GLE Environmental Report

Section 4.6 – Air Quality Impacts

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4.6 Air Quality Impacts

The Wilmington Site is located in a region that is in attainment with all NAAQS for criteria pollutants (see **Section 3.6.3.3** of this Report, *Regional NAAQS Attainment Status [Air Quality]*). There are two current NC DAQ air quality permits for the existing air emissions sources operating at the Wilmington Site (see **Section 3.6.3.5.1** of this Report, *Wilmington Site Existing Air Quality Permits*). This section describes the potential air quality impacts projected to result from the air emissions releases to the atmosphere for the No Action Alternative (**Section 4.6.1**) and the Proposed Action (**Section 4.6.2**). Visibility impacts are discussed in **Section 4.6.3**. A description of the projected cumulative air quality impacts assuming implementation of the Proposed Action is presented in **Section 4.6.4**. The controls planned for the Proposed Action to mitigate air quality impacts are discussed in **Section 4.6.5**.

4.6.1 No Action Alternative

Under the No Action Alternative, a uranium-enrichment facility would not be added to the Wilmington Site. The air emissions sources for the existing Wilmington Site facilities would continