning would be less than the 221,000 tons (200,000 metric tons) of CO_2 emissions that are associated with use of diesel trucks at the regional scale during 40 years of facility operations (see Table 4-30).

As discussed in 4.2.17.4, large-scale soil disturbances are not likely during decommissioning. In addition, GLE does not currently plan to demolish buildings associated with the proposed GLE Facility during decommissioning. Therefore, significantly less heavy equipment use would be used during decontamination and decommissioning than during access road construction and land clearing, and the CO_2 emissions from heavy equipment use during decontamination and decommissioning would be bounded by the offroad construction vehicle CO_2 emissions during access road construction and land clearing listed in Table 4-30. Similarly, because the number of employees during operations is significantly greater than during decontamination and decommissioning, the GHG emissions associated with employee traffic during decontamination and decommissioning would be bounded by the emissions provided in Table 4-30 for local automobile use during operations.

Based on the considerations of the expected CO_2 emissions attributable to shipment of depleted UF_6 to a conversion facility, shipment of LLRW for disposal, heavy equipment use, and employee traffic as described in this section, the total quantity of GHGs emitted during decontamination and decommissioning would be less than the amount emitted during operations.

Indirect Impacts from Operation of the Proposed GLE Facility

Nuclear power generation with fuel fabricated from the proposed GLE Facility would indirectly displace GHG emissions that would otherwise be released from fossil-fuel power plants. It is estimated that, at full production, the proposed GLE Facility would produce approximately 2047 metric tons (2257 tons) of enriched UF_6 annually, which would be equivalent to

1570 metric tons (1731 tons) of uranium dioxide (UO_2) fuel.[25] A typical 1100-megawatt pressurized water reactor (PWR) would have approximately 98 metric tons (108 tons) of UO_2 in its core (Nero, 1979). Thus, annual production of the proposed GLE Facility could replace the fuel cores of 16 PWRs. Operating at a capacity factor of 95 percent, each PWR would be capable of producing 9154 gigawatt-hours per year, so the total amount of power associated with GLE-enriched UF_6 production would be 146,654 gigawatt-hours per year.

Carbon Dioxide and Other GHG Emissions Summary

In summary, over the lifespan of construction, operation, and decommissioning of the proposed GLE Facility, the building construction phase was projected to generate the highest emissions. These direct emissions would be about 0.0067 percent of North Carolina GHG emissions in 2005 and 0.00018 percent of U.S. GHG emissions in 2007 (the most recent publicly reviewed data). The NRC concludes that potential impacts from the construction, operation, and decommissioning of the proposed GLE Facility on climate change would be SMALL.

4.2.18.5 Mitigation Measures

The applicant should consider measures that would reduce GHG emissions. These could include, but would not necessarily be limited to, energy-efficient design features and features to reduce space conditioning energy requirements, use of renewable energy sources, use of low-GHG-emitting vehicles, and other policies to reduce GHG emissions from vehicle use, such as anti-idling policies and van- or carpooling.

4.3 Cumulative Impacts

The Council on Environmental Quality regulations implementing NEPA define cumulative effects as “the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (40 CFR 1508.7). Cumulative impacts are presented below for resource areas in which there are anticipated changes related to other activities that may arise from single or multiple actions and may result in additive or interactive effects (e.g., other new facilities that are planned at the Wilmington Site).

Impacts from preconstruction activities for the proposed GLE Facility are addressed as cumulative impacts in this EIS, as these actions are not part of the proposed action. These impacts are discussed within the various resource area discussions in Section 4.2 so that they can be presented alongside similar impacts from construction of the facility that are included in the proposed action. In Section 4.2.16, impacts resulting from preconstruction are identified as a percentage of total impacts estimated to occur prior to facility operations. In this sense, site preconstruction activities would be considered past activities for the purposes of cumulative impacts.

[25] AREVA Enrichment Services, LLC, (AES) estimated that, at full production, EREF would produce approximately 2252 metric tons (2482 tons) of enriched UF_6 annually, which would be equivalent to 1727 metric tons (1904 tons) of UO_2 fuel (AES, 2008; NRC, 2011). The capacity of the proposed GLE Facility would be 6 million SWU and the total production volume of enriched UF_6 annually is estimated in proportion to production capacity of EREF (6.6 million SWU).

Consultation with local development boards and agencies with which proposed new projects are filed identified other actions or activities in the area that could affect the same resources as the proposed GLE Facility, contributing to cumulative effects.

Identified activities include several that exist or will exist at the Wilmington Site. Onsite and adjacent offsite activities are summarized below:

- Existing facilities on the Wilmington Site. These include the existing FMO facility and other existing facilities.

- Facilities planned for the Wilmington Site. Two new facilities, which could contribute to cumulative effects, are planned for the Wilmington Site – the Advanced Technology Center (ATC) II complex and the Tooling Development Center (see Figure 4-1). Since publication of the Draft EIS in June 2010, construction of the ATC II complex has been completed; construction of the Tooling Development Center has not begun. The newly constructed ATC II is an office building located adjacent to the existing ATC I building, near the South Gate entrance to the Wilmington Site (GLE, 2008; GLE, 2011c). Construction of this facility disturbed approximately 12 hectares (30 acres). The planned Tooling Development Center would consist of five new buildings and would also disturb approximately 12 hectares (30 acres). This planned facility would be located in the southwestern portion of the Eastern Site Sector of the Wilmington Site (GLE, 2008).

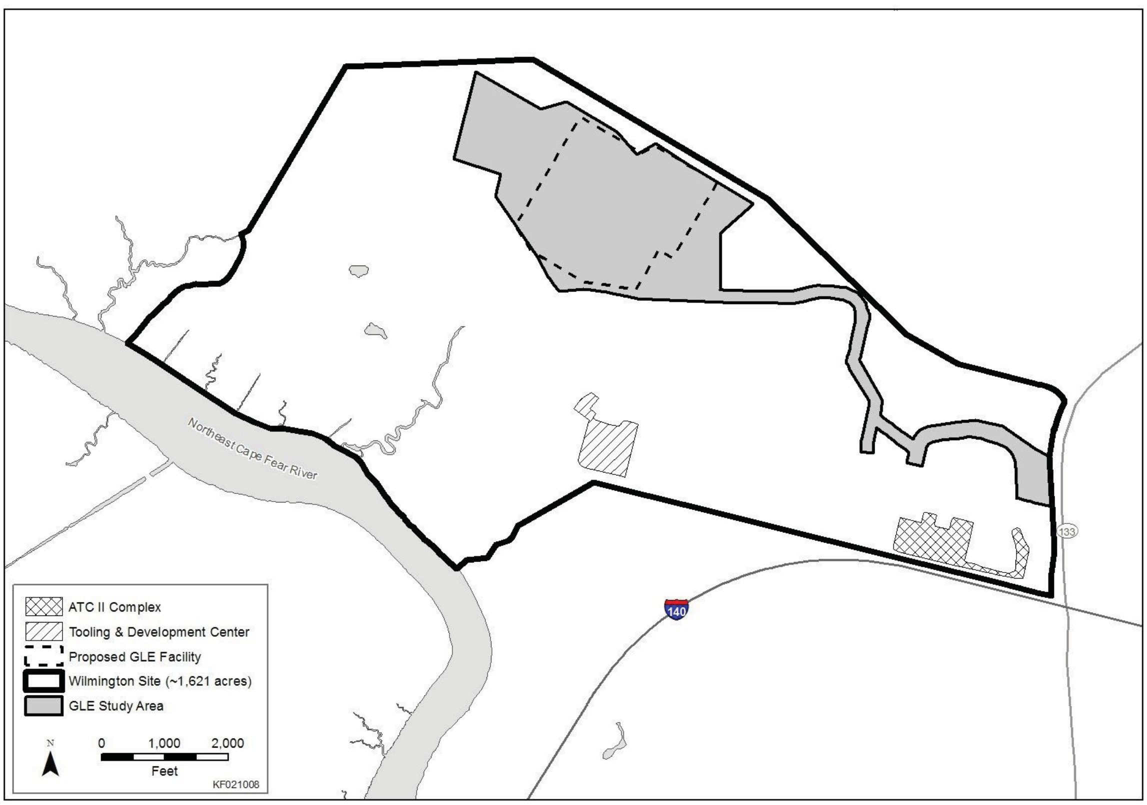

Figure 4-1 Planned Projects at the Wilmington Site (Modified from GLE, 2008)

Both facilities are located in previously disturbed areas (GLE, 2011c). The ATC II complex is located on a former stormwater drainage area and the planned Tooling Development Center would be constructed where a parking lot currently exists (GLE, 2008; GLE, 2011a). In addition, it is reasonably foreseeable that a security-related feature, independent of security measures specific to the proposed GLE Facility, may be developed on the Wilmington Site (GLE, 2009d). Additional information about this feature and the cumulative impacts of the proposed action in combination with this feature are provided in Appendix H.

- New processes planned for the Wilmington Site. Sanitary wastewater from the existing FMO facility is currently treated for reuse for industrial purposes. This process would be expanded to include similar sanitary wastewater from the proposed GLE Facility for industrial reuse.

- Offsite industrial development. (1) The Carolinas Cement Company has submitted an application for an air permit to construct a new cement manufacturing plant (also referred to as Titan Cement Plant) in northeastern Hanover County, roughly 6 miles northeast of the proposed GLE Facility. (2) The River Bluffs residential development has been proposed to be built on 95 hectares (237 acres) adjacent to the southern boundary of the Wilmington Site. (3) The proposed North Carolina International Terminal (near Southport, NC, approximately 35 miles south of the proposed GLE Facility) and/or the upgrade of existing facilities at the Port of Wilmington (approximately 10 miles south of the proposed GLE Facility).

- Offsite UF_6 transportation and local traffic increases. Increased transport of UF_6 feed and waste materials could increase doses to the public over those from current transport of such materials from operation of the FMO facility. Increased traffic from workers at the proposed GLE Facility would contribute to traffic congestion on local roads and highways.

The following sections present assessments of the potential cumulative impacts of the proposed action in combination with above activities by resource area. Cumulative impacts associated with the no-action alternative on the various resource areas would be generally less than those for the proposed action, except in terms of local job creation. Therefore, except for socioeconomic impacts, the cumulative impacts of the no-action alternative are not discussed in detail.

4.3.1 Land Use

Cumulative impacts on land use would result if the proposed action in combination with other projects prohibited other land uses from occurring or were incompatible with current zoning. The proposed GLE Facility site is located on property currently owned by GE. The eastern portion of the property already contains the GNF-A and GE AE/SCO facility. The proposed GLE Facility is consistent with the current zoning. Other developments in the area include several new housing complexes and the proposed Titan Cement Plant, which is roughly 6 miles (9.6 kilometers) northeast of the proposed GLE Facility. The construction, operation, and decommissioning of the proposed GLE Facility would not alter the current land use of the Wilmington Site or affect land use in the surrounding area. Therefore, cumulative impacts on land use would be SMALL.

4.3.2 Historic and Cultural Resources

The impacts of constructing, operating, and decommissioning the proposed GLE Facility on historic and cultural resources could range from SMALL to MODERATE. Cumulative impacts on historic and cultural resources can result from the incremental loss of unique site types. Archaeological sites within the vicinity of the project area contain evidence of Middle Woodland Cultures. Several other prehistoric sites of unknown age are found in the region. Historic remains are also found in the vicinity dating to the colonial periods as well as later American era sites. Most impacts on historic and cultural resources are expected to occur during preconstruction activities, because the majority of ground-disturbing activities would occur at this time. Two additional construction projects were identified for the Wilmington Site that could result in 60 additional acres of disturbed land (GLE, 2008). These projects are the ATC II complex and the Tooling Development Center. Since the publication of the Draft EIS, the ATC II complex has been built. Construction impacts would involve activities similar to those of the proposed action, namely clearing, grading, and excavation for building foundations and a stormwater wet detention basin. Both projects are located in a portion of the Wilmington Site that has been previously disturbed. No historic or cultural resources are known to exist in those areas. The security-related feature discussed in Appendix H could impact several Middle Woodland Era NRHP-eligible sites. This security feature is not related to the proposed GLE Facility. Should ground-disturbing activities occur in areas known to have historic properties, GLE, in accordance with the proposed license condition, would contact the North Carolina SHPO prior to initiating the action to ensure that the resources are considered appropriately. GLE also developed Common Procedure CP-24-201, *Unexpected Discoveries of Artifacts or Human Remains,* to ensure that remains or artifacts discovered during the proposed action would be addressed appropriately. In the event that sites are found, proper mitigation would be developed by GLE in consultation with the North Carolina SHPO. Cumulative impacts could range from SMALL to MODERATE given the close proximity of significant resources and possibility of an unanticipated discovery.

4.3.3 Air Quality

As discussed in Section 3.5.3, New Hanover County, in which the proposed GLE Facility would be located, and neighboring Brunswick and Pender Counties, are currently designated as being in attainment for all criteria pollutants (40 CFR 81.334).

As discussed in Section 4.2.4.2, potential incremental air quality impacts of the proposed GLE Facility would be SMALL and localized. Accordingly, the proposed GLE Facility operations would make a small contribution to cumulative impacts for other actions planned in the New Hanover County. In addition to the proposed GLE Facility, a number of onsite and offsite projects are planned in the New Hanover County as discussed below (GLE, 2008).

Two additional projects planned at the Wilmington Site include the Advanced Technology Center (ATC) II complex and the Tooling Development Center. Since publication of the Draft EIS in June 2010, the ATC II complex has been constructed. These projects would not use radioactive materials or include manufacturing operations. Neither of the projects would be a major source of air emissions as defined under EPA or NCDAQ air permit requirements. Emission sources for these projects would be limited to small natural gas-fired boilers for space heating, emergency diesel generators, and other small operating units.

An offsite industrial development, the Carolinas Cement Company LLC, submitted an air permit application to construct a new Portland cement manufacturing plant (referred to as the Titan Cement Plant) on 757-hectare (1868-acre) parcel, which is located about 10 kilometers (6 miles) east-northeast of the proposed GLE Facility (EQM, 2008). Per the “potential to emit” section in the air permit application, the facility can be classified as a major source. This plant would also emit toxic air pollutants (TAPs) including a trace amount of fluorides. Air dispersion modeling indicated that maximum concentrations are less than applicable ambient air quality standards and all maximum impacts occurred within a few kilometers of the facility boundaries. Potential cumulative impacts in public health associated with fluoride emissions are discussed in Section 4.3.8.

Another offsite development is new River Bluffs residential and mixed-use project planned on 96 hectares (237 acres) bounded by the Wilmington Site’s southern boundary, I-140, and Northeast Cape Fear River. This project would not include any large stationary sources, and thus, would not be considered as a major source of criteria pollutants under EPA or NCDAQ air permit requirements. This project along with three proposed projects at the Wilmington Site could draw more automobiles and trucks on Castle Hayne Road (NC 133) and I-140, and thus increase air emissions along these routes.

Overall, projects planned in New Hanover County would increase air emissions from current levels. However, incremental impacts of individual projects would be limited to the immediate vicinity of their property lines, and thus, would not be additive due to the distances between them. It is unlikely that combined impacts from all of these projects combined would be high enough to significantly deteriorate ambient air quality or reverse current attainment status. Accordingly, cumulative impacts on ambient air quality in New Hanover County are expected to be SMALL.

4.3.4 Geology and Soils

Two other construction projects identified for the Wilmington Site could result in 60 additional acres of disturbed land (GLE, 2008). These projects are the ATC II complex and the Tooling Development Center. Since publication of the Draft EIS in June 2010, the ATC II complex has been built, disturbing approximately 12 hectares (30 acres) of previously disturbed land. Tooling Development Center construction impacts would involve activities similar to those of the proposed GLE Facility, namely clearing, grading, and excavation for building foundations and a stormwater wet detention basin. Best management practices would avoid or limit the impact on soil. Operational impacts on soil would be negligible. Preconstruction activities at the proposed GLE Facility site would create a similar situation in terms of disturbed land, with approximately 91 hectares (226 acres) of cleared, regraded land.

Proposed developments in the Wilmington area include the Titan Cement Plant 32 kilometers (20 miles) upstream of the site, and several residential developments, including a 600-lot development with nursing home facilities, proposed for siting adjacent to the Wilmington Site’s south boundary (New Hanover County, 2009a). Another possibility is 1000 acres of mixed development near the Wilmington Site, east of Castle Hayne Road (New Hanover County, 2009a). In these offsite areas, BMPs are expected to be required by New Hanover County to control soil erosion (New Hanover County, 2007).

Geologic resources are not expected to be impacted by Wilmington-area activities. Cumulative impacts on soil from the proposed action and the additional construction projects are expected to be SMALL due to county involvement and presumed BMPs..

4.3.5 Water Resources

Other facilities in New Hanover County are permitted to discharge to the Northeast Cape Fear River or the tributary Prince George Creek (EPA, 2009b). These include municipal wastewater treatment plants and various industries. Discharges from these facilities have State oversight through the NPDES permitting system and reporting of monitoring results.

Two other new facilities at the Wilmington Site, the ATC II complex and the Tooling Development Center, would convey stormwater to wet detention basins en route to discharge to surface water bodies. These basins, as with the proposed GLE Facility's basin, would have clay liners to limit the infiltration of stormwater to the groundwater system. Since publication of the Draft EIS in June 2010, the ATC II complex has been built. Therefore, construction of this facility would not coincide with the preconstruction or construction activities associated with the proposed GLE Facility, and some of the impacts that arise from disturbed ground, such as turbidity, would not occur from both sites simultaneously. However, such cumulative impacts may occur from the construction of the Tooling Development Center if the construction activities overlap with preconstruction and construction for the proposed GLE Facility. The Tooling Development Center's construction runoff would run through wooded land, which would provide sediment attenuation beyond that provided by following BMPs.

As described in Section 4.3.4, offsite development for residential and industrial purposes is expected to occur, resulting in additional disturbed land. The timing of possible construction is unknown, but it could provide cumulative detrimental effect of turbidity and sediment load to the Northeast Cape Fear River. Wastewater effluent and stormwater effluent flowing to the river would increase once any residential community or industrial facility was built. Surface water monitoring stations in between the Wilmington Site and the proposed cement facility would provide a basis for determining the relative impact of the site. Enforced adherence to county-level ordinances regarding erosion control and stormwater management (e.g. New Hanover County, 2007; New Hanover County, 2009c) would limit the impact of new developments.

Effective in April 2008, the Wilmington Site's treated sanitary wastewater is used in processes and as makeup water for its cooling tower systems, rather than discharged at Outfall 002. After reuse, wastewater is treated at the Wilmington Site's final process lagoon, and the effluent is discharged to the effluent channel at Outfall 001. The low hardness of the treated sanitary wastewater increases the efficiency of Wilmington Site cooling towers. This reuse of water decreases the need for pumping of groundwater for process needs. The relative increase in groundwater pumping for the proposed GLE Facility includes 11,000 gallons per day additional for potable water and 75,000 gallons per day additional for process water (GLE, 2008). However, the net cumulative amounts of groundwater pumping, including the recently built ATC II complex and the proposed Tooling Development Center, and factoring in the reuse of treated sanitary effluent, would result in an increase of 29,500 gallons per day for potable water, and a decrease of 44,600 gallons per day for process water (GLE, 2008). While appreciable, the potable water need is small compared to the current groundwater withdrawal at the site of 656,640 gallons per day (see Section 3.7.4.2), a rate that has been sustained over a long period of time.

Based on the potential impacts on surface water that are controlled by the NPDES permitting and county ordinances, and based on anticipated groundwater withdrawals that are not significant, the overall cumulative impact on water resources would be SMALL.

4.3.6 Ecology

Many of the natural terrestrial and wetland habitats of New Hanover County have been modified, fragmented, or replaced by commercial, residential, and industrial developments (including silviculture and agriculture) (LeBlond and Grant, 2003). Similarly, extensive areas of natural upland and wetland forests on the Wilmington Site have been modified to pine plantations and operational (industrial) areas. The proposed GLE Facility, the completed ATC II complex, other projects to be developed on the Wilmington Site (i.e., the Tooling and Development Center and a security-related feature discussed in Appendix H), and unrelated projects to be constructed near the Wilmington Site (e.g., residential, industrial, and commercial developments) would contribute to the cumulative impact to ecological resources of the county (GLE, 2008; New Hanover County, 2009a). Overall, cumulative impacts on ecological resources from the proposed action in combination with the security-related feature discussed in Appendix H are SMALL. Impacts from the other projects to be developed on or near the Wilmington Site are discussed in the following paragraphs.

Impacts on ecological resources from the completed ATC II complex, the planned Tooling and Development Center, and the proposed GLE Facility would primarily occur from site clearing and grading. The ATC II complex has impacted about 8.4 hectares (20.8 acres) of pine forest and less than 0.01 hectare (0.01 acre) of pine-hardwood forest; while the Tooling and Development Center would impact about 0.1 hectare (0.3 acre) of pine forest, 2.9 hectares (7.2 acres) of pine-hardwood forest, and 2.6 hectares (6.4 acres) of pine plantation forest (GLE, 2009e). As discussed in Section 4.2.8.1, about 81 hectares (201 acres) of habitat would be impacted by preconstruction and construction activities for the proposed GLE Facility. The majority of this (65 hectares [160 acres]) would be pine plantation, pine forest, or pine-hardwood forest. Overall, these three projects would change over 79 hectares (195 acres) of these forest habitat types on the Wilmington Site to operations area habitat (e.g., buildings, other facilities, and landscaped lawns). An additional 1.2 hectares (3 acres) of alluvial, pocosin/bay, and swamp forest would be impacted by the proposed project (Table 4-5, Section 4.2.8.1). The loss of forested habitat from the three construction projects within the Wilmington Site would be more than 20 percent greater than from the proposed GLE Facility alone; and would total about 15.5 percent of the forest habitat on the Wilmington Site. Overall, the cumulative impacts on vegetation on the Wilmington Site from preconstruction activities for the proposed GLE Facility, completed construction of the ATC II complex, and the planned construction of the Tooling and Development Center would be MODERATE. The contribution to cumulative impacts from the remaining construction of the proposed GLE Facility and operation of the three facilities would be SMALL.

Negligible direct impacts on wetlands within New Hanover County in general or specifically on the Wilmington Site are expected from any of the proposed construction projects on the Wilmington Site (the access road to the proposed GLE Facility may cause the loss of up to 0.021 hectare (0.052 acre) of jurisdictional wetlands and 0.02 hectare (0.06 acre) of an isolated wetland); while indirect (but mitigable) impacts on wetlands from erosion and sedimentation may occur from the proposed GLE Facility and the completed ATC II complex (GLE, 2008; GLE, 2009e; GLE, 2009f). Past drainage of over 120 hectares (298 acres) of wetlands occurred

on the Wilmington Site; while over 198 hectares (490 acres) of wetlands would be impacted by the proposed cement manufacturing plant and quarry to be located east of the Town of Castle Hayne (FWS, 2008b). The contribution of the completed ATC II complex, the proposed GLE Facility, and the planned Tooling and Development Center to cumulative impacts on wetlands within New Hanover County and on the Wilmington Site would be SMALL.

No environmentally sensitive areas occur within the proposed GLE Facility area. Any indirect impacts on environmentally sensitive areas from preconstruction activities, construction, and operation of the proposed GLE Facility would be SMALL (Section 4.2.8). Therefore, any cumulative impacts on environmentally sensitive areas due to the proposed GLE Facility would be SMALL.

Impacts on wildlife from construction and operation of the completed ATC II complex and the planned Tooling and Development Center would be similar to those discussed for the proposed GLE Facility (Section 4.2.8). Construction of the ATC II complex disturbed approximately 12 hectares (30 acres) of previously disturbed land, in a former stormwater drainage area (GLE, 2008; GLE, 2011a). The main impacts on wildlife that occur from a construction project are habitat disturbance (i.e., habitat loss, alteration, and fragmentation). Habitat fragmentation would be minor for the ATC II complex and Tooling and Development Center, as they would be closely situated within the main operations area in the Eastern Site Sector of the Wilmington Site. Past actions that have affected wildlife habitat on the Wilmington Site have involved primarily the drainage of over 120 hectares (298 acres) of forested wetlands, and alteration of natural habitats (e.g., pine and pine-hardwood forests) for pine plantations, power line corridors, or operations areas. These habitat alterations have affected 255 hectares (631 acres), nearly 39 percent, of the Wilmington Site (GLE, 2008). Overall, the cumulative impacts on wildlife on the Wilmington Site from the completed ATC II complex, preconstruction activities for the proposed GLE Facility, and the planned construction of the Tooling and Development Center would be MODERATE. The contribution to cumulative impacts from the remaining construction of the proposed GLE Facility and operation of the three facilities would be SMALL.

As discussed in Section 4.3.5, cumulative impacts on water resources are expected to be SMALL. As a result, cumulative impacts on aquatic biota due to the proposed GLE Facility would also be SMALL.

Federally threatened and endangered species are not known to occur in the area of the completed ATC II complex and the planned Tooling and Development Center (GLE, 2008). Therefore, cumulative impacts on Federally threatened and endangered species from these facilities and the proposed GLE Facility would be SMALL. Similarly, cumulative impacts on a number of the Federal species of concern or State-listed species that occur within New Hanover County would be SMALL, because they are not expected to inhabit the areas within which these three facilities would occur. For those species that may be present within areas that would be impacted by one or more of these facilities (i.e., those species assessed in Section 4.2.8.1), cumulative impacts from the completed ATC II complex, preconstruction activities for the proposed GLE Facility, and the planned construction of the Tooling Development Center would be SMALL to MODERATE, depending on how many individuals could be impacted and possible mitigation measures that would be undertaken to protect those individuals. Cumulative impacts from remaining GLE construction and from the operation of all three projects to those species would be SMALL.

4.3.7 Transportation

The additional 300 to 400 operations workers for the proposed GLE Facility represent a 10 percent to 15 percent increase from the 2800 workers currently employed at the Wilmington Site. Furthermore, approximately 1000 more employees (GLE, 2008) may be added to the site with the addition of the ATC II complex and the Tooling Development Center noted in Section 4.3. However, the additional 1000 workers would be using the existing site entrances, not the one to be dedicated for GLE Facility use.

A foreseeable event in the vicinity of the site is a planned retirement community project that would use Chair Road, which intersects Castle Hayne Road about one-quarter mile south of the I-140 interchange (GLE, 2008). This project is anticipated to generate 3700 average daily trips in the local area. Combined with the increased employment at the Wilmington Site, the local incremental transportation impacts associated with the construction, operation, and decommissioning of the proposed GLE Facility would be MODERATE as the annual average daily trips could increase approximately 50 percent (about 1000 from GLE; 2000 from ATC II and the TDC; 3700 from the retirement community) from the current value of 12,000 on Castle Hayne Road near the site entrance.

Approximately 2086 radioactive material shipments annually to or from the Wilmington Site would be added in support of the proposed GLE Facility (GLE, 2008). These shipments would roughly triple the number of radioactive material shipments occurring at the site, with about 996 annual shipments currently supporting site activities (GLE, 2009a). The additional radiological impact on those in the vicinity of the additional shipments would be SMALL. If the same person were to be present for all current shipments, that person would receive approximately 0.01 millisievert per year (1 millirem per year) from these shipments if they were by the road (such as a security guard) 2 meters (6.6 feet) from the side of each shipment as it passed by at a speed of 24 kilometers per hour (15 miles per hour). That same person would only receive approximately 0.002 millisievert per year (0.2 millirem per year) from the GLE shipments because the expected external dose rates are much lower on average than those from current operations at the site. Thus, any expected exposure would only increase approximately 20 percent at the most over current conditions, despite three times the number of current shipments.

4.3.8 Public and Occupational Health

This section describes the cumulative impacts on public and occupational health associated with preconstruction, construction, operation, and decommissioning of the proposed GLE Facility on the Wilmington Site in combination with other past, present or foreseeable actions in the region that may affect the same resources as the proposed facility. The focus of the discussion is on radiological cumulative effects, and when appropriate, cumulative non-radiological effects are described.

4.3.8.1 Preconstruction and Construction Activities

The cumulative impacts associated with preconstruction and construction activities on public and occupational health could be received by some workers during the 6-year overlap of construction and operations. Accordingly, the potential annual radiological exposure to an onsite construction worker (3.85×10^{-4} millisievert per year [3.85×10^{-2} millirem per year])

would be well below the applicable dose limits for the general public of 1 millisievert per year (100 millirem per year) limit listed at 10 CFR 20.1301(a)(1). During preconstruction and construction activities, the potential dose to offsite personnel would not increase.

4.3.8.2 Operations

The cumulative radiological and non-radiological impact of uranium emissions from the proposed GLE Facility and existing FMO facility at the Wilmington Site were evaluated.

The yearly average TEDE to involved workers for 2003–2007 at the Wilmington Site from FMO operations varied from 0.50–0.75 millisievert per year (50–75 millirem per year), which is less than the applicable dose limits for the general public of 1 millisievert per year (100 millirem per year) limit listed in 10 CFR 20.1301(a)(1) and well below the 10 CFR 20.1201 limit of 50 millisievert (5000 millirem) for involved workers (i.e., workers in radiologically controlled areas) (NRC, 2009c). The average estimated dose to involved workers at the proposed GLE Facility is expected to be less than 1.5 millisievert per year (150 millirem per year), which is well below the regulatory thresholds. Because the workers at the FMO facility and the proposed GLE Facility would not be working at both facilities, there would not be a cumulative exposure and even considering the overall collective dose to workers from existing conditions, and ongoing and anticipated operations at the Wilmington Site, the cumulative radiological impacts on workers from existing conditions and ongoing and anticipated site operations will be SMALL.

To assess the cumulative impacts on public health, the potential cumulative impacts of radiological air emissions from the existing FMO facility and the proposed GLE Facility were analyzed. Radiological releases to air from both facilities would be routinely monitored to ensure that releases are at or below the expected and regulated levels. In addition, the North Carolina Division of Radiation Protection collects data from a monitoring network of six ambient air samplers (GLE, 2008). The monitoring network is intended to assess whether the radiological air emissions from the FMO facility affect air quality in the surrounding area. Data are collected both onsite and in the area surrounding the Wilmington Site. A background ambient air monitoring station is located approximately 1.6 kilometers (1 mile) west of the site. The analytical results from air sampling stations closer to the plant are compared to background measurements (GLE, 2008). Based on the predicted emission rates associated with the FMO facility and the proposed GLE Facility, and on current data from the comprehensive site monitoring program, the cumulative radiological emissions would result in a SMALL impact on air quality.

Currently there is an insignificant contribution to direct radiation exposure at the site boundary from FMO facility operations. None of the TLDs used to monitor such exposures showed readings above the background exposure rate of 5 microroentgens per hour at the site boundary (GLE, 2009b). The additional storage planned for the proposed GLE Facility is expected to have a similar minor effect on the direct radiation exposure rate at the site boundary. Therefore, the cumulative impact from direct exposure to the public would be SMALL.

The cumulative effect of operating the existing FMO facility and the proposed GLE Facility may result in some increase of dose at the fenceline of the Wilmington Site from air emissions. The estimated maximum dose due to air emissions from the FMO facility at the fenceline is approximately 4×10^{-4} millisievert per year (4×10^{-2} millirem per year) (Section 3.11.1.2). The

operation of the proposed GLE Facility would introduce a new source of radiological emissions. The estimated maximum dose due to air emissions from the proposed GLE Facility at the fenceline is 1.4×10^{-6} millisievert per year (1.4×10^{-4} millirem per year) (Section 4.2.11.2). The estimated doses from both the FMO facility and proposed GLE Facility are far less than the applicable dose limits for the general public of 1 millisievert per year (100 millirem per year) limit listed at 10 CFR 20.1301(a)(1) and would result in a SMALL cumulative impact.

Non-radiological cumulative impacts on occupational and public health could accrue from the airborne emissions of UF_6 and HF from the proposed GLE Facility (Section 4.2.11.2) in combination with those from the adjacent FMO facility. However, as noted in Section 4.2.11.2, the estimated emissions of these chemicals from the proposed GLE Facility would be well below levels of concern. Fluoride emissions from the FMO facility between 1995 and 2005 were typically a fraction of their permitted levels of 0.29 kilograms per day (0.63 pounds per day), while measured air concentrations were a small fraction of the recommended workplace exposure limit of 2.5 milligrams per cubic meter (NRC, 2009b). Additional fluoride emissions from the proposed GLE Facility are expected to be much lower than those from the FMO facility and would not materially increase the total levels of fluorides in the air onsite or at the site boundary. Fluoride emissions from the proposed Titan Cement Plant, the only other significant potential source of fluoride emissions in the region, would be located about 6 miles (9.6 kilometers) to the north and would not adversely impact ambient air quality outside the boundary of that plant, according to the analysis prepared to support its permit application (EQM, 2008). Impacts from mercury emissions from the same facility would be minor and would not contribute to adverse health effects in the region, as discussed in Section 3.11.3.4. In addition, health impacts from mercury, a neurological toxin, would not combine cumulatively with those from HF, a respiratory irritant. Given the distance between the contributing facilities, the required fluoride emission permits for the facilities, and the relatively minor contributions of the proposed GLE Facility, the cumulative impacts of fluoride and other toxic chemical emissions in the region would be SMALL.

Uranium emissions, as UF_6, from the FMO facility, evaluated in terms of radiological effects, were estimated to be a tiny fraction of the applicable dose limit for members of the public (GLE, 2008). Because predicted uranium and HF emissions would produce air concentrations that are far below levels of health concern, it is expected that effects of chemical toxicity of uranium and HF from the facility would also be minor. Thus, the expected low-level uranium and HF emissions from the proposed GLE Facility would not contribute to material increases in public or worker exposure, while the cumulative effects of both uranium and HF emissions would be SMALL.

4.3.9 Waste Management

Potential average daily process and sanitary wastewater flow rates from existing facilities, the proposed GLE Facility, and potential future facilities at the Wilmington Site are summarized in Table 4-32. As shown in the table, the total site process and sanitary wastewater flow rates, without taking credit for reuse in the site cooling towers, are approximately 1,956,000 liters per day (516,200 gallons per day) and 236,000 liters per day (62,300 gallons per day), respectively, which are well below the NPDES permit levels of 6.8 million liters per day (1.8 million gallons per day) and 284,000 liters per day (75,000 gallons per day), respectively. Thus, cumulative impacts from wastewater generation would be SMALL.

Table 4-32 Cumulative Wastewater Generation at the Wilmington Site

Wilmington Site Wastewater Source	Total Average Daily Wastewater Flow Rate (gpd)		
	Process Wastewater	Sanitary Wastewater	Combined Wastewater Flow Rate
Existing Wilmington Site facilities[a]	476,200	33,300	509,500
Proposed GLE Facility[b]	35,000	10,500	45,500
Other planned onsite projects[c]	5000	18,500	23,500
Total projected treated wastewater effluent (not including industrial reuse of treated sanitary wastewater effluent)	516,200	62,300	578,500
Effects of industrial reuse of treated effluent from the Wilmington Site sanitary wastewater treatment facility[d]	−62,300[e]	−62,300[f]	−124,600
Projected NPDES-permitted discharges of wastewaters to the onsite effluent channel	453,900[e]	0[f]	453,900

[a] Total averaged daily volumes based on measured flow for 2006.
[b] Total averaged daily volumes based on estimated flow rates for GLE operations (see Table 4-24).
[c] Total averaged daily volumes based on estimated flow rates for ATC II complex and Tooling Development Center.
[d] Although the reuse of treated sanitary wastewater effluent from the Wilmington Site sanitary wastewater treatment facility as Site process water commenced in April 2008, it is included in the cumulative impacts assessment because it postdates the 2006 baseline set of conditions.
[e] Because the treated sanitary wastewater effluent has such low hardness, its addition to the Wilmington Site cooling towers increases efficiencies. Each gallon of reuse water introduced into a cooling tower offsets 2 gal of process makeup water, which reduces the amount of process water to be treated in the final process lagoons and discharged to the effluent channel.
[f] The effluent reuse process water resulted in a switch away from discharge of treated sanitary wastewater effluent to the effluent channel, which flows to Unnamed Tributary #1 to Northeast Cape Fear River (Waters of the United States). The NPDES discharge permit remains valid should discharges of treated sanitary wastewater become necessary in the future. The effluent reuse process also reduces the requirement to withdraw groundwater to meet the Wilmington Site process-water requirement.
Note: Total wastewater quantities presented in this table are lower than the process-water and potable-water demands due to consumptive losses. To convert gal to l, multiply by 3.8.
Source: GLE, 2008.

Current disposal of hazardous and solid wastes from the Wilmington Site is expected to continue, and disposal of hazardous, nonhazardous solid, and solid LLRW from the proposed GLE Facility at appropriate facilities is shown in Section 4.2.12.2 to comprise a small fraction of the disposal rates and capacities at these disposal facilities. The majority of waste expected from the completed ATC II complex and the planned Tooling Development Center at the Wilmington Site would be municipal solid waste destined for disposal at the New Hanover County Landfill (GLE, 2008). Based on available capacities at LLRW and hazardous waste treatment and disposal sites in conjunction with the anticipated expansion of the New Hanover

County Landfill (see Section 3.12.4.1), the cumulative impacts from hazardous and solid waste generation are anticipated to be SMALL.

4.3.10 Socioeconomics

Preconstruction and construction activities in the peak year would employ 680 workers at the proposed GLE Facility. An additional 3131 indirect jobs could be created in the ROI from the procurement of material and equipment and the spending of worker income (Table 4-26). Facility construction would generate $139.8 million in income in the ROI. Beginning in 2014, start-up activities would employ 200 workers annually at the proposed GLE Facility, with an additional 218 indirect jobs and $28.0 million in income in the ROI. During the period 2014 to 2020, construction and start-up activities would occur at the same time. Construction activities during this period would employ 231 construction workers, with 981 indirect workers and approximately $45.6 million in income in 2014, to employing 136 construction workers, with 626 indirect workers and approximately $29.1 million in income in 2020. The cumulative impact of construction and start-up during this period would range from the creation of 413 direct and 1199 indirect jobs and approximately $73.5 million in income in 2014, to 486 direct and 1008 indirect jobs and approximately $77.5 million in income in 2020.

Operations activities beginning in 2020 would employ 350 workers at the proposed GLE Facility, with an additional 382 indirect jobs, and would constitute less than 1 percent of total ROI employment. Facility operations would generate approximately $51.5 million in income in the ROI in 2020. Compared to existing employment levels in the ROI, the economic impact of construction, operations, and decommissioning activities would be SMALL.

Construction would generate $1.7 million in income taxes and $1.2 million in sales taxes in the peak construction year, while start-up activities would generate $1.3 million in income taxes and $0.9 million in sales taxes annually, beginning in 2014 and continuing through 2020. During the period 2014 to 2020, construction and start-up activities would occur at the same time, generating $1.9 million in income taxes and $1.3 million in sales taxes in 2014, and $2.6 million in income taxes and $1.9 million in sales taxes in 2020. Compared to current income and sales tax revenues, the impact of constructing, operating, and decommissioning the proposed GLE Facility on sales and income taxes would be SMALL.

Given the duration and scale of activities and the availability of local workers, construction of the proposed GLE Facility could cause some workers and their families to relocate from outside the ROI, with between 299 and 598 persons moving into the ROI during the peak year of construction (2012) and between 92 and 120 persons migrating into the area during start-up activities. During the period 2014 to 2020, construction and start-up activities would occur at the same time. In-migration associated with construction activities during this period could vary from 153 and 195 in 2014 and between 97 and 124 in 2020. Cumulatively, between 245 and 315 persons could move into the ROI in 2014 and between 167 and 194 persons in 2020. Between 161 and 210 persons could move into the ROI during the first year of full operations (2020). Although in-migration may potentially impact local housing markets, the relatively small number of people relocating to the ROI and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of facility construction on the number of vacant rental housing units would be small. Between 87 and 173 rental units in the ROI would be required during construction and between 27 and 47 rental units would be required during start-up activities. During the period 2014 to 2020, construction and start-up

activities would occur at the same time. The demand for rental housing would range between 54 and 103 units in 2014 and between 64 and 97 units in 2020. Between 47 and 61 owner-occupied units would be required during operations. These occupancy rates would represent less than 1 percent of the vacant rental units expected to be available in the ROI; the impact of GLE Facility construction, operations, and decommissioning on housing would, therefore, be SMALL.

In addition to the potential impact on housing markets, in-migration would also affect local-community and educational services. These increases would represent less than 1 percent of community service employment expected in the ROI; therefore, the impact of GLE Facility construction, operations, and decommissioning on community services would be SMALL.

Two other projects have been constructed or are planned at the Wilmington Site, in addition to the proposed GLE Facility. Since publication of the Draft EIS in June 2010, construction of the ATC II complex has been completed and is anticipated to employ approximately 500 workers (GLE, 2008). The Tooling Development Center, construction of which is projected to occur in 10 years, would employ approximately 500 workers annually when operational (GLE, 2008). The timing, workforce requirements, and worker residential locations of the Tooling Development Center would overlap with the operation of the proposed GLE Facility.

Elsewhere, additional reasonably foreseeable projects include the Carolinas Cement Company LLC, proposal to construct the Titan Cement Plant in New Hanover County, which would employ approximately 1000 workers during its 3-year construction phase, and approximately 160 workers during operations (Carolinas Cement Company, 2011). GLE Facility operations are expected to begin in 2014 (GLE, 2008; GLE, 2011), overlapping with the ongoing construction of the proposed GLE Facility. There are also plans to upgrade container port facilities in the Wilmington area, including the construction of the North Carolina International Terminal (NCIT) near Southport (Star News Online, 2008; Journal of Commerce, 2010), and upgrades to existing facilities at the Port of Wilmington (Greater Wilmington Business Journal, 2010). However, the timeline and employment requirements for the NCIT are not known because the project has been postponed indefinitely (Journal of Commerce, 2010). If construction does occur, it is likely that there would be some overlap with the construction of the proposed GLE Facility. Assuming these projects would occur at the same time as the proposed GLE Facility, relatively SMALL annual increases are expected in population within the socioeconomic region of cumulative impacts. Housing growth trends in the region and plans for new school construction suggest that the cumulative effect of these projects would be SMALL. Therefore, the overall cumulative socioeconomic impact of the construction and operation of the proposed GLE Facility and reasonably foreseeable projects in the region would be SMALL to MODERATE.

4.3.11 Environmental Justice

Construction, operation, and decommissioning of the proposed GLE Facility and other proposed projects onsite and offsite would not have a disproportionately high and adverse effect on minority and low-income populations in the vicinity of the Wilmington Site.

4.4 Impacts of the No-Action Alternative

As presented in Section 2.2 of this EIS, the no-action alternative would be to not construct, the proposed GLE Facility in Wilmington, North Carolina. As discussed in Section 1.4.1 and the introduction to Section 4.2, the NRC granted an exemption for GLE to conduct certain preconstruction activities in advance of a formal licensing decision. It is assumed that up to 1 year of preconstruction activities would take place (preconstruction activities could begin prior to the licensing decision in 2012, but construction cannot begin until a licensing decision is made) regardless of the decision to issue a license for the proposed GLE Facility under both the proposed action and the no-action alternative. It follows that the impacts associated with these preconstruction activities, as described in Section 4.2, would also have occurred. The impact conclusions presented in this section address the impacts of denying the license; preconstruction activities are assumed to have occurred prior to the licensing decision.

Under the no-action alternative, enrichment services would continue to be performed by existing domestic and foreign uranium enrichment suppliers. Paducah GDP and the NEF would continue to supply enrichment services. The ACP and EREF also may provide enrichment services in the future. Impacts from these other domestic enrichment facilities have been evaluated in other NRC environmental reviews.

4.4.1 Land Use

Under the no-action alternative, preconstruction activities would occur even if the proposed GLE Facility is not constructed. Preconstruction activities would remove the undeveloped forest within the Wilmington Site and would not affect surrounding land use. Preconstruction impacts on land use are addressed in Section 4.2.1.1. The baseline for the no-action assessment is a cleared property with utilities and administrative structures extant.

Denying the license would not preclude other uses of the land at the Wilmington Site; therefore, land use impacts would be SMALL.

4.4.2 Historic and Cultural Resources

Under the no-action alternative, ground disturbance associated with preconstruction activities could impact historic and cultural resources (unanticipated discovery) at the Wilmington Site. Preconstruction impacts on historic and cultural resources are addressed in Section 4.2.2.1. Since the proposed GLE Facility would not be constructed, no further impacts to historic and cultural resources would occur from the no-action alternative.

Denying the license would result in no further land disturbance at the Wilmington Site; therefore, impacts on historic and cultural resources in New Hanover County from the no-action alternative would not occur and would be SMALL.

4.4.3 Visual and Scenic Resources

Under the no-action alternative, preconstruction activities would consist of clearing vegetation. Preconstruction impacts on visual and scenic resources are addressed in Section 4.2.3.1. Since the proposed GLE Facility would not be constructed,,the visual appearance of the Wilmington Site would not change because the vegetation screen along the northern part of the site would

remain. The baseline for the no-action alternative is a property cleared of vegetation with utilities and support structures in place. The discussion of impacts from preconstruction activities on visual and scenic resources is provided in Section 4.2.3.1.

Since denying the license would not introduce any additional visual disturbance at the Wilmington Site, local visual impacts of the no-action alternative would be SMALL.

4.4.4 Air Quality

Under the no-action alternative, preconstruction activities would have an impact on ambient air quality conditions at the Wilmington Site. Preconstruction impacts on air quality are addressed in Section 4.2.4.1. Since the proposed GLE Facility would not be constructed, air emission sources for the existing facilities at the Wilmington Site would continue to operate according to the allowable emission limits and emission control requirements set forth in the current two "synthetic minor" operating permit issued by the North Carolina Division of Air Quality (NCDAQ). As discussed in Section 3.5.3.1, point source emissions from current operations at the Wilmington Site are negligible compared with the annual total emissions in New Hanover County.

Since denying the license would not result in local air quality impacts from additional vehicle emissions, land disturbance, or facility emissions, impacts of no-action alternative on ambient air quality would be SMALL.

4.4.5 Geology and Soils

Under the no-action alternative, preconstruction activities such as grading, wet retention basin construction, and drainage changes would have occurred at the proposed GLE Facility site and along site roads. Erosion control measures on the land disturbed during preconstruction (such as seeding) would limit soil loss due to erosion. Preconstruction impacts on geology and soil are addressed in Section 4.2.5.1. Since the proposed GLE Facility would not be constructed, there would be no further impacts on geologic and soils conditions at the Wilmington Site. The discussion of geologic and soil impacts resulting from preconstruction activities is presented in Section 4.2.5.1.

Since denying the license would not lead to additional land disturbance, impacts of the no-action alternative would be SMALL.

4.4.6 Water Resources

Under the no-action alternative, preconstruction activities would have occurred. Preconstruction impacts on water resources are addressed in Sections 4.2.6.1 and 4.2.7.1. As described in Section 4.4.5, preconstruction would require measures for control of soil erosion on land disturbed during preconstruction activities. By taking steps to minimize erosion, the impact on turbidity of surface water can likewise be limited. Additional water use may or may not occur under the no-action alternative (depending on GLE's future plan for the site).

Under the no-action alternative, the proposed GLE Facility would not be constructed. Groundwater quality would not be reduced at the GLE site, but rather, would be gradually

improved sitewide due to continued use and improvement of the site remediation systems and also due to some degree of natural attenuation.

Since denying the license would not result in additional water use or changes to surface or groundwater quality, the overall impact of the no-action alternative on water resources would be SMALL.

4.4.7 Ecological Resources

Under the no-action alternative, preconstruction activities would have occurred. Preconstruction impacts on ecological resources are addressed in Section 4.2.8.1. The baseline for the no-action alternative is an area cleared of vegetation with administrative structures, utilities, and north access road in place.

Because denying the license would not result in additional land disturbance on the Wilmington Site, anticipated impacts on ecological resources from the no-action alternative would be SMALL.

4.4.8 Noise

Under the no-action alternative, noise impacts associated with preconstruction would be short-term and limited to the immediate vicinity of the location of the proposed GLE Facility. Noise impacts from preconstruction activities are addressed in Section 4.2.9.1. Since the proposed GLE Facility would not be constructed, noise from existing GE operations at the Wilmington Site would remain unchanged. As discussed in Section 3.9, a sound survey indicated that noise levels at the nearest residences were well below the New Hanover County Noise Ordinance and EPA guideline.

Since denying the license would not result in additional noise sources on the site, noise impacts of the no-action alternative on surrounding communities would be SMALL.

4.4.9 Transportation

Under the no-action alternative, preconstruction activities would affect traffic conditions on access roads at the Wilmington Site. These impacts would be short-term and limited to the vicinity of the Wilmington Site. Transportation impacts from preconstruction are addressed in Section 4.2.9.1. Since the proposed GLE Facility would not be constructed, there would be no further transportation impacts relating to the proposed GLE Facility on roads in the vicinity of the Wilmington Site. Additional national impacts from the transportation of radioactive materials to and from the Wilmington Site would also not occur.

Since denying the license would not result in additional traffic, transportation impacts of the no-action alternative would be SMALL.

4.4.10 Public and Occupational Health

Under the no-action alternative, impacts on workers associated with preconstruction activities would have occurred. Occupational exposures during preconstruction would be minor and minimized by using work practices and personal protective equipment. Preconstruction

activities are not expected to cause any exceedances of ambient air quality criteria, with the possible exception of short-term criteria for particulate matter from fugitive dust. Public and occupational health impacts from preconstruction are addressed in Section 4.2.11.1. Since the proposed GLE Facility would not be constructed, public and occupational health risks would remain the same as described in Section 3.11 to onsite workers and the public. Therefore, the public and occupational health impacts of the no-action alternative would be SMALL.

4.4.11 Waste Management

Under the no-action alternative, preconstruction activities would occur. Preconstruction impacts on waste management are addressed in Section 4.2.12.1. Since the proposed GLE Facility would not be constructed, there would be no additional waste generated at the Wilmington Site beyond the waste generated by existing GE activities. Impacts of the no-action alternative on waste management would be SMALL.

4.4.12 Socioeconomic Impacts

Under the no-action alternative, preconstruction activities would increase the number of onsite construction workers, resulting in a short-term increase in the demand for rental housing and public services in the vicinity of the Wilmington Site. The socioeconomic impacts from preconstruction are addressed in Section 4.2.13.1. Since the proposed GLE Facility would not be constructed under the no-action alternative, population and employment in the ROI (Brunswick County, New Hanover County, and Pender County) would change in accordance with current projections. Total population in the region is projected to be approximately 368,000 in 2010 and 444,000 in 2020 (NCOSBM, 2009). Employment in Brunswick, Columbus, New Hanover, and Pender counties is projected to grow approximately 1.7 percent per year, from 150,648 workers in 2004 to 178,714 workers in 2014. Assuming growth continues at this rate after 2014, total employment would reach 198,005 by the year 2020 (NCOSBM, 2009). As discussed in Section 4.2.13, completion of preconstruction activities is not expected to have a noticeable effect on these trends or on county services.

Since denying the license would not directly result in changes to current county services or growth projections, the socioeconomic impact of the no-action alternative would be SMALL.

4.4.13 Environmental Justice

Under the no-action alternative, potential impacts to minority and low-income populations from preconstruction activities would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts would be short-term and limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased commuter vehicle traffic during shift changes. Increased demand for rental housing during preconstruction could disproportionately affect low-income populations. However, due to the short duration of the preconstruction activities and the availability of rental housing, impacts to minority and low-income populations would be short-term and limited. Since the proposed GLE Facility would not be constructed under the no-action alternative, there would be no further impacts to minority and low-income populations residing in the vicinity of the Wilmington Site.

Based on this information and the assessment of human health and environmental impacts presented in Chapter 4, the no-action alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the Wilmington Site.

4.4.14 Accident Impacts

Under the no-action alternative, the proposed GLE Facility would not be constructed and no accidents would occur from facility operations or decommissioning. Therefore, impacts of the no-action alternative from facility accidents would be SMALL.

4.5 References

(ACHP, 2008) Advisory Council on Historic Preservation. "National Register Evaluation Criteria." ADAMS Accession No. ML082880723.

(AES, 2008) AREVA Enrichment Services, LLC. "Eagle Rock Enrichment Facility, Application for a Uranium Enrichment Facility License under 10 CFR 70, 'Domestic Licensing of Special Nuclear Material.'" December. ADAMS Accession No. ML090300656.

(ATSDR, 2003) Agency for Toxic Substances and Disease Registry. "Toxicological Profile for Fluorides, Hydrogen Fluoride, and Fluorine." September. <http://www.atsdr.cdc.gov/toxprofiles/tp11.pdf> (Accessed January 29, 2010).

(Beaulaurier et al., 1984) Beaulaurier, D.L., et al. "Mitigating the Incidence of Bird Collisions with Transmission Lines." In *Proceedings of the Third International Symposium on Environmental Concerns in Rights-of-Way Management*. A.F. Crabtree (Ed.).

(Bevanger, 1995) Bevanger, K. "Tetraonid Mortality Caused by Collisions with Power Lines in Boreal Forest Habitats in Central Norway." *Fauna norv. Ser. C, Cinclus* 18:41–51.

(BirdLife International, 2003) BirdLife International. "Protecting Birds from Powerlines: A Practical Guide on the Risks to Birds from Electricity Transmission Facilities and How to Minimise Any Such Adverse Effects." T-PVS/Inf (2003) 15, Convention on the Conservation of European Wildlife and Natural Habitats, Standing Committee, 23rd Meeting, Strasbourg, December 1-4, 2003. <http://www.coe.int/T/E/Cultural_Co-operation/Environment/Nature_and_biological_diversity/Nature_protection/> (Accessed October 23, 2006). Document no longer available online.

(BLM, 2007) Bureau of Land Management, U.S. Department of the Interior. "Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Final Programmatic Environmental Report." June. <http://www.blm.gov/pgdata/etc/medialib/blm/wo/Planning_and_Renewable_Resources/veis.Par.81642.File.dat/Final%20Biological%20Assessment%20%20(June%202007).pdf> (Accessed March 2, 2010).

(Bolander and Yamada, 1999) Bolander, P., and A. Yamada. "Dust Palliative Selection and Application Guide." U.S. Department of Agriculture, Forest Services. November. <http://www.fs.fed.us/eng/pubs/html/99771207/99771207.html> (Accessed January 30, 2009).

(Brown et al., 1999) Brown, B.T., et al. "The Influence of Weapons-Testing Noise on Bald Eagle Behavior." *Journal of Raptor Research* 33:227–232.

(BTS, 2009) Bureau of Transportation Statistics. "National Transportation Statistics, 2009." U.S. Department of Transportation, Research and Innovative Technology Administration. <http://www.bts.gov/publications/national_transportation_statistics/2009/pdf/entire.pdf> (Accessed May 4, 2009).

(Buckler, 2009) Buckler, C. Personal communication from C. Buckler (North Carolina Department of Environment and Natural Resources) to Y.-S. Chang (Argonne National Laboratory). September 4.

(Burrows and Hagemeyer, 2004) Burrows, S., and D.A. Hagemeyer. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2003." NUREG-0713, Volume 25. U.S. Nuclear Regulatory Commission. October. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713> (Accessed March 2, 2010).

(Burrows and Hagemeyer, 2005) Burrows, S., and D.A. Hagemeyer. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2004." NUREG-0713, Volume 26. U.S. Nuclear Regulatory Commission. December. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713> (Accessed January 29, 2010).

(Burrows and Hagemeyer, 2006) Burrows, S., and D.A. Hagemeyer. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2005." NUREG-0713, Volume 27. U.S. Nuclear Regulatory Commission. December. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713> (Accessed January 29, 2010).

(Campbell and Johns, 2000) Campbell, M., and M. Johns. "Habitat Fragmentation and Birds." North Carolina Wildlife Resource Commission. <http://faculty.ncwc.edu/mbrooks/pif/Fact%20Sheets/fragmentation%20fact%20sheet.htm> (Accessed September 3, 2009).

(Carolinas Cement Company, 2011) Carolinas Cement Company. "Carolinas Cement Company: Questions and Answers." <http://www.carolinascement.com/faq/> (Accessed December 22, 2011).

(Countess Environmental, 2006) Countess Environmental. "WRAP Fugitive Dust Handbook." Prepared by Countess Environmental for Western Governors' Association. September 7. <http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf> (Accessed August 24, 2009).

(CPC, 2008a). Center for Plant Conservation. "CPC National Collection Plant Profile *Solidago villosicarpa*." <http://www.centerforplantconservation.org/Collection/CPC_ViewProfile.asp?CPCNum=44450> (Accessed October 2, 2009).

(CPC, 2008b). Center for Plant Conservation. "CPC National Collection Plant Profile *Stylisma pickeringii* var. *pickeringii*." <http://www.centerforplantconservation.org/Collection/CPC_ViewProfile.asp?CPCNum=4157> (Accessed October 2, 2009).

(CPC, 2008c). Center for Plant Conservation. "CPC National Collection Plant Profile *Lysimachia asperulifolia*." <http://www.centerforplantconservation.org/Collection/CPC_ViewProfile.asp?CPCNum=2750> (Accessed October 2, 2009).

(CPC, 2008d). Center for Plant Conservation. "CPC National Collection Plant Profile *Solidago verna*." <http://www.centerforplantconservation.org/Collection/CPC_ViewProfile.asp?CPCNum=4050> (Accessed October 2, 2009).

(Delaney et al., 1999) Delaney, D.K., et al. "Effects of Helicopter Noise on Mexican Spotted Owls." *Journal of Wildlife Management* 63(1):60–76.

(DNFSB, 1995a) Defense Nuclear Facility Safety Board. "Integrity of Uranium Hexafluoride Cylinders." Technical Report DNFSB/TECH-4. May 5.

(DNFSB, 1995b) Defense Nuclear Facility Safety Board. "Improved Safety of Cylinders Containing Depleted Uranium." Recommendation 95-1 to the Secretary of Energy. May 5. ADAMS Accession No. ML101810041.

(DNFSB, 1999) Defense Nuclear Facility Safety Board. Letter from J. Conway to B. Richardson, Secretary of Energy. Closing of Recommendation 95-1. December 16. ADAMS Accession No. ML101810043.

(DOE, 1995) U.S. Department of Energy. "Department of Energy Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 95-1, Improved Safety of Cylinders Containing Depleted Uranium." October 16. <http://www.hss.doe.gov/deprep/1995-2/fs95o16a.pdf> (Accessed August 7, 2009).

(DOE, 2002) U.S. Department of Energy. "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota." DOE-STD-1153-2002. July. <http://www.doeal.gov/SWEIS/DOEDocuments/027%20DOE%20STD-1153-2002.pdf> (Accessed February 13, 2012).

(DOE, 2004a) U.S. Department of Energy. "Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky Site." DOE/EIS-0359. June. <http://www.gc.doe.gov/nepa/downloads/eis-0359-final-environmental-impact-statement> (Accessed January 26, 2012).

(DOE, 2004b) U.S. Department of Energy. "Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site." DOE/EIS-0360. June. <http://www.gc.doe.gov/nepa/downloads/eis-0360-final-environmental-impact-statement> (Accessed January 26, 2012).

(DOE, 2010) U.S. Department of Energy. "Background on Public Notification of Depleted Uranium Hexafluoride Cylinders Transferred from East Tennessee Technology Park to Piketon, Ohio Facility." July. <http://www.ports-ssab.energy.gov/Meetings/2010/D&D/July/Cylinder%20Transfer%20from%20ETTP%20to%20PORTS%20Fact%20Sht%20FINAL.pdf> (Accessed February 10, 2012).

(DOL, 2010a) U.S. Department of Labor, Bureau of Labor Statistics. "Table 1, Incident rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2009." October 21. <http://www.bls.gov/iif/oshwc/osh/os/ostb2435.pdf> (Accessed February 8, 2012).

(DOL, 2010b) U.S. Department of Labor, Bureau of Labor Statistics. "Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries for civilian workers by selected worker characteristics, occupations, and industries, 2009." <http://www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2009hb.pdf> (Accessed January 27, 2011).

(EEI, 1980) Edison Electric Institute. "Compatibility of Fish, Wildlife, and Floral Resources with Electric Power Facilities." A Report Prepared by the Urban Wildlife Research Center, Inc., for the Edison Electric Institute.

(EIA, 2009) Energy Information Administration, U.S. Department of Energy. "Frequently Asked Questions – Environment." June 30. <http://tonto.eia.doe.gov/ask/environment_faqs.asp> (Accessed December 16, 2009).

(EPA, 1974) U.S. Environmental Protection Agency. "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety." EPA-550/9-74-004. <http://www.nonoise.org/library/levels74/levels74.htm> (Accessed October 5, 2009).

(EPA, 1999) U.S. Environmental Protection Agency. "Cancer Risk Coefficients for Exposure to Radionuclides: Federal Guidance Report No. 13." EPA 402-R-99-001. Prepared by Oak Ridge National Laboratory. September. <http://www.epa.gov/rpdweb00/docs/federal/402-r-99-001.pdf> (Accessed March 2, 2010).

(EPA, 2003) U.S. Environmental Protection Agency. "User's Guide to MOBILE6.1 and MOBILE6.2, Mobile Source Emission Factor Model." EPA420-R-03-010. August. <http://www.epa.gov/OMS/models/mobile6/420r03010.pdf> (Accessed December 14, 2009).

(EPA, 2004) U.S. Environmental Protection Agency. "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling—Compression-Ignition." EPA420-P-04-009. April. <http://www.epa.gov/oms/models/nonrdmdl/nonrdmdl2004/420p04009.pdf> (Accessed December 14, 2009).

(EPA, 2005) U.S. Environmental Protection Agency. "Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel." EPA420-F-05-001. February 1. ADAMS Accession No. ML120440122.

(EPA, 2009a) U.S. Environmental Protection Agency. "Preferred/Recommended Models - AERMOD Modeling System." <http://www.epa.gov/scram001/dispersion_prefrec.htm> (Accessed November 8, 2009).

(EPA, 2009b) U.S. Environmental Protection Agency. Water Discharge Permits (PCS) query on NPDES permits in New Hanover County, North Carolina. <http://www.epa.gov/enviro/html/pcs/pcs_query.html> (Accessed October 16, 2009).

(EPA, 2009c) U.S. Environmental Protection Agency. “Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2007.” EPA 430-R-09-004. April 15. <http://www.epa.gov/climatechange/emissions/downloads09/GHG2007entire_report-508.pdf> (Accessed December 14, 2009).

(EPA, 2009d) U.S. Environmental Protection Agency. “Fact Sheet - Final Rule: Effluent Guidelines for Discharges from the Construction and Development Industry.” November. <http://water.epa.gov/scitech/wastetech/guide/construction/upload/2009_11_23_guide_construction_files_c_and_d_final_rule_factsheet.pdf> (Accessed February 12, 2012).

(EPA, 2009e) U.S. Environmental Protection Agency. “AEGL Program: Hydrogen fluoride results.” <http://www.epa.gov/oppt/aegl/pubs/results53.htm> (Accessed January 10, 2010).

(EPA, 2009f) U.S. Environmental Protection Agency. “AEGL Program: Uranium hexafluoride results.” <http://www.epa.gov/oppt/aegl/pubs/results58.htm> (Accessed January 10, 2010).

(EQM, 2008) Environmental Quality Management, Inc. “Air Dispersion Modeling Report: Class II and Ambient Air Quality Standards (AAQS) Analysis, Carolina Cement Company LLC – Castle Hayne Plant.” Prepared for Carolina Cement Company LLC. February 25. <http://daq.state.nc.us/permits/psd/docs/titan/CCC_Class_II_and_AAQS_Modeling_Report.pdf> (Accessed August 24, 2009).

(ESI, 2009) Environmental Services, Inc. “Addendum Report Area E- An Intensive Cultural Resource Investigation: Potential GE Expansion New Hanover County, North Carolina.” ESI Report of Investigations No. 1126A. November.

(Faanes, 1987) Faanes, C.A. “Bird Behavior and Mortality in Relation to Power Lines in Prairie Habitats, Fish and Wildlife.” Technical Report 7. U.S. Department of the Interior, Fish and Wildlife Service.

(Floridata, 2003). Floridata. “Floridata #923 *Dionaea muscipula*.” <http://www.floridata.com/ref/D/dion_mus.cfm> (Accessed October 3, 2009).

(FWS, 2003) U.S. Fish and Wildlife Service, U.S. Department of the Interior. “Red-cockaded Woodpecker in North Carolina.” <http://www.fws.gov/nc-es/birds/rcwood.html> (Accessed June 4, 2009). Document no longer available online.

(FWS, 2008a) U.S. Fish and Wildlife Service, U.S. Department of the Interior. “Species Profile Red-cockaded Woodpecker (*Picoides borealis*).” <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B04F> (Accessed July 10, 2009).

(FWS, 2008b) Benjamin, P. Letter from P. Benjamin (U.S. Fish and Wildlife Service) to H. Wicker (U.S. Army Corps of Engineers). “Subject: Action ID # SAW-2007-00073, Carolina Cement Company (Titan America), New Hanover County, North Carolina.” August 6.

(FWS, 2009) U.S. Fish and Wildlife Service, U.S. Department of the Interior. Letter from H. Hall (U.S. Fish and Wildlife Service) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 8. “Subject: Docket No. 70-7016; General Electric-Hitachi Global Laser Enrichment Facility, New Hanover County, North Carolina.” ADAMS Accession No. ML091700024.

(FWS, 2010) U.S. Fish and Wildlife Service, U.S. Department of the Interior. Letter from H. Hall (U.S. Fish and Wildlife Service) to K. Hsueh (U.S. Nuclear Regulatory Commission) dated August 10. “Subject: Comments on the Draft Environmental Impact Statement (DEIS) for the Proposed GE-Hitachi Global Laser Enrichment (GLE) LLC Facility in Wilmington, North Carolina.” ADAMS Accession No. ML102420377.

(GLE, 2008) GE-Hitachi Global Laser Enrichment LLC. “Environmental Report for the GLE Commercial Facility, Revision 0.” December. ADAMS Accession No. ML090910573.

(GLE, 2009a) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 8. “Subject: GE-Hitachi Global Laser Enrichment Submittal of Additional Information Related to NRC Review of GLE Environmental Report.” Letter number GLEL-09-004. ADAMS Accession No. ML092110764.

(GLE, 2009b) GE-Hitachi Global Laser Enrichment LLC. “Environmental Report Supplement 1 – Early Construction.” July. ADAMS Accession No. ML092100528.

(GLE, 2009c) GE-Hitachi Global Laser Enrichment LLC. “GE-Hitachi Global Laser Enrichment LLC Commercial Facility, Wilmington, North Carolina: License Application April 2009.” April 30. ADAMS Accession No. ML091871003.

(GLE, 2009d) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 8. “Subject: GE-Hitachi Global Laser Enrichment Submittal of Additional Proprietary and Security-Related Information Related to NRC Review of GLE-Environmental Report.” ADAMS Accession No. ML092360488.

(GLE, 2009e) GE-Hitachi Global Laser Enrichment LLC. “Global Laser Enrichment Environmental Report Supplement 2.” November. ADAMS Accession No. ML093240935.

(GLE, 2009f) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 5. “Subject: GE-Hitachi Global Laser Enrichment Response to Request for Additional Information Related to NRC Review of GLE Environmental Report.” ADAMS Accession No. ML093200137.

(GLE, 2009g) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 11. “Subject: GE-Hitachi Global Laser Enrichment Response (#2) to Request for Additional Information Related to NRC Review of GLE Environmental Report.” ADAMS Accession No. ML093220060.

(GLE, 2009h) GE-Hitachi Global Laser Enrichment LLC. Letter from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to J. Davis (U.S. Nuclear Regulatory Commission) dated December 29. "Subject: Submittal of GLE Procedure for Unanticipated Discovery of Human Remains/Artifacts." ADAMS Accession No. ML093631158.

(GLE, 2011a) GE-Hitachi Global Laser Enrichment LLC. Letter from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to J. Davis (U.S. Nuclear Regulatory Commission) dated January 17. "Subject: Response to Questions from Telecon Held on January 5, 2011, Regarding the Global Laser Enrichment Environmental Report." ADAMS Accession No. ML110460567.

(GLE, 2011b) GE-Hitachi Global Laser Enrichment LLC. "GE-Hitachi Global Laser Enrichment LLC Commercial Facility, Wilmington, North Carolina: License Application November 2011." Revision 6. November 11. ADAMS Accession No. ML11326A177.

(GLE, 2011c) GE-Hitachi Global Laser Enrichment LLC. Personal communication from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to J. Davis (U.S. Nuclear Regulatory Commission) dated December 14. "Subject: Info on ATC II and Tooling Center." ADAMS Accession No. ML113480296.

(GLE, 2012) GE-Hitachi Global Laser Enrichment LLC. Personal communication from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to J. Davis (U.S. Nuclear Regulatory Commission) dated February 6. "Subject: Re: Transportation Table 4.2-1." ADAMS Accession No. ML120440072.

(GNF-A, 2007) Global Nuclear Fuel-Americas LLC. "Site Environmental Report Supplement for the Period 1995–2005." March 30. ADAMS Accession No. ML071000137.

(Greater Wilmington Business Journal, 2010) Greater Wilmington Business Journal. "NC to Give Study Funds for Wilmington Harbor Work, not NCIT." December 10. <http://www.wilmingtonbiz.com/industry_news_details.php?id=2089> (Accessed March 22, 2011).

(Hagan et al., 1996) Hagan, J.M., et al. "The Early Development of Forest Fragmentation Effects on Birds." *Conservation Biology* 10(1):188–202.

(Hanson et al., 2006) Hanson, C.E., D.A. Towers, and L.D. Meister. "Transit Noise and Vibration Impact Assessment." FTA-VA-90-1003-06. Prepared by Harris Miller Miller & Hanson Inc., for U.S. Department of Transportation. May. <http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf> (Accessed September 1, 2009).

(Hill, 2008) Hill, H. "Food Miles: Background and Marketing." ATTRA Publication IP312. National Sustainable Agriculture Information Service. <https://attra.ncat.org/attra-pub/download.php?id=281> (Accessed February 13, 2012).

(Hockin et al., 1992) Hockin, D., et al. "Examination of the Effects of Disturbance on Birds with Reference to Its Importance in Ecological Assessments." *Journal of Environmental Management* 36:253–286.

(Hubricht, 1985) Hubricht, L. "The Distributions of the Native Land Mollusks of the Eastern United States." Fieldiana Zoology New Series, No. 24, Publication 1359, Field Museum of Natural History.

(IAEA, 1992) International Atomic Energy Agency. "Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards." Technical Report No. 332.

(ICRP, 1991) International Commission on Radiological Protection. "1990 Recommendations of the International Commission on Radiological Protection." ICRP Publication 60. April.

(IDEM, 2008) Indiana Department of Environmental Management, Office of Land Quality. "Hazardous Waste Received in 2007." September 4. <http://www.in.gov/idem/files/waste_received2007.pdf> (Accessed April 29, 2009).

(IPCC, 2007) International Panel on Climate Change. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (Eds.). <http://www.ipcc.ch/ipccreports/ar4-wg1.htm> (Accessed March 2, 2010).

(Irons et al., 2000) Irons, et al. "Nine Years after the Exxon Valdez Oil Spill: Effects on Marine Bird Populations in Prince Sound, Alaska." *The Condor* 102:723–737.

(ITE, 2004) Institute of Transportation Engineers. *Trip Generation Handbook*, 2nd Edition. Institute of Transportation Engineers, Washington, D.C.

(Janss, 2000) Janss, G.F.E. "Avian Mortality from Power Lines: A Morphological Approach of Species-Specific Mortality." *Biological Conservation* 95:353–359.

(Jennings and Reganold, 1989) Jennings, M.D., and J.P. Reganold. "Local Government Policies toward Environmentally Sensitive Areas in British Columbia, Canada; Washington and Oregon, USA." *Environmental Management* 13(4):443–453.

(Jordan, 1998) Jordan, R.A. "Species Profile: Southern Hognose Snake (*Heterodon simus*) on Military Installations in the Southeastern United States." Technical Report SERDP-98-4, U.S. Army Corps of Engineers. March. <http://el.erdc.usace.army.mil/tes/pdfs/serdp984.pdf> (Accessed January 29, 2010).

(Journal of Commerce, 2010) Journal of Commerce. "NC Ports Shelve Container Terminal Plan." July 22. <http://www.joc.com/maritime/north-carolina-ports-shelve-planned-container-terminal> (Accessed March 22, 2011).

(Knight and Cole, 1991) Knight, R.L., and D.N. Cole. "Effects of Recreational Activity on Wildlife in Wildlands." In *Transactions of the Fifty-sixth North American Wildlife and Natural Resources Conference*, March 17–22, 1991. R.E. McCabe (Ed.). Wildlife Management Institute.

(LeBlond and Grant, 2003) LeBlond, R.J., and G.S. Grant. "Natural Area Inventory of New Hanover County, North Carolina." Department of Environment and Natural Resources, Office of Conservation and Community Affairs, North Carolina Natural Heritage Program. May. <http://digital.ncdcr.gov/cdm4/document.php?CISOROOT=/p249901coll22&CISOPTR=192104&REC=4> (Accessed January 29, 2010).

(Lewis et al., 2008) Lewis, D.E., et al. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2007." NUREG-0713, Volume 29. U.S. Nuclear Regulatory Commission. December. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0713 (Accessed March 2, 2010).

(MIG, 2009) Minnesota IMPLAN Group Inc. "2009 State Data Files." Stillwater, Minn.

(MRI, 1996) Midwest Research Institute. "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report." Prepared for South Coast AQMD. March 29.

(Napier, 2007) Napier, B.A. "GENII Version 2 Users' Guide." PNNL-14583, Rev. 2. Prepared by Pacific Northwest National Laboratory for U.S. Environmental Protection Agency. March.

(Napier et al., 2007) Napier, B.A., et al. "GENII Version 2. Software Design Document." PNNL-14584, Rev. 2. Prepared by Pacific Northwest National Laboratory for U.S. Environmental Protection Agency. March.

(NatureServe, 2009) NatureServe. "NatureServe Explorer: An Online Encyclopedia of Life." Version 7.1. <http://www.natureserve.org/explorer> (Accessed September 21, 2009).

(NCDCR, 2009) North Carolina Department of Cultural Resources, State Historic Preservation Office. Letter from P. Sandbeck (State Historic Preservation Office) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 2. "Re: Initiation of the National Historic Preservation Act Section 106 Process for General Electric-Hitachi Global Laser Enrichment Proposed Uranium Enrichment Facility, New Hanover County, ER 07-2157." ADAMS Accession No. ML091630258.

(NCDCR, 2010) North Carolina Department of Cultural Resources, State Historic Preservation Office. Personal communication from R. Gledhill-Earley (State Historic Preservation Office) to J. Davis (U.S. Nuclear Regulatory Commission) dated February 23. "Subject: Inadvertent Discovery Procedure." ADAMS Accession No. ML120240765.

(NCDCR, 2011) North Carolina Department of Cultural Resources, State Historic Preservation Office. Letter from R. Gledhill-Earley (State Historic Preservation Office) to K. Hsueh (U.S. Nuclear Regulatory Commission) dated April 5. "Re: General Electric-Hitachi Laser-Based Uranium Enrichment Facility near Wilmington, Docket 70-7016, New Hanover County, ER 07-2157." ADAMS Accession No. ML110950680.

(NCDENR, 2001) North Carolina Department of Environment and Natural Resources. North Carolina Natural Heritage Program, Division of Parks and Recreation, "Guide to Federally Listed Endangered and Threatened Species of North Carolina." <http://www.ncnhp.org/Pages/guide.htm> (Accessed March 2, 2010).

(NCDENR, 2007) North Carolina Department of Environment and Natural Resources, Division of Water Quality. "Stormwater Best Management Practices Manual." <http://www.lenoirnc.govoffice2.com/vertical/Sites/%7B916BA528-4D3A-4AF2-9B92-9AC1C284EA52%7D/uploads/%7B89C8F254-2353-49D2-9787-A6C91C23D2E9%7D.PDF> (Accessed February 13, 2012).

(NCDENR, 2008) North Carolina Department of Environment and Natural Resources. Letter from F. Rohde (North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries) to H. Wicker (U.S. Army Corps of Engineers) dated August 8. "Subject: ID#SAW-2007-00073, Carolina Cement Company (Titan America)."

(NCDENR, 2009a) North Carolina Department of Environment and Natural Resources. "North Carolina Solid Waste Management Annual Report, July 1, 2007 – June 30, 2008." January. <http://portal.ncdenr.org/web/wm/sw/swmar?p_p_id=110_INSTANCE_V4fV&p_p_lifecycle=0&p_p_state=maximized&p_p_mode=view&p_p_col_id=column-3&p_p_col_count=1&_110_INSTANCE_V4fV_struts_action=%2Fdocument_library_display%2Fview&_110_INSTANCE_V4fV_folderId=4649254> (Accessed February 8, 2012).

(NCDENR, 2009b) Department of Environment and Natural Resources, Division of Water Quality. "General Permit NCG 010000 To Discharge Stormwater under the National Pollutant Discharge Elimination System for Construction Activities." December 29. <http://h2o.enr.state.nc.us/su/documents/NCG01_FinalSignedPermit.pdf> Accessed January 13, 2010).

(NCDENR, 2009c). North Carolina Department of Environment and Natural Resources, North Carolina Natural Heritage Program, Office of Conservation and Community Affairs. "North Carolina Heritage Program Virtual Workroom." <http://nhpweb.enr.state.nc.us/nhis/public/gmap75_main.phtml> (Accessed June 23 and October 1, 2009) Document no longer available online.

(NCDENR, 2010) North Carolina Department of Environment and Natural Resources, Division of Air Quality. "Large Diesel and All Dual-Fuel Engines Emissions Calculator (LGD2009 Revision A)." <http://daq.state.nc.us/cgi-bin/permit_forms.cgi?id=intlarge&type=sheets> (Accessed January 19, 2010).

(NCOSBM, 2009) North Carolina Office of State Budget and Management. "Population Estimates and Projections." <http://demog.state.nc.us> (Accessed September 1, 2009).

(NCRP, 2009) National Council on Radiation Protection and Measurements. "Exposure of the Population in the United States and Canada from Natural Background Radiation." Report No. 94. August.

(NCSCHS, 2009) North Carolina State Center for Health Statistics. "NC-CATCH – North Carolina Comprehensive Assessment for Tracking Community Health." <http://www.schs.State.nc.us/SCHS/catch/> (Accessed June 2009).

(Nero, 1979) Nero, A.V., Jr. *A Guidebook to Nuclear Reactors*. University of California Press. Berkeley, California.

(New Hanover County, 2006) New Hanover County. “New Hanover County Flood Damage Prevention Ordinance.” Adopted by the New Hanover County Board of County Commissioners June 5, 2006. <http://www.nhcgov.com/Documents/Floodplain%20Ordinance.pdf> (Accessed November 18, 2009).

(New Hanover County, 2007) New Hanover County. “County Code of Ordinances, Chapter 23, Environment, Article VI: Erosion and Sedimentation Control.” <http://www.municode.com/resources/gateway.asp?pid=11337&sid=33> (Accessed October 16, 2009).

(New Hanover County, 2009a) New Hanover County Planning Department. Letter from C. O’Keefe (New Hanover Planning Department) to A. Kock (U.S. Nuclear Regulatory Commission). “Subject: Request for Information Regarding Land Use in the Vicinity of the Proposed General Electric-Hitachi Global Laser Enrichment Facility.” Document is undated. ADAMS Accession No. ML092360197.

(New Hanover County, 2009b) New Hanover County. “County Code of Ordinances, Chapter 23, Environment, Article II, Noise.” <http://www.municode.com/resources/gateway.asp?pid=11337&sid=33> (Accessed April 7, 2009).

(New Hanover County, 2009c) New Hanover County. “County Code of Ordinances, Chapter 23, Environment, Article VII, Stormwater Management.” <http://www.municode.com/resources/gateway.asp?pid=11337&sid=33> (Accessed October 15, 2009).

(Newcombe and MacDonald, 1991) Newcombe, C.P., and D.D. MacDonald. “Effects of Suspended Sediments on Aquatic Ecosystems.” *North American Journal of Fisheries Management* 11: 72–82.

(NextGenerationEarth, 2009) NextGenerationEarth. “U.S. State Impacts to Climate Change.” <http://www.nextgenerationearth.org/usstates/statelist/> (Accessed December 14, 2009). Document no longer available online.

(NOAA, 2002) National Oceanic and Atmospheric Administration. “Reasor Chemical Company.” <http://archive.orr.noaa.gov/book_shelf/257_reasor.pdf> (Accessed February 8, 2012).

(NRC, 1977) U.S. Nuclear Regulatory Commission. “Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes.” NUREG-0170. December.

(NRC, 1990) U.S. Nuclear Regulatory Commission. “Control Room Habitability System Review Models.” NUREG/CR-5659. December. <http://www.osti.gov/bridge/servlets/purl/6156999-0o2iC4/6156999.pdf> (Accessed January 29, 2010).

(NRC, 1991) U.S. Nuclear Regulatory Commission. “Chemical Toxicity of Uranium Hexafluoride Compared to Acute Effects of Radiation.” NUREG-1391. February. ADAMS Accession No. ML072610185.

(NRC, 1998) U.S. Nuclear Regulatory Commission. "Nuclear Fuel Cycle Facility Accident Analysis Handbook." NUREG/CR-6410. March. ADAMS Accession No. ML072000468.

(NRC, 2001) U.S. Nuclear Regulatory Commission. "RASCAL 3.0: Description of Models and Methods." NUREG-1741. March. ADAMS Accession No. ML010940218.

(NRC, 2005a) U.S. Nuclear Regulatory Commission. "Environmental Impact Statement on the Construction and Operation of a Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina." NUREG-1767. January. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1767> (Accessed March 3, 2010).

(NRC, 2005b) U.S. Nuclear Regulatory Commission. "Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico." NUREG-1790. June. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/> (Accessed March 26, 2009).

(NRC, 2006) U.S. Nuclear Regulatory Commission. "Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio, Final Report." NUREG-1834. April. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/> (Accessed March 26, 2009).

(NRC, 2009a) U.S. Nuclear Regulatory Commission. Letter from D.H. Dorman (U.S. Nuclear Regulatory Commission) to A.E. Kennedy (GE-Hitachi Global Laser Enrichment LLC) dated May 8. "Subject: Approval of GE-Hitachi Exemption Request Related to Commencement of Construction." ADAMS Accession No. ML083510647.

(NRC, 2009b) U.S. Nuclear Regulatory Commission. "Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM-1097 for Global Nuclear Fuel-Americas, Wilmington Fuel Fabrication Facility," Docket No. 70-1113. May 14. ADAMS Accession No. ML091180239.

(NRC, 2009c) U.S. Nuclear Regulatory Commission. "Fact Sheet: Depleted Uranium and Other Waste Disposal." August. <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-du-other-waste-disposal.pdf> (Accessed December 16, 2009).

(NRC, 2010) U.S. Nuclear Regulatory Commission. Letter from M. Bartlett (U.S. Nuclear Regulatory Commission) to J.J. Miller (International Isotopes, Inc.) dated February 23. "Subject: License Application for International Isotopes Fluorine Products, Inc. Facility – Acceptance Review (TAC No's. L32739 and L32740)." ADAMS Accession No. ML100480302.

(NRC, 2011) U.S. Nuclear Regulatory Commission. "Environmental Impact Statement for the Proposed Eagle Rock Enrichment Facility in Bonneville County, Idaho, Final Report." NUREG-1945. February. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1945/> (Accessed March 3, 2011).

(NWCC, 2002) National Wind Coordinating Committee. *Permitting of Wind Energy Facilities: A Handbook*. Prepared by the NWCC Siting Subcommittee. August. <http://www.nationalwind.org/assets/publications/permitting2002.pdf> (Accessed September 16, 2011).

(Ozier et al., 1999) Ozier, J.C., J.L. Bohannon, and J.L. Anderson. “Protected Animals of Georgia.” Georgia Department of Natural Resources, Wildlife Resources Division, Nongame Wildlife-Natural Heritage Section.

(Patrick et al., 1995) Patrick, T.S., J.R. Allison, and G.A. Krakow. “Protected Plants of Georgia, An Information Manual on Plants Designated by the State of Georgia as Endangered, Threatened, Rare, or Unusual.” Georgia Department of Natural Resources, Wildlife Resources Division.

(Peterson et al., 2007) Peterson, T., et al. “Final North Carolina Greenhouse Gas Inventory and Reference Case Projections 1990-2020.” North Carolina Department of Environment and Natural Resources and Center for Climate Strategies. September. <http://daq.state.nc.us/news/leg/ghg_dft_inv_10102005.pdf> (Accessed December 8, 2009).

(Policastro, 1997) Policastro, A.J., et al. “Facility Accident Impact Analyses in Support of the Depleted UF_6 Programmatic Environmental Impact Statement.” Environmental Assessment Division, Argonne National Laboratory. June.

(Reed et al., 1996) Reed, R.A., J. Johnson-Barnard, and W.A. Baker. “Contribution of Roads to Forest Fragmentation in the Rocky Mountains.” *Conservation Biology* 10(4):1098–1106.

(Rosnick, 2007) Rosnick, R. “CAP88-PC Version 3.0 User Guide.” December 9. <http://www.epa.gov/rpdweb00/docs/cap88/userguide_120907.pdf> (Accessed January 29, 2010).

(SME, 1992) Society for Mining, Metallurgy, and Exploration, Inc. “SME Mining Engineering Handbook,” 2nd Edition, Volume 2. H.L. Harman (Ed.). Society for Mining, Metallurgy, and Exploration, Inc., Littleton, Colorado.

(Star News Online, 2008) Star News Online. “A Look at the Preliminary Plan for the Proposed North Carolina International Terminal.” August. <http://www.starnewsonline.com/assets/pdf/WM12788827.PDF> (Accessed March 22, 2011).

(Thelander and Rugge, 2000) Thelander, C.G., and L. Rugge. “Bird Risk Behaviors and Fatalities at the Altamont Wind Resource Area.” In *Proceedings of NWCC National Avian-Wind Power Planning Meeting III.* May 1998.

(Thompson, 1978) Thompson, L.S. “Transmission Line Wire Strikes: Mitigation through Engineering Design and Habitat Modification.” In *Impacts of Transmission Lines on Birds in Flight: Proceedings of a Conference*, January 31–February 2, 1978, ORAU-142, Oak Ridge Associated Universities.

(Trombulak and Frissell, 2000) Trombulak, S.C., and C.A. Frissell. “Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities.” *Conservation Biology* 14(1):18–30.

(UDRC, 2009) Utah Division of Radiation Control. “Utah Department of Environmental Quality Division of Radiation Control Radioactive Material License, License Number: UT 2300478, Amendment #6.” <http://www.deq.utah.gov/businesses/energysolutions/docs/2012/Feb/RML%20UT2300478%20Amendment%207.PDF> (Accessed February 12, 2012).

(USDA, 2012) U.S. Department of Agriculture. Web Soil Survey (Web site). <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx> (Accessed February 13, 2012).

(USMC, 2009) U.S. Marine Corps. "Final Environmental Impact Statement U.S. Marine Corps Grow the Force at MCB Camp Lejeune, MCAS New River, and MCAS Cherry Point, North Carolina." December. <http://www.lejeune.usmc.mil/emd/FINAL_GTF_EIS_Vol_1.pdf> (Accessed February 12, 2012).

(Weakley, 2008) Weakley, A.S. "Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas." Working draft of April 7, 2008. <http://www.herbarium.unc.edu/WeakleyFlora_2008-Apr.pdf> (Accessed October 3, 2009).

(WHO, 2007) World Health Organization. "Extremely Low Frequency Fields." *Environmental Health Criteria* 238. June. <http://www.who.int/entity/peh-emf/publications/Complet_DEC_2007.pdf> (Accessed November 15, 2010).

(Williams, 1990) Williams, R.D., 1990, "Bobcat Electrocutions on Powerlines." *California Fish and Game* 76(3):187–189.

(Yu et al., 2001) Yu, C., et al. "User's Manual for RESRAD Version 6." ANL/EAD/04. Argonne National Laboratory. July. <http://web.ead.anl.gov/resrad/documents/resrad6.pdf> (Accessed October 29, 2009).

(Yu et al., 2003) Yu, C., et al. "User's Manual for RESRAD-BUILD Version 3." ANL/EAD/03-1. Argonne National Laboratory. June. <http://web.ead.anl.gov/resrad/documents/ANL-EAD-03-1.pdf> (Accessed October 29, 2009).

5 MITIGATION

This chapter addresses potential means to mitigate adverse environmental impacts from the proposed action as required by Appendix A of Title 10, Part 51, of the U.S. *Code of Federal Regulations* (10 CFR Part 51). Under Council on Environmental Quality regulation 40 CFR 1500.2(f), Federal agencies shall, to the fullest extent possible, “use all practicable means consistent with the requirements of the *National Environmental Policy Act* (NEPA) and other essential considerations of national policy to restore and enhance the quality of the human environment and avoid or minimize any possible adverse effects of their actions on the quality of the human environment.” The Council on Environmental Quality regulations defines mitigation to include activities that (1) avoid the impact altogether by not taking a certain action or parts of an action; (2) minimize impacts by limiting the degree or magnitude of the action and its implementation; (3) repair, rehabilitate, or restore the affected environment; (4) reduce or eliminate impacts over time by preservation or maintenance operations during the life of the action; or (5) compensate for the impact by replacing or substituting resources or environments. This definition has been used in identifying potential mitigation measures. As such, mitigation measures are those actions or processes (e.g., process controls and management plans) that would be implemented to control and minimize potential adverse impacts from construction, operation, and decommissioning activities for the proposed Global Laser Enrichment (GLE) Facility.

General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) must comply with applicable laws and regulations, including obtaining all appropriate construction and operating permits. A complete discussion of applicable laws and regulations is included in Chapter 1 of this Environmental Impact Statement (EIS). The mitigation measures proposed by GLE, many of which are compliance related, are discussed in Section 5.1 (GLE, 2008).

Based on the potential impacts identified in Chapter 4 of this EIS, the U.S. Nuclear Regulatory Commission (NRC) staff has identified additional potential mitigation for the proposed GLE Facility. These mitigation measures are described in Section 5.2.

The proposed mitigation measures provided in this chapter do not include environmental monitoring activities. Environmental monitoring activities are described in Chapter 6 of this EIS.

5.1 Mitigation Measures Proposed by GLE

GLE identified mitigation measures in its Environmental Report (GLE, 2008) that would reduce the environmental impacts associated with preconstruction activities and the proposed action. Table 5-1 lists the mitigation measures proposed for each impact area. Because many of GLE’s proposed mitigation measures apply to preconstruction and construction activities as well as facility operation, they are listed together in the table.

5.2 Potential Mitigation Measures Identified by NRC

The NRC reviewed the mitigation measures proposed by GLE and finds that these measures are sufficiently protective of human health and the environment. The NRC identified additional mitigation measures as recommendations (Table 5-2). While the NRC cannot impose mitigation outside its regulatory authority under the *Atomic Energy Act*, these additional mitigation measures in Table 5-2 could potentially reduce the impacts of the proposed action. These

Table 5-1 Summary of Mitigation Measures Proposed by GLE

Impact Area	Activity	Proposed Mitigation Measures
Land Use	Land disturbance	Use existing service road routes and utility rights-of-way (ROWs) to the fullest extent practicable to minimize the need for clearing additional wooded areas. Use existing wastewater treatment and solid waste management infrastructure to the fullest extent practicable to reduce the total area needed for construction and operation of the proposed facility.
Historic and Cultural Resources	Disturbance of prehistoric archaeological sites eligible for listing on the *National Register of Historic Places*	To prevent disturbance of site 31NH801, maintain conditions of the bank at the side of the existing gravel road unchanged from its current graded and vegetated state. Signs are posted to prevent unauthorized excavation.
Visual and Scenic Resources	Potential visual intrusions in the existing landscape character	Locate the proposed facility in a sector of the Wilmington Site away from site boundaries bordering existing development along NC 133 and I-140. To the fullest width practicable, maintain the existing tree buffer along the northeast Wilmington Site boundary to limit visibility of the proposed facility structures and access road traffic from offsite viewpoints in nearby residential neighborhoods. Use exterior building colors and landscaping that would soften the visual impact of the proposed facility.
Air Quality	Fugitive dust, construction equipment, and facility operation emissions	Water the facility site and unpaved roads to reduce dust. Remove dirt from truck tires by driving over a gravel pad prior to leaving the facility site or unpaved access road to avoid spreading sediments on paved roads. Cover trucks carrying soil and debris to reduce dust emissions from the back of trucks driving on roadways. Pave access road and parking lots as soon as practicable. Conduct uranium-enrichment operations inside an enclosed building using a closed-system process with no routine venting of process gases. Install and operate leak-detection monitors for process equipment. In the event a leak is detected due to an equipment component malfunction or other reason, safety interlocks will isolate the section of the process where the leak is detected, limiting the potential quantity of gaseous material that could be released inside the proposed facility operations building.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Air Quality (Cont.)	Fugitive dust, construction equipment, and facility operation emissions (Cont.)	Maintain process areas inside the operations building under continuous negative pressure relative to atmospheric pressure. In the event of a gaseous release in one of these process areas, the negative pressure conditions would prevent outflow of the air from the process areas, effectively containing the released gaseous material to the affected process area. Ventilate the operations building with a high-efficiency, multi-stage air emissions control system. Components of the air emissions control system planned for the operations building consist of high-efficiency particulate arresting (HEPA) filters for removal of solid particulate matter and activated carbon beds for adsorption of hydrogen fluoride (HF). Exhaust gases from this emission-control system would be vented to the atmosphere through a single stack. Implement a periodic inspection and maintenance program for uranium hexafluoride (UF_6) cylinders stored in outdoor areas. Burn low-sulfur fuel oil in the auxiliary diesel generators. Store organic solvents, paints, and other volatile organic compound–containing liquids in containers covered with tightly fitting lids.
Geology and Soil Resources	Soil disturbance and contamination	Minimize the construction footprint to the extent possible. Engineer design plans that minimize soil disturbance during construction activities. If additional soil is necessary for construction purposes, use soils from onsite borrow pits that are accessible via existing roadbeds, to minimize disturbance to other areas of the Wilmington Site outside of the GLE study area. Manage construction activities so that only designated areas within the GLE study area are disturbed and so that no heavy equipment or construction operations are allowed to affect areas outside the study area unless specifically designated, such as potential use of existing onsite borrow areas. Use adequate containment methods during excavation and/or similar operations.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Geology and Soil Resources (Cont.)	Soil disturbance and contamination (Cont.)	Use site-stabilization practices (i.e., placing crushed stone on top of disturbed soil in areas of concentrated runoff).
		Use silt berms, dikes, and sediment fences.
		Stabilize drainage culverts and ditches by lining surface with rock aggregate/rip-rap to reduce flow velocity and prohibit scouring.
		Reuse and/or appropriately place excavated materials to decrease exposed soil piles.
		Place gravel construction pads at the entrances/exits of construction acres.
		Stabilize site with low-maintenance landscaping and pavement.
Surface Water Resources	Runoff	Follow proper construction Best Management Practices (BMPs) as specified by the *New Hanover County Erosion and Sedimentation Control Ordinance* (New Hanover County, 2007).
		Construct an access road perpendicular to Unnamed Tributary #1 to minimize the area impacted.
		Design and construct the upgrade of the crossing over Unnamed Tributary #1 following procedures required by the *New Hanover County Flood Damage Prevention Ordinance* (New Hanover County, 2006).
		Construct a stormwater wet detention basin and implement a Wilmington Site stormwater management plan to mitigate a portion of the increased floodwaters from extreme storm events and all stormwater from smaller storm events.
		Limit cut/fill slopes to a horizontal-vertical ratio of 3:1 or less.
		Use silt fencing and covering of soil stockpiles to prevent sediment runoff.
		Suspend general construction activities during storms and impending precipitation.
		Construct stream crossings (i.e., installation of culverts) following at least 48 hours of dry weather.
		Divert stream flow during stream-crossing construction to minimize excavation in flowing water.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Surface Water Resources (Cont.)	Runoff (Cont.)	Maintain construction equipment so that equipment is in good repair and without visible leaks of oil, greases, or hydraulic fluids. Restore disturbed areas to original surface elevations, where possible. Comply with all National Pollutant Discharge Elimination System (NPDES) stormwater and wastewater permit requirements. Route stormwater from the proposed facility to a new stormwater wet detention basin, designed in accordance with the North Carolina Department of Environment and Natural Resources (NCDENR) *Stormwater Best Management Practices Manual* (NCDENR, 2007). Perform onsite treatment of process and sanitary wastewaters to NPDES-permit limits before discharge to receiving waters. Routinely monitor and inspect onsite liquid waste storage tanks and containers to detect any leaks or releases to the environment due to equipment malfunctions to ensure that actions according to the Spill Prevention Control and Countermeasure (SPCC) plan or other appropriate corrective action can be taken promptly. Discharge stormwater runoff from UF_6 storage pads area to a holding pond for monitoring prior to discharge to the stormwater wet detention basin. Perform periodic visual inspections of the stormwater wet detention basin to verify proper function, at a frequency sufficient to allow for identification of basin high-water-level conditions and implementation of corrective actions to restore the water level prior to overflow. Ensure easy access to the stormwater wet detention basin to allow the prompt, systematic sampling of runoff.
Floodplains	Floodplain disturbance	Select a non-wetland, non-floodplain area for the proposed facility.
Groundwater Resources	Infiltration	Implement hazardous material and waste-handling procedures and secondary containment, as required by applicable laws and regulations.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Groundwater Resources (Cont.)	Water use	Provide water necessary during construction via tanker truck from off-site potable water sources.
		Reuse treated sanitary wastewater effluent as makeup water in Wilmington Site cooling towers.
		Routinely monitor sitewide groundwater levels, and continue to analyze the groundwater monitoring-well and pumping-well networks to confirm that changes in groundwater levels associated with the proposed action are minimal.
		Readjust pumping well rates and/or perform well maintenance or rehabilitation, as appropriate, in the event of unexpected changes in groundwater levels.
		Use low-water-consumption landscaping.
		Install low-flow toilets, sinks, and showers.
		Perform localized floor washing using mops and self-contained cleaning machines to reduce water usage compared to conventional washing techniques.
Ecological Resources	Disturbance of habitats	Minimize the construction footprint to the extent possible and limit habitat disruption.
		Perform surveys of trees greater than 61 centimeters (24 inches) in diameter before beginning preconstruction and construction activities, and plant one 61-centimeter (24-inch) diameter tree, two 30.5-centimeter (12-inch) diameter trees, or three 20.3-centimeter (8-inch) diameter trees elsewhere on the Wilmington Site.
		Restrict preconstruction activities and the harvesting of trees to periods when the ground is dry.
		If trenches are necessary, ensure that they are closed overnight; inspect trenches left open overnight and remove animals prior to backfilling. Place escape ramps in trenches at less than 45-degree angles to provide exit strategies for animals.
		Sod, seed, and/or landscape disturbed areas of the study area in accordance with the Sediment and Erosion Control Permit.
		Install animal-friendly fencing around the proposed facility site so that wildlife cannot be injured by or entangled in the site's security fence.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Ecological Resources (Cont.)	Disturbance of habitats (Cont.)	Plant native plant species (i.e., not invasive species) to revegetate disturbed areas and for landscaping.
		Use nectar- and berry-producing plants for landscaping plants.
		Conduct site-stabilization practices to reduce the potential for erosion and sedimentation.
		Place bluebird boxes throughout the study area.
		Establish food plots along roadways and under power lines.
		Consider the recommendations of appropriate State and Federal agencies, including the U.S. Fish and Wildlife Service (FWS) and NCDENR.
	Wetland disturbance	Select a non-wetland, non-floodplain area for the proposed facility.
		Use existing service road routes and utility ROWs to the fullest extent practicable to minimize the need for additional wetlands crossings.
		Construct access road perpendicular to wetland to minimize the area impacted.
		Limit cut/fill slopes to a horizontal-vertical ratio of 3:1 or less.
		Avoid temporary storage of materials in wetlands during construction.
		Maintain the hydrological connectivity of wetlands to surface waters.
		Place fencing/barriers and use signs around wetland areas.
		Use silt fencing and cover soil stockpiles to prevent sediment runoff.
		Restore disturbed areas to original surface elevations.
		Revegetate disturbed areas with native plant species.
Noise	Exposure of workers and the public to noise	Prohibit heavy truck and earth-moving equipment usage after twilight and during early morning hours.
		Equip construction equipment with the manufacturer’s noise-control devices, and maintain these devices in effective operating condition.
		When possible, use quiet equipment or methods to minimize noise emissions.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Noise (Cont.)	Exposure of workers and the public to noise (Cont.)	For equipment with internal combustion engines, operate equipment at the lowest operating speed to minimize noise emissions, when possible and practical. Close engine-housing doors during operation of equipment to reduce noise emissions from the engine. Avoid equipment engine idling. Use quieter, less-tonal devices that comply with all applicable safety restrictions (e.g., Occupational Safety and Health Administration [OSHA] standards) on back-up alarms for construction equipment. Use a quieter, high-efficiency transformer to mitigate noise from the proposed electrical substation.
Transportation	Traffic volume	Locate the proposed facility near an interstate highway interchange to minimize the distance that truck traffic must travel on local surface streets and to facilitate employee commuter traffic. Increase the number of entry gates onto the Wilmington Site from NC 133 (Castle Hayne Road), including one dedicated to worker entrance/exit. Add roadway improvements (e.g., a turn lane) to NC 133 as required by the North Carolina Department of Transportation (NCDOT) for issuance of a driveway permit for connections of the new entrance. Work with NCDOT to evaluate driveway- and roadway-improvement options to minimize impacts. Schedule worker shift intervals so that shift start and end times are staggered from peak periods of worker-commuting traffic for existing site facilities and other planned operations. Promote carpooling among construction and operations workers to help reduce congestion by minimizing the additional number of vehicle trips necessary during peak commuting periods. Route truck shipments of radioactive materials around cities by using a U.S. Interstate Highway System bypass or beltway (when available). Schedule truck deliveries and shipments for off-peak traffic periods to reduce potential congestion on local roadways during peak worker commuting periods.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Public and Occupational Health	Facility operation	Install a building ventilation system to maintain the majority of the interior of the process building under sub-atmospheric pressure. Install alarms in the Emergency Control Center to detect, alarm, and/or activate the automatic safe shutdown of process equipment in the event of operational problems. Isolate leaks and shut down process lines to prevent damage to equipment. Vent exhaust gases from the emission control system to the atmosphere through a single rooftop stack. Install radiation monitors in effluent stacks to detect, alarm, and activate the automatic safe shutdown of process equipment, should contaminants be detected in the system exhaust. Comply with all applicable State, NRC, and OSHA regulations concerning worker health and safety, as well as the existing Wilmington Site Nuclear Safety Program and the Industrial Safety Program. Comply with the Site Radiation Protection Program, the SPCC plan, and the GLE Environmental, Health, and Safety Program. Conduct routine radiological surveys to characterize and minimize potential radiological exposure. Monitor all radiation workers via the use of dosimeters and area air sampling to ensure that radiological doses remain within regulatory limits and As Low As Reasonably Achievable (ALARA). Conduct operations activities involving hazardous respirable effluents with ventilation control and/or respiratory protection, as required. Use personal protective equipment based on the nature of the work and chemical and/or radiological hazards present. Perform environmental monitoring and sampling to ensure compliance with regulatory discharge limits. Route treated process wastewater effluents to the existing final process lagoon facility for additional treatment.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Waste Management	Generation of industrial, hazardous, radiological, and mixed wastes (air emissions are addressed under Air Quality and liquid emissions are addressed under Groundwater and Surface Water Resources)	Select the laser enrichment process to reduce the amount of waste generated for production of the same amount of enriched product. Minimize the quantities of waste generated by the proposed facility by implementing the *Waste Minimization Plan*. Perform an integrated safety analysis (ISA) for each onsite waste storage area to identify and prevent accidental releases to the environment. Monitor and inspect onsite liquid waste storage tanks and containers on a periodic schedule to detect leaks or releases to the environment due to equipment malfunctions so that actions identified in the SPCC plan or other appropriate corrective action can be taken promptly. Use the existing Wilmington Site onsite wastewater treatment facilities within current regulatory permit limits to avoid the need to add new onsite waste treatment and disposal facilities for the proposed facility. Pre-treat radioactive liquid wastewaters in a treatment system planned for the proposed facility before the wastewater effluent is pumped to the existing NPDES-permitted final process lagoon facility for further treatment. Ship each waste generated by the proposed facility that requires offsite storage, treatment, or disposal to a licensed facility (as appropriate for the waste type) in compliance with U.S. Environmental Protection Agency (EPA) and NRC requirements. Minimize onsite storage volumes and times and ship waste destined for offsite treatment and disposal facilities as soon as practicable. Conduct onsite treatment of process and sanitary wastewaters to NPDES permit limits before discharge to receiving waters.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Waste Management (Cont.)	Generation of industrial, hazardous, radiological, and mixed wastes (Cont.)	Avoid and minimize potential hazardous and radiological waste impacts from the UF_6 storage pads by implementing design elements and safety procedures during operation, including: – Use of a storage array that permits easy visual inspection (stacked no more than two cylinders high); – Segregation of storage pad areas from the rest of the enrichment facility by barriers (e.g., vehicle guardrails); – Inspection of cylinders for external contamination (i.e., a "wipe test") prior to placing on the storage pads or transporting them offsite; – Ensuring that UF_6 cylinders are not equipped with defective valves; – Allowing only designated vehicles with a limited amount of fuel in the storage pad area; – Allowing only trained and qualified personnel to operate vehicles in the storage pad area; and – Monitoring the holding pond that collects stormwater from the cylinder pads. Inspect cylinders of UF_6 initially prior to placing a filled cylinder on a storage pad and, thereafter, inspect periodically for damage or surface coating defects. Inspection criteria would include ensuring that: – Lifting points are free from distortion and cracking; – Cylinder skirts and stiffener rings are free from distortion and cracking; – Cylinder surfaces are free from bulges, dents, gouges, cracks, or significant corrosion; – Cylinder valves are fitted with the correct protector and cap; – Cylinder valves are straight and not distorted, two to six threads are visible, and the square head of the valve stem is undamaged; and – Cylinder plugs are undamaged and not leaking.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Waste Management (Cont.)	Generation of industrial, hazardous, radiological, and mixed wastes (Cont.)	If inspections of a cylinder reveal significant deterioration or other conditions that may affect its safe use, transfer the contents of the cylinder to another cylinder and discard the defective cylinder. Investigate the cause of any significant deterioration, and if necessary, perform additional inspection of cylinders. Conduct continuous or periodic monitoring of waste management processes and storage facilities for the detection of non-intentional releases to the environment, so that corrective actions would be taken to minimize adverse impacts on the environment. For example, directing stormwater runoff from the UF_6 storage pads to a holding pond, where it would be monitored to ensure that unexpected radioactive material releases to the wet detention basin did not occur.
Accidents	Accident prevention and consequence management	Incorporate the following features into facility design to mitigate fire and explosion accidents: – Fire alarm and detection systems, including suppression capability; – Fire barriers to prevent propagation of fire in and out of areas containing uranic material; – System and component design features that isolate combustible material and/or shut down affected systems; – Continuous detection of a flammable gas in the laser systems, for automatic isolation in the event of high readings; – Structural design features that ensure peak explosive blast loads and eliminate or minimize propagation of structural material into a UF_6 process or handling area; and – Limit combustibles in outside areas where cylinders are stored.

Table 5-1 Summary of Mitigation Measures Proposed by GLE (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Accidents (Cont.)	Accident prevention and consequence management (Cont.)	Incorporate the following features into facility design and operating procedures to mitigate criticality accidents, and to contain UF_6 gas within specified building areas and attenuate any release to the environment: – Maintain safe geometry of all vessels, containers, and equipment containing fissile material and ensure that the concentration and/or mass of fissile material is limited to a specified amount; – Install radiation detection and criticality monitoring systems to quickly alert personnel and isolate systems when parameters exceed expected limits; – Physically separate areas within the facility to prevent or reduce exposure; – Control positive or negative air pressures within designated areas to prevent or maintain leakage between facility areas; – Install carbon adsorbers, HEPA filters, and, where necessary, automatic trips for ventilation systems to help minimize the potential for a release outside the affected area; and – Implement appropriate door and building design features to limit leakage paths to the outside environment.

NRC-recommended measures are not requirements being imposed upon GLE. For the purposes of NEPA per 10 CFR 51.71(d) and 51.80(a), the NRC is disclosing measures that could potentially reduce or avoid environmental impacts of the proposed action.

No additional mitigation measures were identified for the resource areas of:

- Transportation
- Waste Management
- Accidents
- Decontamination and Decommissioning
- Socioeconomics
- Environmental Justice

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC

Impact Area	Activity	Proposed Mitigation Measures
Land Use	Land disturbance	Construction BMPs required under the New Hanover County Soil Erosion and Sedimentation Ordinance are listed under Geology and Soil. Following those measures would help moderate the short-term land use effects associated with preconstruction and construction activities. Use BMPs to control waste disposal, erosion, and runoff to help restrict the effect of facility operation on surrounding land use.
Historic and Cultural Resources	Disturbance of prehistoric archaeological sites and sites eligible for listing on the *National Register of Historic Places*	Follow internal procedural guidance for unexpected archaeological discoveries, including the unexpected discovery of human remains. The procedures include notification of certain local and State agency representatives, including the State Archaeologist. Consider the effect of facility activities on historic and cultural resources, as required by the license condition (which would be applicable if the license is granted).
Visual and Scenic Resources	Potential visual intrusions in the existing landscape character	Plant additional vegetation on the perimeter of the facility site to help screen the study area.
Air Quality	Fugitive dust, construction equipment, and facility operation emissions	Post speed limits (e.g., 10 mph) visibly within the construction site, and enforce them to minimize airborne fugitive dust. Limit access to the construction site and staging areas to authorized vehicles only, through the designated treated roads. Stage construction to limit the exposed/disturbed area at any given time, when practical. Train workers to comply with the speed limit, use good engineering practices, minimize drop height of materials, minimize disturbed areas, and employ other BMPs as appropriate. To the extent practicable, conduct soil-disturbing activities and travel on unpaved roads during periods of favorable meteorological conditions, as conducting these activities during periods of unfavorable meteorological conditions may result in exceedances of air quality standards. Unfavorable meteorological conditions are infrequent and include (1) periods of low winds, stable, and relatively low mixing height conditions (primarily encountered around sunrise in colder months from late fall to early spring) and (2) periods of high winds.

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Air Quality (Cont.)	Fugitive dust, construction equipment, and facility operation emissions (Cont.)	All heavy equipment should meet emission standards specified in the *State Code of Regulations*, and routine preventive maintenance, including tuneup to the manufacturer's specification, should be implemented to ensure efficient combustion and minimum emissions. Fuel all diesel engines used in the facility and auxiliary diesel generator units with ultra-low sulfur diesel with a sulfur content of 15 parts per million or less. Limit idling of diesel equipment to no more than 10 minutes, unless idling must be maintained for proper operation; for example, drilling, hoisting, and trenching. Implement more aggressive dust control measures during road construction and land clearing, such as more frequent water spraying and the application of an appropriate dust suppressant.
Geology and Soil	Soil disturbance and contamination	Implement erosion control BMPs by following the New Hanover County Erosion and Sedimentation Control Ordinance. Implement BMPs for storage, handling, spill prevention, and spill response to reduce the impact of soil contamination associated with fuels, oils, and grease from equipment used onsite or from other chemicals or wastes managed onsite.
Surface Water Resources	Runoff	Implement BMPs for storage, handling, spill prevention, and spill response to reduce the impact of surface water contamination associated with the runoff of fuels, oils, and grease from equipment used onsite or from other chemicals or wastes managed onsite.
Groundwater Resources	Infiltration	Implement BMPs for storage, handling, spill prevention, and spill response to reduce the impact of groundwater contamination associated with the accidental release of fuels, oils, and grease from equipment used onsite or from other chemicals or wastes managed onsite. If the proposed action results in measurable onsite changes in groundwater levels, expand groundwater level monitoring to appropriate offsite areas.

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Ecological Resources	Disturbance of habitats	Reduce or prevent the collection, harassment, or disturbance of plants, wildlife, and their habitats (particularly threatened, endangered, and sensitive species) through employee and contractor education on applicable State and Federal laws. Additionally, instruct all personnel to avoid harassment and disturbance of local plants and wildlife; make personnel aware of the potential for wildlife interactions around facility structures; and ensure that food refuse and other garbage is not available to scavengers. Establish a trash abatement program that focuses on containing trash and food in closed containers and removing them periodically to reduce their attractiveness to opportunistic species, such as bears, coyotes, and feral dogs. Avoid known locations of listed plant species and habitats of listed wildlife species and establish a setback distance (minimum 60 meters [200 feet]) to prevent any destructive impacts associated with construction and decommissioning activities. Minimize the number of areas where wildlife could hide or be trapped (e.g., open sheds, pits, uncovered basins, and laydown areas). If any Federally threatened or endangered species such as the roughleaf loosestrife or the red-cockaded woodpecker are encountered, consult with FWS (as required by Section 7 of the *Endangered Species Act* [ESA]) and determine an appropriate course of action to avoid or mitigate impacts. Observe all trees >61 centimeters (24 inches) identified during GLE's surveys for potential compensatory tree plantings for the potential presence of red-cockaded woodpecker cavities. If any cavity trees are observed, consult the FWS (as required by Section 7 of the ESA) and determine an appropriate course of action to avoid or mitigate impacts. Develop an integrated vegetation management plan for the control of noxious weeds and invasive plant species. Minimize the area disturbed by preconstruction activities and the installation of facilities (pipelines, transmission towers, pump stations, substations, laydown areas, assembly areas) to retain native vegetation and minimize soil disturbance.

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Ecological Resources (Cont.)	Disturbance of habitats (Cont.)	Backfill open trenches as quickly as is reasonable.
		To the extent practicable, avoid the use of guy wires, which pose a collision hazard for birds.
		Maintain areas left in a natural condition during construction (e.g., wildlife crossings) in as natural a condition as possible within safety and operational constraints.
		To minimize habitat loss and fragmentation, reestablish as much habitat as possible after construction is complete by maximizing the area reclaimed or re-vegetated during operations.
		Prevent the establishment and spread of invasive species and noxious weeds within the transmission line ROW, along the access road, and in associated areas of ground surface disturbance or vegetation cutting. Monitor the area regularly and eradicate invasive species immediately.
Noise	Exposure of workers and the public to noise	When possible, schedule different noisy activities to occur at the same time. Less-frequent but noisy activities would generally minimize overall noise disturbance compared to lower-level noise occurring more frequently.
		Implement noise control measures (e.g., erection of temporary wooden noise barriers) if noisy activities would be expected near sensitive receptors.
		Operate all vehicles traveling within and around the project area in accordance with posted speed limits.
		Post warning signs in high noise areas and implement a hearing protection program for work areas in excess of 85 dBA.
		Because complaints about noise may occur even when noise levels from the facility do not exceed regulatory or guideline levels, implement a noise complaint process and hotline for the surrounding communities, including documentation, investigation, evaluation, and resolution of all legitimate project-related noise complaints.

Table 5-2 Summary of Potential Mitigation Measures Identified by NRC (Cont.)

Impact Area	Activity	Proposed Mitigation Measures
Public and Occupational Health	Effects from facility operation	Move UF_6 cylinders only when cool and when UF_6 is in solid form, to minimize the risk of inadvertent release due to mishandling.
		Direct process off-gas from UF_6 purification and other operations through cold traps to solidify and reclaim as much UF_6 as possible. Pass remaining gases through high-efficiency filters and chemical absorbers to remove hydrogen fluoride and uranic compounds.
		Separate uranic compounds and various other heavy metals in waste material generated by decontamination of equipment and systems.

5.3 References

(GLE, 2008) GE-Hitachi Global Laser Enrichment LLC. “Environmental Report for the GLE Commercial Facility, Revision 0.” December. ADAMS Accession No. ML090910573.

(NCDENR, 2007) North Carolina Department of Environment and Natural Resources, Division of Water Quality. “Stormwater Best Management Practices Manual.” <http://www.lenoirnc.govoffice2.com/vertical/Sites/%7B916BA528-4D3A-4AF2-9B92-9AC1C284EA52%7D/uploads/%7B89C8F254-2353-49D2-9787-A6C91C23D2E9%7D.PDF> (Accessed February 13, 2012).

(New Hanover County, 2006) New Hanover County. “New Hanover County Flood Damage Prevention Ordinance.” Adopted by the New Hanover County Board of County Commissioners June 5, 2006. <http://www.nhcgov.com/Documents/Floodplain%20Ordinance.pdf> (Accessed November 18, 2009).

(New Hanover County, 2007) New Hanover County. “County Code of Ordinances Chapter 23, Environment, Article VI: Erosion and Sedimentation Control.” <http://library.municode.com/index.aspx?clientId=11337> (Accessed November 18, 2009).

6 ENVIRONMENTAL MEASUREMENT AND MONITORING PROGRAMS

This chapter describes the proposed environmental measurements and monitoring program to characterize the effect of radiological and nonradiological releases from the proposed General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) Facility in New Hanover County, North Carolina, on human health and environment. The proposed monitoring program includes monitoring of radiological and physiochemical gaseous and liquid effluents from facility operations, and monitoring and measurement of ambient air, surface water, groundwater, stormwater, soil, sediment, and direct radiation in the vicinity of the proposed GLE Facility.

The proposed GLE Facility would be located on GE's Wilmington Site near Wilmington, North Carolina. Two of GE's principal manufacturing operations – the Global Nuclear Fuel-America (GNF-A) Fuel Manufacturing Operation (FMO) facility, Wilmington Field Services Center (WFSC), and the GE Aircraft Engines/Services Components Operation (AE/SCO) facility – are located at the Wilmington Site. For the last 40 years, the FMO facility possessed nuclear materials for the conversion of low-enriched uranium hexafluoride (UF_6) to uranium dioxide (UO_2). The FMO facility fabricates and constructs nuclear assemblies for use in commercial light water reactors. There is an existing monitoring program for the Wilmington Site. The environmental monitoring program for the proposed GLE Facility is based on the experience and data accumulated at the Wilmington Site. The existing monitoring program would be expanded to include and account for the proposed GLE Facility (GLE, 2008); this program is referred to throughout this chapter as the Expanded Monitoring Program. The existing monitoring program would provide the baseline for air quality, surface water, sediment, treated sanitary wastewater effluent, and treated process wastewater effluent (GLE, 2008). The baseline data for groundwater and soil would be collected before the proposed GLE Facility becomes operational. The baseline uranium concentration in shallow soil across the 100-acre (40-hectare) proposed GLE Facility site would be established through statistical sampling program before the construction of the proposed GLE Facility (GLE, 2008). Table 6-1 (GLE, 2008) provides a summary of the proposed monitoring program for the proposed GLE Facility, including the types, frequency, and sampling locations in addition to locations currently monitored by GNF-A.

In addition to routine sampling, provisions would be in place to respond to emergency situations, accidents, or increased emission levels found in routine sampling. Sampling frequency and locations would be determined by GLE environmental staff in accordance with the permit requirements, to demonstrate compliance. All liquid and solid hazardous and radioactive wastes related to operation of the proposed GLE Facility would be analyzed for chemical and radiological properties to determine appropriate disposal methods or treatment requirements.

Effluent compliance levels would be set primarily in the respective permits issued and administered by the North Carolina Division of Air Quality (NCDAQ) and under National Pollutant Discharge Elimination System (NPDES) permits. To ensure that the permit requirements are met, administrative action levels would be established at levels below compliance levels for all measured parameters. Response actions for elevated measurements would be set in documented procedures at increasing levels of priority, ranging from (1) increasing monitoring frequency, to (2) adjusting operations, and (3) performing corrective actions to prevent exceedances of regulatory compliance levels.

Table 6-1 Summary of GLE Environmental Monitoring Program

Medium	Additional Sample Locations[a]	Sample Type	Analyte/Parameter Frequency[b]
Direct radiation	Personnel dosimetry	Continuous film badges, TLDs, and pocket dosimeters	• Gamma and neutron activity
	UF_6 storage pads area and other outdoor storage areas	Continuous film badges or TLDs	• Gamma and neutron activity
Air	Main GLE process building stack (see Figure 6-1)	Continuous air particulate filter	• Gross alpha activity – Weekly • Fluoride – Weekly
	Around the proposed GLE Facility. Site boundary point of highest potential impact, and ambient (background) (see Figure 6-1)	Continuous air particulate filter	• Gross alpha activity – Weekly • Uranium isotopes – Weekly
Surface Water	None in addition to the current effluent channel location at the Site dam and Northeast Cape Fear River locations upstream and downstream of the Site	Grab sample	• Gross alpha/beta activities – Monthly • Total uranium – Monthly • LCFRP physical, chemical, and biological monitoring
Treated process wastewater effluent	None in addition to the current monitoring at the wastewater treatment and reclamation facility	Continuous, composite, or grab samples, per permit	• Total uranium – Daily composite • Gross alpha/beta activities – Weekly composite • Technetium-99 – Quarterly composite • NPDES permit requirements
Treated sanitary wastewater effluent	None in addition to the current monitoring at NPDES Outfall 002	Continuous proportional sample of liquid effluent	• NPDES permit requirements
Groundwater	21 monitoring wells	Grab sample after typical 3-well purge	• Total uranium – Quarterly • Gross alpha/beta activities – Only if total uranium concentration in previous sample >0.02 mg/L • Fluoride – Quarterly

Table 6-1 Summary of GLE Environmental Monitoring Program (Cont.)

Medium	Additional Sample Locations[a]	Sample Type	Analyte/Parameter Frequency[b]
Stormwater	Stormwater wet detention basin	Stormwater grab samples	• NPDES permit requirements
	UF_6 storage pads area holding pond	Stormwater grab sample	• Gross alpha/beta activities – Before transfer of held water to detention pond • Total uranium – Before transfer of held water to detention pond • Fluoride – Before transfer of held water to detention pond
Soil	4 locations	Shallow soil grab sample	• Total uranium – Semiannual
Sediment	None in addition to current monitoring locations	Sediment grab sample	• Total uranium – Semiannual

[a] Sampling locations for the proposed action in addition to locations currently monitored by GNF-A (GNF-A, 2007).
[b] Initial monitoring frequencies may be evaluated and adjusted. UF_6 = uranium hexafluoride; TLDs = thermoluminescent dosimeters; LCFRP = Lower Cape Fear River Program; NPDES = National Pollutant Discharge Elimination System.
Source: Adapted from GLE, 2008.

The following sections describe the monitoring program in detail.

6.1 Radiological Measurements and Monitoring Program

The U.S. Nuclear Regulatory Commission (NRC) requires that the proposed GLE Facility establish a radiological monitoring and measurement program to monitor and report quantities of the radionuclides released to the environment from gaseous and liquid effluents. These requirements are specified in Title 10, "Energy," of the U.S. *Code of Federal Regulations* (10 CFR) Part 20 Appendix B and 10 CFR 70.59. The U.S. Environmental Protection Agency (EPA) specifies additional monitoring requirements for air and liquid (40 CFR 70.6(a)(3), 40 CFR 122.48, and 40 CFR 123.25). The corresponding requirements from the State of North Carolina are specified in 15A North Carolina (NC) Administrative Code 02Q.0508 and 15A NC Administrative Code 2B.0500. The radiological monitoring and measurement program for the proposed GLE Facility was developed based on the above regulatory requirements, the existing GNF-A monitoring program, and NRC guidance documents listed in Table 6-2.

The Expanded Monitoring Program at the proposed GLE Facility would demonstrate compliance with effluent release requirements in 10 CFR Part 20 Appendix B, and would be implemented by the GNF-A and GLE Environmental, Health, and Safety (EHS) functions. The expanded radiological monitoring program would start when the proposed GLE Facility begins operation and would remain operational during the decommissioning phase. The monitoring during the decommissioning phase may be reduced as the contaminants are removed from the site.

The following sections describe radiological air monitoring, direct radiation monitoring, radiological sampling and monitoring for wastewater and stormwater discharge, surface water and sediment monitoring, groundwater monitoring, and soil sampling.

6.1.1 Air Monitoring

Radioactive airborne releases from the proposed GLE Facility would be discharged primarily from the stack on the main process building. Figure 6-1 shows the proposed location of the

Table 6-2 Guidance Documents That Apply to the Radiological Monitoring Program

Document	Applicable Guidance
Regulatory Guide 4.15[a] "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment."	This guide describes a method acceptable to the NRC for designing a program to ensure the quality of the results of measurements for radioactive materials in the effluents and the environment outside of nuclear facilities during normal operations.
Regulatory Guide 4.16[b] "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants."	This guide describes a method acceptable to the NRC for submitting semiannual reports that specify the quantity of each principal radionuclide released to unrestricted areas to estimate the maximum potential annual dose to the public resulting from effluent releases.

[a] NRC, 2007.
[b] NRC, 1985.

stack, which would be about 21.3 meters (70 feet) above the ground. Airborne release monitoring procedures for this source would be designed in a manner to determine the quantities and concentrations of radionuclides discharged to the environment, in accordance with 10 CFR 70.59. Uranium isotopes anticipated to be released as airborne emissions would include uranium-234, uranium-235, uranium-236, and uranium-238. The stack would be sampled continuously. During initial operation, the collection filter would be removed daily and analyzed for gross alpha activity. If, during normal operations, the monitoring results show continued low alpha activity, the removal frequency for the collection filter would eventually be decreased to weekly.

In addition to stack monitoring for compliance with regulatory requirements, ambient air monitoring for radioactive emissions would take place around the proposed GLE Facility, to ensure that the facility is operating properly. A total of 11 active air monitors would be used for analysis of a weekly composite sample for gross alpha activity and concentrations of uranium isotopes, resulting primarily from the GLE stack emissions and activities from UF_6 cylinder pads. As shown in Figure 6-1, nine monitors would be placed around the proposed GLE Facility. Considering prevailing wind directions, three monitors each would be placed to the north and south. Three monitors to the south would be placed to monitor for levels of radioactive material from the UF_6 storage pads and the stack under prevailing northerly winds. Three monitors would be placed to the north and northeast to monitor levels of radioactive materials under prevailing southwesterly winds. Additionally, one monitor would be placed to the east of the UF_6 storage pads, and two monitors would be placed on the western side of the facility to cover potential impacts from all wind directions. Finally, one monitor would be placed where the highest potential impact was predicted to occur, on the Wilmington Site property boundary about 0.5 kilometers (0.3 miles) to the northeast of the proposed GLE Facility stack.

An active air monitor would be placed approximately 0.8 kilometers (0.5 miles) to the west–northwest of the proposed GLE Facility stack. The monitor is located in the least-prevailing wind direction from the proposed GLE Facility and thus, considered as an onsite background monitor associated with the operation of the proposed GLE Facility.

6.1.2 Direct Radiation Monitoring

Direct radiation monitoring would be conducted to demonstrate compliance with the NRC requirements in 10 CFR Part 20 and North Carolina State requirements for radiation protection (GLE, 2008). Direct gamma radiation in offsite locations from processes inside the proposed GLE Facility main process building would be expected to be minimal, because the low-energy gamma radiation associated with uranium would be shielded by the building structure, process piping, and equipment. Personal dosimetry would be used to evaluate the dose to the workers. Thermoluminescent dosimeters (TLDs) or film badges would be used for direct radiation monitoring for the cylinder pads and other outdoor storage areas and would be placed at strategic locations along the boundaries of the cylinder storage pads. TLDs would be placed at locations where there is higher employee traffic, such as near the access gates for each cylinder storage pad. TLDs would also be placed on the three fencelines that do not have access gates. TLDs would be replaced and analyzed every six months. Periodic surveys using portable survey meters would be performed monthly in the general storage pad area and along the boundary of the storage pads (GLE, 2009a).

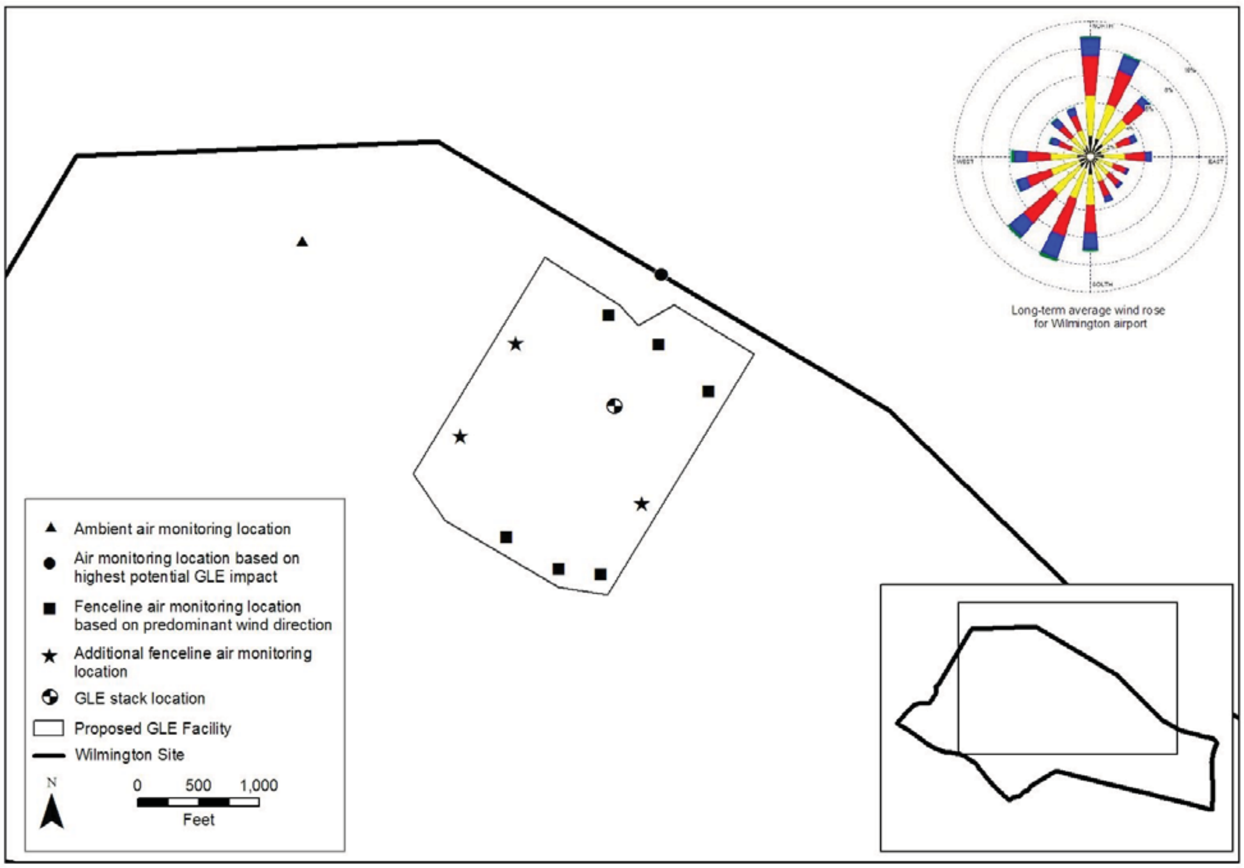

Figure 6-1 GLE Air Monitoring Locations[1] (GLE, 2008)

6.1.3 Wastewater and Stormwater Discharge Monitoring

The proposed GLE Facility would generate and treat liquid process wastewater containing uranium and fluoride. A treatment process would remove uranium through pH adjustment and fluoride through addition of a salt to precipitate the fluoride (GLE, 2008). Either filtration or evaporation would then take place on the fluoride precipitate. The treatment process would be very similar to what is currently in effect at the FMO facility, and effluent concentrations of uranium are expected to be similar or lower compared to the existing process (GLE, 2009b). The treated wastewater would be conveyed to the existing Wilmington Site final process lagoon facility for further treatment. From the lagoon, treated effluent is discharged under NPDES permit to the effluent channel via Outfall 001. Continuous proportional samples of the treated wastewater are collected at Outfall 001 (see Figure 3-20). The monitoring would include daily composite samples for uranium; weekly composite samples of the daily samples for gross alpha and gross beta activity; and quarterly composite samples of the weekly composites for technetium-99.

[1] The locations shown are approximate.

Stormwater runoff from the UF_6 storage area would travel to a new holding pond for monitoring for uranium, gross alpha, and gross beta (GLE, 2008, 2009b). Afterwards, the stormwater would be released to a stormwater wet detention basin. The purpose of the holding pond would be to detain stormwater from the UF_6 storage area in the event of an incident involving the release of uranium on the storage pad. Treatment of the stormwater would not, therefore, normally take place. If such an incident occurred, water in the holding pond would be retained and monitored until uranium stabilized through precipitation or was subjected to active treatment. Afterward, the holding pond liner would be sampled to assess the need for remediation (GLE, 2009b).

Wilmington Site stormwater basins are not currently monitored during rainfall events. The NPDES stormwater permit states that no analytical sampling is required if a basin is designed to discharge only in response to a 10-year storm (GLE, 2009b).

GLE intends to consult with the North Carolina Division of Water Quality (NCDWQ) to develop a monitoring plan for the UF_6 storage area stormwater holding pond (GLE, 2009b). Per 10 CFR Part 70 Appendix A(c), any release that is reportable to the State would also be reported to NRC.

6.1.4 Surface Water and Sediment Monitoring

The current monitoring program would be expanded to account for the proposed GLE Facility (GLE, 2008). As part of this Expanded Monitoring Program, GLE would continue the surface water monitoring activities that are currently conducted under the GNF-A monitoring program at the Wilmington Site. Gross alpha, gross beta, and uranium are monitored in the effluent channel, the Northeast Cape Fear River 27 kilometers (17 miles) upstream of the Wilmington Site, and the Northeast Cape Fear River at the Wilmington Site dock, which is downstream of the discharge of the effluent channel to the river (via a tributary), as described in Section 3.7.1. Monitoring consists of monthly grab samples.

Current sediment sampling under the GNF-A Environmental Monitoring Program includes semiannual uranium samples in the effluent channel downstream of Outfall 001 (GLE, 2008). Because the proposed GLE Facility's process wastewater would follow the same route, the current sediment sampling program would provide relevant samples.

6.1.5 Groundwater Monitoring

Current groundwater monitoring for radiological contaminants involves monitoring wells across the Wilmington Site. Thirteen more wells would be installed at the proposed location to complement the existing eight wells already in the North-Central Site Sector (GLE, 2008). This set of 21 wells would become part of the Expanded Monitoring Program. They would be arranged in seven clusters with wells installed at three depths in each cluster (at or near the water table in the surficial aquifer, in the upper portion of the Peedee Sand, and in the intermediate Peedee Sand).

Quarterly sampling for uranium would take place from the 21 wells. If a result exceeded 0.02 milligrams per liter (1.7×10^{-7} pounds per gallon), then subsequent quarterly samples from that well would also include analysis for gross alpha and gross beta activity (GLE, 2008). After sufficient data were gathered for a statistical trend analysis, the sampling frequency for each

well would be reviewed, and adjusted if necessary. Quarterly monitoring would begin prior to GLE operations to establish baseline conditions, and the Expanded Monitoring Program would continue through the operations and decommissioning phases.

6.1.6 Soil Sampling

The existing soil sampling and analysis program at the Wilmington Site would be supplemented with four additional sampling locations; two to the north and two to the south of the proposed GLE Facility (GLE, 2008). The sampling at these new locations would begin before startup of the proposed GLE Facility to establish the baseline condition. In addition, uranium baseline concentration in shallow soil across the 100-acre (40-hectare) proposed GLE Facility site would be established before preconstruction and construction of the proposed GLE Facility (GLE, 2008).

6.2 Nonradiological Measurements and Monitoring Program

This section describes the proposed physiochemical, ecological, and industrial health and safety monitoring for the proposed GLE Facility. Discussions of physiochemical monitoring cover effluent monitoring of chemical constituents to meet permit requirements, and environmental media sampling to detect impacts from site operations.

6.2.1 Physiochemical Monitoring

A physiochemical monitoring program would be conducted during the construction and operation of the proposed GLE Facility as part of an environmental protection program to control chemical and other nonradiological exposures to workers, the public, and the environment. During the preconstruction and construction phases, worker and public exposure to dust would be monitored as required under GNF-A's Industrial Safety Program and Occupational Safety and Health Administration (OSHA) requirements. Stormwater would be monitored during construction under the provisions of an NPDES General Permit for Construction Stormwater. The specific monitoring requirements under the permit would be specified in an Erosion and Sedimentation Control Plan submitted to and approved by the North Carolina Division of Land Resources.

During facility operation, the primary objective of monitoring would be to confirm that effluent controls for gaseous and liquid effluents are working properly, and if not, to alert operators when actions, including corrective measures, need to be taken. Physiochemical sampling of effluent streams and of environmental media potentially affected by the effluents, including soil, sediments, groundwater, surface water, and biota, would be conducted. Specific parameters monitored would include uranium, fluoride, and any other chemicals or parameters specified in facility or site permits.

In addition, environmental media samples would be collected periodically and analyzed for chemicals present in effluents. Much of this sampling is already conducted for the existing facilities at the Wilmington Site, including sampling of uranium at various surface water locations, uranium and fluoride in groundwater at 21 site perimeter monitoring wells, and in sediments at various site locations. In addition to current sampling, four new soil sampling locations would be sampled near the boundaries of the proposed GLE Facility (GLE, 2008). Soil and sediment samples would be collected semiannually.

Groundwater sampling would be performed quarterly as described in Section 6.1.5, and would include analysis for fluoride and measurements of pH, temperature, and specific conductance. Water levels would be measured at each sampling event and in semiannual comprehensive measurement events across the Wilmington Site.

6.2.1.1 Effluent Monitoring

Hydrogen fluoride (HF), as fluoride ions, would be collected continuously on particulate filters in vent stacks and analyzed weekly in accordance with an NCDAQ air permit that would be required for the facility. Uranium isotopes would be collected continuously on particulate filters in air samplers located around the proposed GLE Facility. These filters would likewise be analyzed weekly. Fluoride and uranium would be monitored in liquid effluents along with any other chemicals required under the Wilmington Site's NPDES permits. Effluents would be sampled at outfalls from treatment systems for process wastewater and sanitary wastewater and in stormwater retention basins, including the holding pond for UF_6 storage pads.

The Expanded Monitoring Program would include continued monitoring at effluent outfalls under the current NPDES permit as described in Section 3.7.1.

Outfall 001 (Figure 3-20) is for process wastewater. It is monitored prior to discharge to the effluent channel for various parameters and has limitations on total suspended solids (TSS), total nitrogen, fluoride, cyanide, pH, metals (total cadmium, lead, chromium, copper, nickel, silver, zinc), oil and grease, and total toxic organics. The permit lists a number of equipment systems that contribute flow to the outfall, including treatment tanks, lime slurry system, and hydrofluoric acid equipment. The permitted maximum flow at the outfall is 6.8 million liters per day (1.8 million gallons per day).

Outfall 002 (Figure 3-20) was used for treated domestic (sanitary) wastewater until April 2008. Permit limitations included biochemical oxygen demand (BOD), TSS, and fecal coliform, and a maximum allowed flow of 280,000 liters per day (75,000 gallons per day). Because the new sanitary wastewater treatment facility does not release effluent, the outfall is unused; however, the permit is in place if discharge is necessary in the future. Effluent limits for both monthly average and daily maximum values include turbidity, nitrogen, BOD, TSS, and fecal coliform.

Monitoring of pH at the site dam is also described in Section 3.7.1.

Surface water monitoring would continue to be monitored by GLE, the NCDWQ, and the Lower Cape Fear River Program, as described in Section 3.7.1 of this EIS. The NCDWQ maintains two monitoring stations along the Northeast Cape Fear River; one is 27 kilometers (17 miles) upstream of the site and the other is 10 kilometers (6 miles) downstream. A third station near the Wilmington Site's south border is monitored by the Lower Cape Fear River Program. GE monitors water quality parameters along with gross alpha, gross beta, and uranium concentrations in the effluent channel at the Wilmington Site dam, the Northeast Cape Fear River significantly upstream of the Wilmington Site, and the Northeast Cape Fear River just downstream of the Wilmington Site.

6.2.1.2 Stormwater Monitoring

A stormwater permit would be required for the proposed GLE Facility (GLE, 2008). For nonradiological monitoring, sampling would be performed semiannually during storm events, as discussed in Section 3.7.1. Analyses would include lead, oil and grease, pH, and TSS.

6.2.2 Ecological Monitoring

The current ecological monitoring program for the Wilmington Site consists of a forestry management plan to improve natural habitats on the Wilmington Site. This program would also provide appropriate monitoring and habitat management for the proposed GLE Facility. Monitoring would include ecological surveys to identify potential issues and habitat areas that need improvement. GLE would consider survey recommendations made by appropriate Federal and State agencies (e.g., U.S. Fish and Wildlife Service and the North Carolina Department of Environment and Natural Resources) (GLE, 2008). Such actions could include surveys for listed species or their suitable habitat, particularly the roughleaf loosestrife (*Lysimachia asperulaefolia*) and red-cockaded woodpecker (*Picoides borealis*) (FWS, 2009).

To mitigate losses of more mature trees, GLE would conduct surveys for trees >61 centimeters (24 inches) in diameter in areas that would be affected by preconstruction activities and construction of the proposed GLE Facility, in order to determine compensatory requirements for tree plantings that would be performed elsewhere on the Wilmington Site. If trenches are required, any that would be left open overnight would be inspected for animals prior to backfilling.

Any nonradiological ecological monitoring prescribed through the various environmental permits for the preconstruction, construction, operation, and decommissioning of the proposed GLE Facility are expected to be sufficient to evaluate any nonradiological ecological impacts.

6.2.3 Industrial Health and Safety Monitoring

The existing industrial health and safety program at the Wilmington Site would be expanded to include the activities of the proposed GLE Facility (GLE, 2008). This would include monitoring of indoor air quality and noise in workplaces. It would also include training of workers in safe work practices and monitoring of workplace safety-related occurrences and taking appropriate corrective actions. An ergonomic program would also be included as part of the industrial health and safety program to reduce or eliminate worker injuries (GLE, 2008).

6.2.4 Cylinder Surveillance and Monitoring

Surveillance and monitoring of depleted UF_6 cylinders would be conducted prior to placement on the storage pad (and periodically thereafter, including prior to transportation) to ensure cylinder integrity and prevent or minimize the potential release of UF_6 (GLE, 2008). GLE's cylinder monitoring program would include inspection criteria to ensure that lifting points, skirts, and stiffener rings are free from distortion and cracking; surfaces are free from bulges, dents, gouges, cracks, and significant corrosion; valves are equipped with correct protectors and caps; valves are not distorted and valve stems are undamaged; and cylinder plugs are undamaged and not leaking. If inspections reveal significant deterioration or other conditions that may affect safe use of a cylinder, the contents of the affected cylinder would be transferred to another

cylinder and the defective cylinder would be discarded. Investigation of the cause of the deterioration would be performed, and if necessary, additional cylinder inspections would be performed (GLE, 2008). In addition, radiological surveys would be conducted to ensure that cylinders are not externally contaminated and to help ensure that radiation exposures during cylinder handling and storage comply with the regulatory limits in 10 CFR Part 20 (GLE, 2008).

6.3 Quality Assurance

The Expanded Monitoring Program (which would incorporate the proposed GLE Facility) would fall under the oversight of the Wilmington Site Quality Assurance Program and would be managed by a qualified quality assurance officer. The program would employ written procedures for the collection of representative environmental samples, appropriate sampling methods and equipment, selection of sampling points, and sample preservation, transport, handling, storage, and custody. Additional written procedures would be used to ensure that sampling and monitoring equipment is properly maintained and calibrated, and in good working order.

Onsite and contractor analytical laboratories would similarly implement a formal quality assurance/quality control program to monitor, assess, and control the performance of radiological and chemical analysis so that required performance standards specified in permits and within the standard analytical procedures are met. Good laboratory practices would be employed in all aspects of analysis. Laboratories would participate in third-party comparison studies to validate their performance.

Quality assurance measures employed in sampling and analysis would be adequate to produce valid analytical results. Procedures would require the use of calibration standards traceable to a primary National Institute of Standards and Technology (NIST) standard, as appropriate. Industry-accepted, regulatory agency-approved sampling, analysis, and reporting methods would be employed, such as those endorsed by the National Environmental Laboratory Accreditation Conference (NELAC).

The quality assurance program would specify an adequate set of quality assurance samples to validate field samples. Both field and laboratory quality control samples would be analyzed, including appropriate blank, duplicate, and spiked samples, as well as laboratory calibration and sample recovery standards. Performance standards would be set to meet the requirements of specific measurement programs, and would include standards for minimum detectable concentrations (MDCs), sample recovery, and analysis reproducibility. MDCs would be sufficient to meet action level, regulatory, and permit requirements, as well as the requirements of environmental media monitoring programs.

6.4 Reporting

Reporting would comply with the requirements of 10 CFR 70.59 and the guidance specified in *NRC Regulatory Guide 4.16* (NRC, 1985). It is expected that a single semiannual report for the Wilmington Site (that would include the proposed GLE Facility) would be submitted to the NRC. The semiannual report would include the quantities of the radionuclides released in the unrestricted area and other information necessary to evaluate the radiation dose from effluent releases to the public (GLE, 2008). The NRC would place this report (and all other relevant

information pertaining to environmental sampling) on the NRC's web site to make it available to the public.

6.5 References

(FWS, 2009) U.S. Fish and Wildlife Service. Letter from H. Hall (U.S. Fish and Wildlife Service) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 8. "Subject: Docket No. 70-7016; General Electric-Hitachi Global Laser Enrichment Facility, New Hanover County, North Carolina." ADAMS Accession No. ML091700024.

(GLE, 2008) GE-Hitachi Global Laser Enrichment LLC. "Environmental Report for the GLE Commercial Facility, Revision 0." December. ADAMS Accession No. ML090910573.

(GLE, 2009a) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated June 8. "Subject: GE-Hitachi Global Laser Enrichment Submittal of Additional Information Related to NRC Review of GLE Environmental Report." Letter number GLEL-09-004. ADAMS Accession No. ML092110764.

(GLE, 2009b) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 5. "Subject: GE-Hitachi Global Laser Enrichment Response to Request for Additional Information Related to NRC Review of GLE Environmental Report." ADAMS Accession No. ML093170517.

(GNF-A, 2007) Global Nuclear Fuel-Americas LLC. "Site Environmental Report Supplement for the Period 1995–2005." March 30. ADAMS Accession No. ML071000137.

(NRC, 1985) U.S. Nuclear Regulatory Commission. "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants." *Regulatory Guide 4.16*, *Revision 1*. December. ADAMS Accession No. ML003957058.

(NRC, 2007) U.S. Nuclear Regulatory Commission. "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operation to License Termination) – Effluent Streams and the Environment." *Regulatory Guide 4.15*, *Revision 2*. July. ADAMS Accession No. ML072070314.

7 COST-BENEFIT ANALYSIS

The costs and benefits of the proposed action and no-action alternative are considered in this chapter as an aid in evaluating environmental consequences. Costs and benefits are presented, to the extent possible, in monetary terms. Important costs and benefits that cannot be quantified in monetary terms, such as environmental impacts, are presented qualitatively.

Cost-benefit analysis can provide a rationale for deciding whether a project is likely to have a net positive impact by aggregating each of the costs and benefits resulting from the project. Cost-benefit analysis involves valuing the benefits and costs associated with a project in monetary terms, to the extent possible. Depending on the extent of the data available, cost-benefit analyses may rely partially on qualitative data to assess the various costs and benefits; the methodology employed for a cost-benefit analysis is usually dependent on the specific issues involved in a project. Costs and benefits are often separated into two categories – private and societal. Private costs and benefits are those that impact the owner of a project or facility, in this case General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE), while societal costs and benefits are those that impact society as a whole. Much of the data associated with the construction and operation of the proposed GLE Facility that would be used to assess private costs (i.e., the costs of constructing and operating the proposed facility) are proprietary commercial information, withheld in accordance with 10 CFR 2.390. Although these costs are presented in Appendix H, they cannot be discussed in this section of this Environmental Impact Statement (EIS).

The analysis focuses on the various private and societal costs and benefits associated with the proposed action and the no-action alternative using data provided by GLE (GLE, 2008, 2009a, and 2011). These data include the economic and fiscal benefits of facility construction, operation, and decommissioning to the region in which the facility is located, and to the North Carolina state economy. As described in Section 3.13, the area in which workers are expected to live and spend most of their salary is referred to as the region of influence (ROI) for the analysis of socioeconomic impacts. The ROI corresponds to the Wilmington Metropolitan Statistical Area (MSA), a three-county area comprising Brunswick, New Hanover, and Pender Counties. Although the majority of the costs and most of the socioeconomic impacts of the various phases of the proposed GLE Facility development would occur in the ROI, there would be economic, fiscal, and, in particular, energy security benefits that would occur at both the local and national level. Therefore, the cost-benefit analysis addresses a larger area than the ROI that was considered in the analysis of socioeconomic impacts. Also discussed are the benefits of the proposed GLE Facility at the national level in fulfilling the need for enriched uranium to fulfill domestic electricity requirements, for domestic supplies of enriched uranium for national energy security, and for upgraded uranium enrichment technology in the United States. Societal costs considered include those related to impacts on land use, historical and cultural resources, visual resources, air quality, geology and soils, water resources, ecological resources, environmental justice, noise, transportation, public and occupational health, and waste management.

This chapter analyzes the costs and benefits both quantitatively, in monetary terms where possible, and qualitatively. Section 7.1 weighs the costs and benefits associated with the proposed action. Section 7.2 compares the costs and benefits for the proposed action to those of the no-action alternative. Section 7.3 combines these sections into overall conclusions.

Alternatives that have previously been ruled out for failing to meet the project's technical and policy objectives are described in Section 2.3 of this EIS and are not revisited in this chapter.

7.1 Costs and Benefits of the Proposed Action

Under the proposed action, GLE would construct, operate, and eventually, decommission (under a separate licensing action) the proposed GLE Facility in Wilmington, North Carolina. In order for GLE to carry out the proposed action, the U.S. Nuclear Regulatory Commission (NRC) would grant a license to GLE to possess and use source material, byproduct, and special nuclear material in accordance with the requirements of Title 10, "Energy," Parts 40, 30, and 70 of the U.S. *Code of Federal Regulations* (10 CFR), respectively, if all regulatory requirements are met. The proposed GLE Facility would be constructed from 2012 to 2020, and preconstruction activities could begin prior to the licensing decision in 2012 (GLE, 2011). The start-up activities would begin in 2014 and continue until 2020. Full production would be achieved in 2020, and continue through 2051, followed by license termination in 2052 and decommissioning.[1]

The principal socioeconomic impact or benefit from the proposed GLE Facility would be an increase in employment and income in the ROI. Although the majority of the costs and most of the socioeconomic impacts of the various phases of GLE Facility development would occur in the ROI, there would be economic, fiscal, and, in particular, energy security benefits, which would occur at both the local and national level. Therefore, the cost-benefit analysis addresses a larger area than the ROI, which was considered in the analysis of socioeconomic impacts.

This section describes the costs and benefits of each life-cycle stage of preconstruction and the proposed action. Quantitative estimates (in terms of dollars) are provided where possible. Other costs and benefits are described in qualitative terms.

7.1.1 Costs of Preconstruction and the Proposed Action

The direct costs associated with the proposed action may be categorized by the following life-cycle stages:

- construction
- start-up activities
- facility operation
- depleted uranium disposal
- decommissioning

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[1] As discussed in Section 4.1, the cost-benefit analysis is based on the assumption that a licensing decision will be made in 2012, NRC-licensed construction (if authorized) would begin shortly after the licensing decision, and termination of the 40-year license would occur in 2052. The analysis is also based on the assumption that operations would begin in 2014, construction activities would continue through 2020, and the facility would be fully operational in 2020 (GLE, 2011). Any changes in the licensing and construction schedule could cause slight changes to the cost-benefit analysis, but would not affect the overall impact conclusion.

In addition to the costs of the proposed action, costs would be incurred for preconstruction activities that occur under both the proposed action and no-action alternatives. Because the monetary costs associated with preconstruction, construction, operations, and decommissioning phases of the proposed GLE Facility are withheld under the provisions of 10 CFR 2.390, the costs associated with each of these life-cycle stages are discussed in the proprietary appendix (Appendix H of this EIS) and summarized in Table H-1.

An additional element of the development of the proposed GLE Facility in the Wilmington area would be the tax incentives provided to GLE by the State of North Carolina and New Hanover County. It is anticipated that these incentives would amount to up to $26.6 million from the State, most of which would be payable over a 12-year period; and up to $10 million from the county, payable over a 10-year period. Both incentives are contingent upon GLE reaching specified investment and employment levels at the proposed GLE Facility (GLE, 2009b). In the cost-benefit calculation, the analysis reduced the total cost of construction of the proposed facility by the amount of these tax incentives, and reduced the county and State tax benefits from the proposed GLE Facility.

In addition to monetary costs, the proposed action would result in impacts on various resource areas, which can also be considered “costs” for the purpose of this analysis. The resource areas and corresponding impacts are summarized below and described in more detail in Chapter 4 of this EIS. The impact of the proposed action is estimated to be SMALL or SMALL to MODERATE for all resource areas.

- Land Use. As described in Section 4.2.1, the Wilmington Site is owned by GE and is zoned for heavy industrial use. Preconstruction activities would remove the undeveloped forest. Construction of the proposed GLE Facility is consistent with current zoning. Preconstruction, construction, operations, and decommissioning of the proposed GLE Facility would not alter current land use or zoning of the Wilmington Site or surrounding properties. Impacts would be SMALL during all phases.

- Historic and Cultural Resources. As described in Section 4.2.2, no construction activities would occur in the portion of the Wilmington Site where historic and cultural resources are known to exist. While GLE has no plans to alter the site during operations, there is a high potential for additional historic and cultural resources to be discovered during routine maintenance activities. The Wilmington Site is located within a region containing high concentrations of historic and cultural resources. Operational impacts would depend largely on procedures employed to protect historic and cultural resources. The NRC proposed a license condition that would require GLE to consider the potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed areas of the proposed GLE Facility site. GLE also developed Common Procedure CP-24-201 to address the unanticipated discovery of human remains or artifacts. Based on this information, the NRC determined that the impact level is SMALL to MODERATE given the close proximity of significant historic and cultural resources and high potential for additional historic and cultural resource materials to be discovered during preconstruction, construction, and facility operations. Should decommissioning activities require the disturbance of previously undisturbed land, impacts could result. However, the need to clear previously undisturbed land is not anticipated, therefore, impacts are expected to be SMALL.

- Visual and Scenic Resources. As described in Section 4.2.3, the proposed GLE Facility project area has low scenic quality and would be located adjacent to existing GE industrial facilities. Temporary visual impacts would result from increased truck and worker traffic and the use of construction cranes during preconstruction and construction activities. The proposed project area would be surrounded by a vegetation barrier, so preconstruction and construction activities would largely be screened; therefore, the impacts would be SMALL. During operations, the two most visible features would be the water tower and a portion of the operations building. These features would not represent a major alteration of the existing visual environment; therefore, the impacts would be SMALL. Impacts during decommissioning would be minimal and of short duration. Temporary impacts would result from the use of heavy equipment and increased worker traffic. Once decommissioning is completed, most impacts would cease, therefore, the impacts would be SMALL.

- Air Quality. As described in Section 4.2.4, air quality impacts from the proposed GLE Facility would be highest during preconstruction activities and during the initial 2 years of construction. Criteria pollutants, volatile organic compounds (VOCs), greenhouse gases, hazardous air pollutants (HAPs), fugitive dust emissions, and engine exhaust emissions would be released during these activities. Emissions of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) would have a SMALL impact on ambient air quality (well below applicable standards). Road construction, land-clearing, and building construction activities are projected to cause a temporary increase in the concentrations of particulate matter in the ambient air, which would exceed the air quality standard. These impacts would be MODERATE, but temporary. The proposed GLE Facility would not employ any continuous combustion activities during operation; criteria pollutant and HAPs emission rates would be SMALL. Uranium-related and hydrogen fluoride (HF) stack emissions would be minimal, and emissions from diesel fuel handling would be very low; therefore, these impacts would be SMALL. Decontamination activities would mostly occur inside buildings, where emission controls would minimize atmospheric releases. Overall, decontamination and decommissioning activities at the proposed GLE Facility would be comparable to or less than those during construction; therefore, impacts on ambient air quality are expected to be SMALL.

- Geology and Soils. As described in Section 4.2.5, approximately 91 hectares (226 acres) of land would be disturbed in the Wilmington Site, including approximately 40 hectares (100 acres) for the proposed GLE Facility site in the North-Central Site Sector, plus about 5 hectares (13 acres) for support structures to the east and about 13 hectares (33 acres) associated with the North access road. Soil disturbance during facility operations would continue at reduced levels, as some construction projects are ongoing, while others would be completed. Impervious surfaces such as roads, parking lots, and roofs would increase stormwater runoff, increasing the erosion potential. Although terrain changes would be minimal, a short-term increase in soil erosion would occur. Foundations, roads, and utility lines would likely be undisturbed during decommissioning. Erosion may increase, as portions of the site are disturbed by heavy equipment. Impacts on soils and geology during construction, operation and decommissioning are expected to be SMALL.

- Surface Water Resources. As described in Section 4.2.6, construction excavation could affect surface water quality. Access road construction could lead to erosion and increased sediment load, and erosion may increase as portions of the site are disturbed by heavy equipment. Leaks or spills of fuel, oil, or grease from construction vehicles and equipment

could affect nearby surface water, but infiltration into soil would likely eliminate or reduce the potential for runoff. Impacts on surface water quality during preconstruction and construction are expected to be SMALL due to the nature of the work activities, the site soil characteristics and slopes, and the use of best management practices (BMPs). Process wastewater effluent would be discharged at an existing outfall during operations, increasing the site's wastewater volume. Treatment of liquid radioactive waste would produce an effluent similar to process wastewaters currently produced at the Wilmington Site. No consumption of surface water would occur during operations. Stormwater runoff would collect in a permitted wet detention basin before regulated discharge, and stormwater runoff from the UF_6 cylinder storage pads would collect in a lined holding pond for radioactivity monitoring prior to discharge to the wet detention basin. Oil, grease, metals, and other automotive-related contaminants would be present in limited quantities due to vehicular traffic; herbicides used in landscaped areas would also be present. Impacts on surface water during operations are expected to be SMALL due to planned systems for runoff, treatment, and monitoring, as well as experience with existing Wilmington Site facilities. Process wastewater flow would cease during decommissioning, but decontamination effluent could be generated. Erosion may increase as portions of the facility site are disturbed by heavy equipment, but BMPs would reduce these impacts. Stormwater runoff would continue to be gathered in a wet detention basin. The impact of decommissioning on surface water resources is expected to be SMALL.

- Groundwater Resources. As described in Section 4.2.7, implementation of BMPs during preconstruction and construction activities for the proposed GLE Facility would reduce the potential for leaks of fuel, oil, and grease to soil and groundwater. The use of portable toilets during construction would eliminate sanitary system impacts on groundwater. Tanker trucks would provide potable and nonpotable water necessary for construction. The impact of preconstruction and construction on groundwater use and quality would be SMALL. Groundwater used for facility operations would come from existing groundwater supplies at the site and would be offset by the industrial reuse of treated sanitary wastewater effluent as process water. A small increase in drawdown is expected, without significant effect on flow directions, water quality, or availability for offsite users. Stormwater runoff collected from the UF_6 cylinder storage pads is expected to have no more than trace amounts of radiological contaminants, and the lined holding pond would limit infiltration to groundwater. A portion of discharged effluents may potentially infiltrate the Peedee sand aquifer, but treatment and monitoring are expected to result in no significant contaminant concentrations in the effluent channel. Diesel tanks at the facility would have appropriate leak detection equipment, and a groundwater monitoring plan would be developed after the facility is constructed. Impacts on groundwater during operations are expected to be SMALL. The impact of decommissioning (including removal of structures, utilities, materials, and products) on groundwater resources is expected to be SMALL.

- Ecological Resources. As described in Section 4.2.8, impacts on wildlife and vegetation from clearing, habitat fragmentation, alteration of topography, changes in drainage patterns, and soil compaction associated with proposed GLE Facility preconstruction activities would be MODERATE; remaining construction impacts (e.g., decline or mortality of trees near the construction boundary, erosion, dust and other particulate matter, invasive plant species, habitat fragmentation, noise, and accidental releases of hazardous materials) would be SMALL. Impacts on wetlands associated with preconstruction and construction activities would be SMALL. Preconstruction and construction activities would result in SMALL

impacts on aquatic biota. Impacts on any Federally listed threatened, endangered, or other special status species from preconstruction and construction activities would be SMALL. Impacts on any State-listed species would also be SMALL. Impacts on vegetation during operation would be SMALL and would include mowing, cutting, and chemical control of vegetation around facilities, utility corridors, and access roads. Impacts on wetlands during operation would be SMALL. No environmentally sensitive areas would be affected by operations, so impacts would be SMALL. Impacts on wildlife, aquatic biota, and threatened, endangered, and other special status species due to operations would also be SMALL. Most decontamination activities would occur inside buildings, so large-scale ecological impacts would not be likely. Removal of facilities could affect vegetation adjacent to the facilities and cause offsite erosion and sedimentation. Decommissioning activities would not directly affect wetlands or environmentally sensitive areas. Impacts would be similar to those occurring during construction. The overall impacts of decommissioning on ecological resources are expected to be SMALL.

- Noise. As described in Section 4.2.9, vehicular traffic to and from the proposed GLE Facility would generate intermittent noise along local roadways during preconstruction and construction. Noise would be limited to the immediate vicinity of the Wilmington Site. Potential noise impacts on the nearest subdivision would be MODERATE, but temporary during road construction (preconstruction). Most land clearing and grading activities would occur away from the fenceline and far from the nearest residential subdivision and would be below day and night ambient sound level in compliance with the New Hanover County Noise Ordinance and U.S. Environmental Protection Agency (EPA) guidelines; therefore, noise impacts on the surrounding community would be temporary and SMALL. During GLE Facility operations, exterior equipment, such as pumps, heat pumps, transformers, and cooling towers, would generate noise. Other sources of noise would include commuter vehicular and delivery truck traffic. Noise levels from facility operations at the fenceline nearest to the Wooden Shoe residential subdivision would be below day and night ambient sound levels that correspond to local and EPA guidelines, therefore, impacts would be SMALL. Most decontamination activities would occur inside the GLE Facility buildings. If decommissioning includes demolition, heavy construction equipment may be required and waste/debris would be hauled offsite by truck. Noise from truck traffic on site access roads would be comparable to that during construction. Noise impacts from decommissioning are expected to be SMALL.

- Transportation. As described in Section 4.2.10, the number of truck shipments would vary over the course of construction. Truck traffic associated with preconstruction and construction activities would have a SMALL impact on local traffic. Prior to start-up, an average increase of up to 1428 daily trips by construction personnel is anticipated, with the heaviest traffic occurring in the immediate vicinity of the site entrance. Impacts on roads in the vicinity of the Wilmington Site would be SMALL to MODERATE; regional impacts are expected to be SMALL. Operations would overlap with construction for 5–6 years, during which time vehicular traffic from commuting operations personnel would be combined with traffic from construction workers and shipments. The average number of additional daily vehicle trips associated with GLE Facility activities would increase to about 1239 at the Wilmington Site during the overlap of construction and operations. Once construction is complete, the average number of daily trips associated with operations personnel is estimated to be approximately 735. The range of additional daily vehicle trips from facility operations would have a MODERATE impact on the local road network and a SMALL

impact on regional traffic flow. Operations would require the shipment of various radioactive materials to and from the facility; impacts on the public and transportation crews from radiation exposure, chemical exposure, and vehicle emissions would be SMALL. No fatalities are expected from accidents (direct physical trauma) on an annual basis. The overall annual transportation accident impacts from the proposed action are expected to be SMALL. Initial decommissioning activities during the final year of operations would increase the total number of workers, and the number of truck shipments is anticipated to be approximately the same as during construction. In this regard, operations and initial decommissioning are anticipated to have a similar impact (i.e., MODERATE local and SMALL regional). Once operations cease and the workforce drops to 50, local and regional transportation impacts would be SMALL. Impacts from radioactive waste shipments would be SMALL due to the low levels of external radiation and the low number of shipments. Transportation impacts from decommissioning would be SMALL.

- Public and Occupational Health. As described in Section 4.2.11, members of the public around the Wilmington Site and the workers who will be involved in the construction, operation, and decommissioning of the proposed GLE Facility (and employees at existing GE facilities on the Wilmington Site) are likely to be exposed to radiation from uranium used and stored at the proposed GLE Facility and other existing operations at the Wilmington Site. They could also be exposed to certain quantities of radioactive materials (primarily UF_6) and chemicals (primarily HF) that are likely to be released to the environment during normal operations and decommissioning of the proposed facility. All radiological doses and chemical exposures received by members of the public and workers due to the proposed action would be well below all applicable regulatory limits and standards. In addition, GLE would implement an As Low As Reasonably Achievable (ALARA) program and use BMPs to keep all public and occupational exposures low. As a result, the public and occupational health impacts from normal operations would be SMALL. The public and occupational health impacts from decommissioning would be SMALL.

- Waste Management. As described in Section 4.2.12, solid nonhazardous wastes generated during construction would be similar to wastes from other industrial construction sites and transported offsite to an approved local landfill. Construction activities would generate less than 2 percent of the waste that the New Hanover County Landfill receives annually from all other sources. Hazardous wastes from construction would be packaged and shipped offsite to licensed facilities. The quantity of all waste materials generated during preconstruction and construction could be managed effectively and would result in SMALL impacts. Operations would generate wastewaters that would be treated onsite before discharge, and solid wastes that would be treated (onsite or offsite) and shipped offsite for disposal. Radioactive process wastewater from facility operations would be collected and treated to remove uranium, other metals, and fluoride. The treated effluent would be discharged to the process wastewater aeration basin and final process lagoon facility. Should discharges to surface waters be necessary, the existing National Pollutant Discharge Elimination System discharge permit would be adequate to cover additional effluent volume. Impacts from sanitary wastewater, cooling tower blowdown, and process wastewater would be SMALL. Impacts of nonhazardous/nonradioactive waste, hazardous waste, and low-level radioactive waste generation would be SMALL due to treatment processes and the availability of disposal pathways. Impacts from radiological exposure to depleted UF_6 in the cylinder storage pads would be SMALL, and impacts from the conversion of depleted UF_6 would be SMALL. Waste management facilities used during operations would be used during

decommissioning. With the decrease in workers during decommissioning, sanitary wastewater treatment would decline. Materials and equipment eligible for recycling or nonhazardous disposal would be sampled or surveyed to ensure that contaminant levels are below release limits. Buildings and other structures would be decontaminated and the debris shipped offsite for disposal. Radioactive material from decontamination and contaminated equipment would be packaged and shipped offsite to a licensed facility. Waste management impacts from decommissioning would be SMALL.

- Socioeconomics. As described in Section 4.2.13, workers and their families could relocate into the ROI in support of GLE Facility operations (over the 40-year license period), which would result in long-term socioeconomic impacts, including increased demand for housing resources and public services. However, these impacts are estimated to be SMALL. All other socioeconomic effects from preconstruction, construction, and decommissioning would be short-term and limited.

- Environmental Justice. As described in Section 4.2.14, potential impacts on minority and low-income populations from the proposed GLE Facility would largely consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Radiation doses from facility operations are expected to remain below regulatory limits. Noise and dust impacts would be temporary and limited to onsite activities. Minority and low-income populations residing along site access and the primary commuter roads could experience increased commuter vehicle traffic during shift changes. Increased demand for rental housing during construction could disproportionately affect low-income populations. However, due to the short duration of construction work and the availability of rental housing, impacts on minority and low-income populations would be short-term and limited. Therefore, construction, operation, and decommissioning of the proposed GLE Facility would have no disproportionately high or adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the Wilmington Site.

- Accidents. As described in Section 4.2.15, five accident scenarios were evaluated in this EIS as a representative selection of the types of accidents that are possible during operation of the proposed GLE Facility. The representative accident scenarios vary in severity from intermediate- to high-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. Two of the accidents involve criticality and the other three involve the release of UF_6. If the higher-consequence-criticality accident were to occur, the consequence for a worker in close proximity would be high (fatality), but GLE has committed to various preventive and mitigating measures to significantly reduce these consequences. A maximally exposed individual at the Controlled Area Boundary would receive a radiation dose of 5.7 millisievert (0.57 rem) total effective dose equivalent, which represents a low consequence to an individual (<0.05 sievert [<5 rem]). For the accidents involving a UF_6 release, worker health consequences would be low for radiological exposures (<0.25 sievert [25 rem]). For uranium chemical exposure, worker health consequences would be intermediate for one (Node 4200) and high for two (Nodes 4100 and 4800) of the accidents. Consequences to the collective offsite public would be less than one lifetime cancer fatality for all accident scenarios. Through a combination of facility design, passive and active engineered controls, and administrative controls, all processes would be maintained non-critical, and accidents at the proposed GLE Facility would pose an acceptably low risk to workers, the environment, and the public. Therefore, the probability weighted consequence (risk) from accidents would be SMALL. No facility accidents would

occur after the cessation of operations, so there would be no potential for facility accidents during decommissioning.

7.1.2 Benefits of the Proposed Action

The proposed action would result in an annual peak capacity of 6 million separative work units (SWU), producing approximately 2.5 million pounds of enriched uranium per year from 2020 through 2051. The benefits to the company will depend on the market price of natural uranium, the cost to enrich the uranium, and the market price of enriched uranium.

As discussed in Section 1.3, the level of production expected by the proposed GLE Facility would augment the domestic supply of enriched uranium and would assist in meeting the need for increased domestic supplies of enriched uranium for national energy security. Under the proposed action, enriched uranium production would be undertaken with the latest enrichment technology.

The proposed action would also result in small positive socioeconomic impacts in the ROI, as described in Section 4.2.13. Table 7-1 presents the estimated employment and tax revenue benefits associated with the proposed action. Between 2012 and 2020, average annual direct and indirect employment at the site as a result of construction activities would be 1264 jobs; State direct income tax revenues would be approximately $0.5 million per year, and State sales tax receipts would be approximately $0.4 million per year during construction on average.[2]

Start-up activities from 2014 to 2020 are expected to create 200 annual direct jobs in the ROI, provide approximately $1.3 million to the State in income tax revenues, and provide approximately $0.9 million in sales tax revenues. During the GLE operations phase between

Table 7-1 Socioeconomic Benefits Associated with the Proposed GLE Facility

Project Phase	Average Direct and Indirect Jobs Created (Full-Time Jobs)	Average Direct State Income Tax Revenues ($ 2008 m)[a]	Average Direct State Sales Tax Revenues ($ 2008 m)
Proposed Action			
Construction	1264[b]	0.5	0.4
Start-up	418	1.3	0.9
Facility operation	732	2.3	1.7
Decommissioning	83	0.3	0.2
Preconstruction	119	0.3	0.2

[a] Includes individual and corporate income taxes.
[b] Chapter 4 lists 3811 preconstruction and construction jobs, which is the peak number of workers; 1264 represents the average number of construction jobs.
Sources: GLE, 2008; 2009b; 2011.

[2] All direct income and direct sales tax impact estimates are provided in 2008 dollars.

Start-up activities from 2014 to 2020 are expected to create 200 annual direct jobs in the ROI, provide approximately $1.3 million to the State in income tax revenues, and provide approximately $0.9 million in sales tax revenues. During the GLE operations phase between 2020 and 2051, 350 direct jobs would be created annually. The State would benefit from approximately $2.3 million in additional income tax, and approximately $1.7 million in sales tax receipts. The decommissioning phase of the proposed action is expected to create a total of 50 annual direct jobs, with annual State income and sales tax revenues of approximately $0.3 million and $0.2 million, respectively.

During the preconstruction phase, 119 jobs would be created; State direct income tax revenues would be $0.3 million and State sales tax receipts would be $0.2 million.

Between approximately 20 percent and 30 percent of direct State income taxes from the construction, operation, and decommissioning of the proposed GLE Facility would be generated as a result of wages and salaries paid to GLE employees moving into the ROI from elsewhere. Procurement of equipment, materials, and services, and the spending of wages and salaries associated with the construction, operation, and decommissioning of the proposed GLE Facility would generate less than 1 percent of annual State sales taxes. Corporate income taxes would also be collected by the State during the facility operational period, and would total an estimated $52.7 million annually.

Although it can be assumed that some portion of State sales and income taxes paid would be returned to the ROI under revenue-sharing arrangements between each county and the State government, the exact amount that would be received by each county cannot be determined.

In addition to sales and income taxes, the proposed GLE Facility would also be subject to property taxes levied by New Hanover County, which were $0.45 per $100 of assessed valuation in 2009, and by the City of Wilmington, which would levy $0.33 per $100 in addition to the County tax (see Section 3.13.4). Assuming that assessed valuation equals total capital investment cost of the proposed GLE Facility, then GLE would pay total property taxes of approximately $8.7 million annually during the period 2020 to 2051.

Beyond the economic and fiscal benefits of the proposed GLE Facility in the ROI, the proposed facility would also create fiscal benefits in the nation as a whole, primarily in the form of Federal income taxes on employee wages and salaries. Based on the distribution of employees in each salary category at the proposed facility, it is estimated that average annual direct individual Federal income taxes during facility construction would be approximately $1.2 million, with approximately $6.4 million generated annually during facility operations. Although, as was the case with State taxes, some portion of Federal income taxes paid by GLE workers would become part of expenditures by various Federal government programs occurring in the ROI, the exact amount that would be received by each county cannot be determined.

7.1.3 Summary of the Proposed Action

This analysis shows that although there are economic and fiscal benefits associated with the proposed action, these impacts are expected to be SMALL. There would also be costs resulting from impacts associated with the proposed action on various resource areas that cannot be expressed in dollar terms. For the majority of these resource areas, impacts are estimated to be SMALL, or SMALL to MODERATE in magnitude.

7.2 Comparative Cost-Benefit Analysis of Proposed Action Relative to No-Action Alternative

This section compares the costs and benefits of the proposed action to those of the no-action alternative. This comparison focuses on the tradeoffs between the proposed GLE Facility compared to not building the facility.

7.2.1 The No-Action Alternative

Although the proposed GLE Facility would not be constructed under the no-action alternative, preconstruction activities would still occur (see Section 1.4.1 of this EIS and the summary of costs and benefits in Section 7.1 above). These activities are not part of the proposed action and would involve the disturbance of land associated with site clearing and the construction of ancillary facilities, in addition to other preconstruction activities, meaning that some ecological, natural, and socioeconomic impacts would therefore occur. All potential local environmental impacts (with the exception of preconstruction activities) related to water use, land use, groundwater contamination, ecology, air emissions, human health and occupational safety, waste storage and disposal, disposition of depleted uranium, and decommissioning projected to occur during the construction, operations, and decommissioning phases would be avoided. Similarly, all socioeconomic impacts (with the possible exception of preconstruction activities) related to employment, economic activity, population, housing, and community resources during the construction, operations, and decommissioning phases would not occur.

Under the no-action alternative, enrichment services would continue to be performed by existing domestic and foreign uranium enrichment suppliers. United States Enrichment Corporation's Paducah Gaseous Diffusion Plant (GDP) and Louisiana Energy Services LLC's (LES) (d/b/a URENCO USA) National Enrichment Facility (NEF) would continue to supply enrichment services. Both the American Centrifuge Plant (ACP) and AREVA's Eagle Rock Enrichment Facility (EREF) also may provide enrichment services in the future.

7.2.2 Methodology

The proposed action and the no-action alternative are first assessed in Section 7.2.3 for compliance with various policy and technical objectives. The proposed action and the no-action alternative are then analyzed in Section 7.2.4 for impacts and values across the following impact areas or attributes:

- construction costs
- operating costs
- depleted uranium disposal costs
- decommissioning costs

While costs and benefits associated with preconstruction activities were discussed in this chapter, they are not included in the comparative analysis, as they are likely to be similar for both the proposed action and the no-action alternative.

The other non-monetary cost areas described in Section 7.1.1 are not included in this comparison because the effect of these impacts is assumed to be either: (1) approximately equal for the proposed action and the no-action alternative as defined above or (2) too small of a differential impact to materially affect the comparative cost-benefit analysis. The NRC assessed impacts and values for these criteria using either: (1) estimated dollars or (2) ordinal ratings based on expert judgment where quantification is regarded as inappropriate or unnecessary. This approach is consistent with NRC guidance and is well suited to the current analysis.

This analysis does not attempt to estimate the economic effects of a cheaper source of enriched uranium for nuclear power plants, or to estimate the impact of lower enriched uranium prices on the ratio of nuclear and non-nuclear power in the domestic economy, on overall power demand and price, and on the potential economic benefits to consumers and suppliers.

7.2.3 Compliance with Policy and Technical Objectives

The following policy and technical objectives are relevant to the choice of an enrichment technology:

- the need for enriched uranium to fulfill domestic electricity requirements
- the need for domestic supplies of enriched uranium for national energy security
- the need for upgraded uranium enrichment technology in the United States

The no-action alternative would not contribute to fulfilling these objectives. The following sections address how the proposed action would meet each of these objectives.

7.2.3.1 Meeting Future Demand

As indicated in Section 1.3.1, the demand for enriched uranium in the United States is currently being met from two categories of sources:

- domestic production of enriched uranium
- foreign sources

The current 5-year average U.S. demand for enriched uranium is approximately 14 million SWU per year (EIA, 2011). This demand could reach 15 million to 16 million SWU by 2025, depending on the rate of nuclear generation growth in the United States (EIA, 2003). Currently, as much as 84 percent of the U.S. demand is supplied by foreign sources. Under the proposed action, construction and operation of the proposed GLE Facility would contribute to reliable domestic supply of enriched uranium to meet the increased demand for nuclear fuel from the nuclear power industry. This benefit could potentially be SMALL to MODERATE.

7.2.3.2 National Energy Security

Foreign sources currently supply approximately 84 percent of the U.S. demand for enriched uranium, and most of the domestic production of enriched uranium takes place at a single

facility – the Paducah GDP. The heavy dependence on foreign sources and the lack of diversification of domestic sources of enriched uranium represent a potential reliability risk for the domestic nuclear energy industry, which supplies 20 percent of national energy requirements. Interagency discussions led by the National Security Council have concluded that the United States should maintain a viable and competitive domestic uranium enrichment industry for the foreseeable future (DOE, 2002).

In a letter to NRC regarding general policy issues raised by the LES license application, the U.S. Department of Energy (DOE) stated that uranium enrichment is a critical step in the production of nuclear fuel and noted the decline in domestic enrichment capacity (DOE, 2002). In its 2002 letter, DOE also referenced comments made by the U.S. Department of State indicating that "Maintaining a reliable and economical U.S. uranium enrichment industry is an important U.S. energy security objective" (DOE, 2002). DOE reaffirmed this position during congressional hearings in June 2010, stating that it (DOE) has made available $4 billion in loan guarantees for the deployment of advanced enrichment technology in the United States in order to increase the domestic uranium enrichment market (DOE, 2010).

In 2007, DOE projected that all gaseous diffusion enrichment operations in the United States would cease in 2012 due to the higher cost of aging facilities (DOE, 2007). Furthermore, the Megatons-to-Megawatts Program is scheduled to expire by 2013 (DOE, 2010). As noted in Section 1.3.1, these two sources meet more than half (53 percent) of the current U.S. demand for low-enriched uranium (LEU). In March 2011, USEC signed an agreement with a Russian corporation, JSC "Techsnabexport" (TENEX), for LEU to be supplied to USEC from Russian commercial enrichment activities (USEC, 2011a). Under the terms of the new agreement, the supply of LEU to USEC will begin in 2013, with the expectation that by 2015, the level of supplied LEU will be approximately one-half the current level supplied under the Megatons-to-Megawatts Program. The level of supplied LEU could eventually meet that supplied under the Megatons-to-Megawatts Program under options in the agreement (USEC, 2011a, 2011b). However, new domestic sources of enriched uranium are still needed to reliably provide fuel to both existing and future nuclear power plants in the United States. Therefore, the projected 6 million SWU production capacity resulting from the proposed action could be important for increasing the nation's energy security. This benefit could potentially be SMALL to MODERATE.

7.2.3.3 Technology Upgrade

The proposed action represents the implementation of a new uranium enrichment technology. Gaseous diffusion technology (in use at Paducah GDP) and gas centrifuge technology (in use at NEF, and planned for ACP and EREF) are the two enrichment technologies currently in commercial use in the United States. Gas centrifuge technology is known to be more efficient and substantially less energy-intensive than gaseous diffusion technology. The GLE laser-based technology that would be deployed at the proposed GLE Facility is newer than gas centrifuge technology, and GE-Hitachi expects it to offer certain advantages over both the gaseous diffusion and gas centrifuge processes (GLE, 2008). This could potentially result in a SMALL to MODERATE beneficial impacts. The proposed action therefore contributes to fulfilling the objective of upgraded domestic uranium enrichment technology, while the no-action alternative does not.

7.2.4 Impacts and Value Analysis

A comparison of the impacts and values of the proposed action and the no-action alternative would include the following cost and categories:

- construction costs
- operating costs
- depleted uranium disposal costs
- decommissioning costs

As the monetary costs associated with preconstruction, construction, operations, and decommissioning phases of the proposed GLE Facility are proprietary and withheld under the provisions of 10 CFR 2.390, the costs associated with each of these life-cycle stages are discussed in a proprietary appendix (Appendix H) and summarized in Table H-1.

7.2.5 Summary Regarding the Proposed Action versus the No-Action Alternative

Based on consideration of local and national socioeconomic benefits, the costs of construction, operation, and decommissioning of the proposed GLE Facility on a range of environmental resources, and on public and occupational health, the proposed action is preferable to the no-action alternative in the following respects:

- The proposed action would contribute to meeting future demand from domestic sources and increase national energy security. It would also introduce a newer technology with potential to have smaller resource requirements and environmental impacts in the United States to fulfill these needs.
- The proposed action would have positive impacts in the ROI on employment, income, and tax revenues during the construction, operations, and decommissioning phases (as discussed in Sections 4.2.13 and 4.2.17.12), and on State and Federal income tax revenues.

7.3 Overall Cost-Benefit Conclusions

While there are national energy security and fiscal benefits associated with the proposed action, and local socioeconomic benefits in the ROI, there are also direct costs associated with the construction and operation phases of the proposed action, as well as impacts associated with the proposed action on various resource areas. However, these impacts are estimated to be SMALL to MODERATE in magnitude and small in comparison to the local and national benefits of the proposed action.

Although the proposed action and the no-action alternative would include the continuation of uranium enrichment using gaseous diffusion, the development of new facilities based on gas centrifuge technology, and imported enriched uranium supplies, the proposed action would better satisfy the objectives to meet future demand for enriched uranium and improve national energy security because it provides a new and reliable domestic source for enriched uranium. It

is therefore apparent that in comparison to the no-action alternative, the proposed action would be associated with net positive benefits.

7.4 References

(DOE, 2002) U.S. Department of Energy. Letter from W.J. Magwood, IV (U.S. Department of Energy) to M.J. Virgilio (U.S. Nuclear Regulatory Commission) dated July 25. ADAMS Accession No. ML022350130.

(DOE, 2007) U.S. Department of Energy. “Uranium Enrichment Decontamination & Decommissioning Fund: 2007 Report to Congress.” ADAMS Accession No. ML103490664.

(DOE, 2010) U.S. Department of Energy, National Nuclear Security Administration. “Highly Enriched Uranium Disposition.” <http://nnsa.energy.gov/aboutus/ourprograms/nonproliferation/materialremovaldisposition/highlyenricheduraniumdisposition> (Accessed January 28, 2010).

(EIA, 2003) Energy Information Administration, U.S. Department of Energy. “U.S. Nuclear Fuel Cycle Projections 2000-2025.” January. ADAMS Accession No. ML101790059.

(EIA, 2011) Energy Information Administration, U.S. Department of Energy. “Uranium Marketing Annual Report.” May. <http://www.eia.gov/FTPROOT/nuclear/umar2010.pdf> (Accessed February 6, 2012).

(GLE, 2008) GE-Hitachi Global Laser Enrichment LLC. “Environmental Report for the GLE Commercial Facility, Revision 0.” December. ADAMS Accession No. ML090910573.

(GLE, 2009a) GE-Hitachi Global Laser Enrichment LLC. “GE-Hitachi Global Laser Enrichment LLC Commercial Facility, Wilmington, North Carolina: License Application April 2009.” April 30. ADAMS Accession No. ML091871003.

(GLE, 2009b) GE-Hitachi Global Laser Enrichment LLC. Letter from A. Kennedy (GE-Hitachi Global Laser Enrichment LLC) to A. Kock (U.S. Nuclear Regulatory Commission) dated November 5. “Subject: GE-Hitachi Global Laser Enrichment Response to Request for Additional Information Related to NRC Review of GLE Environmental Report.” ADAMS Accession No. ML093200137.

(GLE, 2011) GE-Hitachi Global Laser Enrichment LLC. Letter from J. Olivier (GE-Hitachi Global Laser Enrichment LLC) to J. Davis (U.S. Nuclear Regulatory Commission) dated January 17. “Subject: Response to Questions from Telecon Held on January 5, 2011 Regarding the Global Laser Enrichment Environmental Report.” ADAMS Accession No. ML110460567.

(USEC, 2011a) USEC, Inc. News Release: “USEC’s Supply Agreement with TENEX Takes Effect.” December 21. <http://www.usec.com/news/usec%E2%80%99s-supply-agreement-tenex-takes-effect> (Accessed January 31, 2012).

(USEC, 2011b) USEC, Inc. News Release: “Megatons to Megawatts Eliminates Material for 17,000 Nuclear Warheads.” August 24. <http://www.usec.com/news/megatons-megawatts-eliminates-material-17000-nuclear-warheads> (Accessed January 31, 2012).

8 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

On January 30, 2009, General Electric (GE)-Hitachi Global Laser Enrichment LLC (GLE) submitted an environmental report (GLE, 2008) to the U.S. Nuclear Regulatory Commission (NRC) in anticipation of its application for a license to construct, operate, and decommission the GLE Commercial Facility near Wilmington, North Carolina. If licensed, the proposed GLE Facility would enrich uranium for use in commercial nuclear fuel for power reactors. Feed material would be comprised of non-enriched uranium hexafluoride (UF_6). GLE would employ a laser-based enrichment process to enrich uranium to up to 8 percent uranium-235 by weight with an initial planned maximum target production of 6 million separative work units (SWU) per year. The proposed GLE Facility would be licensed in accordance with the provisions of the *Atomic Energy Act*. Specifically, an NRC license under Title 10, "Energy," of the *U.S. Code of Federal Regulations* (10 CFR) Parts 30, 40, and 70 would be required to authorize GLE to possess and use byproduct material, source material, and special nuclear material at the proposed GLE Facility.

GLE could begin preconstruction activities prior to the licensing decision in 2012. If the license application is approved, facility construction would begin in 2012 and continue for 7–8 years. GLE anticipates commencing initial production in 2014 and reaching full production by 2020. Prior to license expiration in 2052, GLE would decide to seek to renew its license to continue operating the facility, or plan for the decontamination and decommissioning of the facility per the applicable licensing conditions and NRC regulations.

Section 102 of the *National Environmental Policy Act* (NEPA) of 1969, as amended (42 USC 4321 et seq.), directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. Section 102(2)(C) of NEPA requires that an EIS include information about the following:

- the environmental impacts of the proposed action;
- any adverse environmental effects that cannot be avoided should the proposal be implemented;
- alternatives to the proposed action;
- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- any irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented.

NRC's regulations under 10 CFR Part 51 implement the requirements of the NEPA, as amended (Public Law 91-190). In particular, 10 CFR 51.20 (b)(10) states that issuance of a license for a uranium enrichment facility requires the NRC to prepare an EIS.

GLE submitted a license application for the proposed GLE Facility on June 26, 2009. GLE proposes to co-locate the facility on the existing General Electric Company (GE)/Global Nuclear Fuel-Americas (GNF-A) site near Wilmington, North Carolina. On May 8, 2009, the NRC granted an exemption authorizing GLE to conduct preconstruction activities on the Wilmington

Site. Subsequently, GLE submitted Supplement 1 to its Environmental Report on July 13, 2009 (GLE, 2009a), which distinguishes between the environmental impacts of preconstruction activities and those of NRC-licensed construction activities, which cannot be undertaken unless a license is granted. On November 13, 2009, GLE submitted Supplement 2 to its Environmental Report (GLE, 2009b), which provides information describing the environmental impacts associated with revising the location of the Wilmington Site entrance and roadway to the proposed GLE site.

Upon acceptance of the Environmental Report, the NRC began the environmental review process described in 10 CFR Part 51 by publishing, on April 9, 2009, a Notice of Intent to prepare an EIS and conduct scoping (Volume 74, page 45075, of the *Federal Register* [74 FR 16237]). The NRC held two public scoping meetings on May 19, 2009. The NRC also met with local officials and conducted a site visit and technical meetings with GLE on May 18–20, 2009. Due to a delay in submission of the license application, the NRC extended the public scoping comment period from June 8, 2009, to August 31, 2009 (74 FR 36781).

The NRC reviewed the GLE Environmental Report and supplemental documentation, and consulted with other Federal, State, and local agencies, and Tribal organizations. The NRC also considered the public comments received during the scoping process for preparation of this EIS; these comments are provided in Appendix A. The NRC issued a Scoping Summary Report in November 2009.

Further comments from the public and government agencies were received after the NRC issued a Draft EIS for public review and comment on June 25, 2010, and announced its availability in the *Federal Register* (75 FR 36447) in accordance with 10 CFR 51.73, 51.74, and 51.117. The public comment period ended on August 9, 2010. During the public comment period, the NRC held two public meetings – in Wilmington, North Carolina, on July 22, 2010 – where oral comments from members of the public were received on the Draft EIS. In addition to comments received at the public meetings, the NRC received written comments by postal mail and email during the public comment period. The public meeting transcripts and the written comments are part of the public record for the proposed GLE Facility. These comments were considered by the NRC in preparing this EIS. Comment summaries and the NRC's responses are contained in Appendix J of this EIS.

Included in this EIS are (1) the results of the NRC's analyses, which consider and weigh the environmental effects of the proposed action; (2) mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC's recommendation regarding the proposed action based on its environmental review.

The NRC defines three significance levels for rating impacts on a resource (10 CFR Part 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.

Mitigation measures were considered for each environmental issue and are discussed in Chapters 4 and 5 of this EIS. During its environmental review, the NRC considered planned activities and actions that GLE indicates it and others would likely take should GLE receive a license. In addition, GLE provided estimates of the environmental impacts resulting from construction, operation, or decommissioning of the proposed GLE Facility at the Wilmington Site.

In a final rule dated October 9, 2007 (72 FR 57416), the Commission limited the definition of "construction" to those activities that fall within its regulatory authority (10 CFR 51.4). In September 2011, the Commission amended the regulations by revising the provisions applicable to the licensing and approval processes for byproduct, source, and special nuclear materials licenses, and irradiators (see 76 FR 56951). The changes clarified the definitions of ''construction'' and ''commencement of construction'' with respect to materials licensing actions conducted under the NRC's regulations. Many of the activities required to build a proposed nuclear facility are not part of the NRC action to license the facility. Activities associated with construction of a facility that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. Although preconstruction activities are not part of the NRC action, they support or are requisite to the NRC action. In addition, certain preconstruction activities require permits from other Federal, State, and local agencies.

8.1 Unavoidable Adverse Environmental Impacts

Section 102(2)(C)(ii) of NEPA requires that an EIS include information about any adverse environmental effects that cannot be avoided should the proposal be implemented. Unavoidable adverse environmental impacts are those potential impacts of the NRC action that cannot be avoided and for which no practical means of mitigation are available.

The environmental impacts associated with the proposed action and the no-action alternative are described in detail for each resource area in Chapter 4. The impacts of the proposed action, no-action alternative, and gas centrifuge technology alternative are summarized and compared in Sections 2.2 and 2.3.4. Brief summaries of the impacts are also provided in Chapter 7 under the Cost-Benefit Analysis and in the Executive Summary. Chapter 4 discusses the mitigation measures that GLE proposed in its Environmental Report to mitigate the potential impacts from the proposed action and the measures that NRC recommends to further reduce the potential impacts on the affected environment. These two sets of mitigation measures are summarized in Tables 5-1 and 5-2, respectively. The cumulative impacts on the environment that would result from the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such action, are described in Section 4.3.

As discussed in Chapter 4, the environmental impacts that would result if the proposed action were to be implemented as proposed by GLE would generally be SMALL, and would, in most cases, be mitigated by the methods proposed by GLE. The only impacts that could potentially be classified as MODERATE would be in the following resource areas: historic and cultural

resources, ecological resources, and transportation. In addition, air quality and noise impacts could be MODERATE on a temporary basis during preconstruction and construction activities.

The impact level on historic and cultural resources has been classified as SMALL to MODERATE, given the close proximity of significant resources and the possibility of an unanticipated discovery. Therefore, the applicant developed GLE Common Procedure CP-24-201, *Unexpected Discoveries of Artifacts or Human Remains.* The NRC has determined that there would be no adverse effect to historic and cultural resources from the proposed action. The staff's determination is based on the license containing the proposed license condition (see Section 4.2.2.2). The North Carolina State Historic Preservation Office (SHPO) concurred with the NRC's determination (NCDCR, 2011).

The impact level on ecological resources has been classified as SMALL to MODERATE, mainly due to clearing of land that would occur during preconstruction activities.

The transportation impacts on local roads in the immediate vicinity of the Wilmington Site could be SMALL to MODERATE due to increases in traffic density during certain phases of the proposed action (e.g., during construction and when the construction and operations overlap from 2014 to 2018) and due to other reasonably foreseeable actions (e.g., the development of a retirement community to the south of the Wilmington Site). The regional transportation impacts would be classified as SMALL.

The ground-disturbing activities during preconstruction and construction activities could result in increased fugitive dust emissions and cause MODERATE air quality impacts. Similarly, noise generated by ground-clearing and construction equipment could raise the noise levels to a range considered to be MODERATE impact. However, both the air quality and noise impacts would be MODERATE and temporary. The majority of the time, these impacts would be considered to be SMALL.

8.2 Relationship between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

Consistent with the Council on Environmental Quality (CEQ) definition and the definition provided in Section 5.8 of NUREG-1748 (NRC, 2003), this EIS defines short-term uses and long-term productivity as follows:

- Short-term uses generally affect the present quality of life for the public (i.e., the 40-year license period for the proposed GLE Facility).
- Long-term productivity affects the quality of life for future generations on the basis of environmental sustainability (i.e., the period after license termination for the proposed GLE Facility).

The construction, operation, and decommissioning of the proposed GLE Facility would necessitate short-term commitments of resources and would permanently commit certain other resources (such as energy and water). The short-term use of resources would result in potential long-term socioeconomic benefits to the local area and the region. The short-term commitments of resources would include the use of materials required to construct new

buildings, the new operations support facilities, transportation, and other disposal resources and materials for proposed GLE Facility operations.

Workers, the public, and the environment would be exposed to increased amounts of hazardous and radioactive materials over the short term from operations of the proposed GLE Facility and the associated materials, including process emissions and the handling of waste and depleted uranium hexafluoride (UF_6) cylinders. Construction and operation of the proposed GLE Facility would require a long-term commitment of terrestrial resources, such as land, water, and energy. Short-term impacts would be minimized by the application of proper mitigation measures and resource management. Upon the closure of the proposed GLE Facility, GLE would decontaminate and decommission the buildings and equipment and restore them for unrestricted use. This work would make the site available for other uses. The use of the site and the buildings for other industrial purposes would constitute a long-term benefit to the community and would increase long-term productivity. Continued employment, expenditures, and tax revenues generated during the implementation of the proposed action would directly benefit the local, regional, and state economies and would be considered a long-term benefit.

8.3 Irreversible and Irretrievable Commitment of Resources

Irreversible commitment of resources refers to resources that are destroyed and cannot be restored, whereas an irretrievable commitment of resources refers to material resources that once used cannot be recycled or restored for other uses by practical means (NRC, 2003). The implementation of the proposed action as described in Section 2.1 would include the commitment of land, water, energy, raw materials, and other natural and manmade resources. About 40 hectares (100 acres) on the 656-hectare (1621-acre) site would be used for the construction and operation of the proposed GLE Facility. The applicant stated in its ER that it plans to decontaminate and decommission the proposed facility for unrestricted use (GLE, 2008). Given the Wilmington Site's current land use zoning, the 40-hectare (100-acre) parcel of land would likely remain industrial beyond license termination. Water required during the entire proposed action, including preconstruction and construction, operation, and decontamination and decommissioning, would be obtained from the existing wells at the Wilmington Site and would be replenished through natural mechanisms. The wastewaters that are generated would be treated to meet applicable standards and would be released to local receiving surface waters. The energy used in the form of electricity, natural gas, and diesel fuel would be supplied through existing systems in the Wilmington area. The specific types of construction materials and the quantities of energy and materials used cannot be determined with certainty until the final facility design is completed. However, it is not expected that the quantities required would put any strains on the availability of these resources.

Even though the land on the Wilmington Site used to construct the proposed GLE Facility would be returned to other productive uses after the facility is decommissioned, there would be some irreversible commitment of land at some offsite locations used to dispose of solid wastes generated at the proposed GLE Facility. In addition, wastes generated during the conversion of depleted UF_6 produced at the proposed GLE Facility and the depleted uranium oxide conversion product from the depleted UF_6 conversion would be disposed of at an offsite location (see Section 2.1.3). The land used for the disposal of these materials would also represent an irreversible commitment of land. No solid wastes or depleted uranium oxide conversion product originating from the proposed GLE Facility would be disposed of at the Wilmington Site.

When the facility is decommissioned, some of the materials used in its construction, such as concrete, steel, other metals, plastics, and other materials, would be recycled and reused. Other materials would be disposed of in a licensed and approved offsite location. The amount of land used to dispose of these materials would also be an irretrievable land resource.

During the operation of the proposed GLE Facility, natural UF_6 would be used as the feed material. This would require the mining of uranium and several other operational steps in the uranium fuel cycle that result in the production of UF_6. The use of uranium minerals would be an irretrievable resource commitment. There would also be other irreversible and irretrievable commitments of resources during uranium fuel cycle operations that result in the production of natural UF_6 feed. As shown in Figure 1-3, there are several fuel cycle operations leading up to the production of the natural UF_6 that feeds enrichment operations. These steps include the mining and processing of uranium ore, which results in the production of natural triuranium octaoxide (U_3O_8), and conversion of natural U_3O_8 to UF_6. All the materials and energy used in the construction and operation of the facilities used to mine and process the uranium ore, and convert natural U_3O_8 to natural UF_6, would constitute irreversible and irretrievable commitment of resources.

8.4 References

(GLE, 2008) GE-Hitachi Global Laser Enrichment LLC. "Environmental Report for the GLE Commercial Facility, Revision 0." December. ADAMS Accession No. ML090910573.

(GLE, 2009a) GE-Hitachi Global Laser Enrichment LLC. "Environmental Report Supplement 1 – Early Construction." July. ADAMS Accession No. ML092100528.

(GLE, 2009b) GE-Hitachi Global Laser Enrichment LLC. "Global Laser Enrichment Environmental Report Supplement 2." November. ADAMS Accession No. ML093240935.

(NRC, 2003) U.S. Nuclear Regulatory Commission. "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs." NUREG-1748. August. <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1748/sr1748.pdf> (Accessed January 29, 2010).

(NCDCR, 2011) North Carolina Department of Cultural Resources, State Historic Preservation Office. Letter from R. Gledhill-Earley (State Historic Preservation Office) to K. Hsueh (U.S. Nuclear Regulatory Commission) dated April 5. "Re: General Electric-Hitachi Laser-Based Uranium Enrichment Facility near Wilmington, Docket 70-7016, New Hanover County, ER 07-2157." ADAMS Accession No. ML110950680.

9 AGENCIES AND PERSONS CONSULTED

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9.1 Federal Agencies

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10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

On January 30, 2009, General Electric (GE)-Hitachi Global Laser Enrichment, LLC (GLE) submitted an environmental report to the U.S. Nuclear Regulatory Commission (NRC) for a license to construct and operate the GLE Global Laser Enrichment Facility. GLE submitted the remainder of the license application on June 26, 2009. The proposed GLE Facility would be located in the North-Central Sector of the existing GE property near Wilmington, North Carolina. The proposed GLE Facility, if licensed, would enrich uranium for use in manufacturing nuclear fuel for commercial power reactors. Feed material for the proposed GLE Facility would be comprised of non-enriched uranium hexafluoride (UF6). GLE would employ a laser-based enrichment process to enrich uranium up to 8 percent uranium-235 by weight, with an initial planned maximum target production of 6 million separative work units (SWU) per year. The proposed GLE Facility would be licensed in accordance with the provisions of the Atomic Energy Act. Specifically, an NRC license under Title 10, "Energy," of the U.S. Code of Regulations (10 CFR) Parts 30, 40, and 70 would be required to authorize GLE to possess and use special nuclear material, source material, and byproduct material at the proposed GLE Facility site.

This environmental impact statement (EIS) was prepared in compliance with the National Environmental Policy Act of 1969, as amended, and the NRC's regulations for implementing the Act (10 CFR Part 51). This EIS evaluates the potential environmental impacts of the proposed action and reasonable alternatives and responds to public comments.

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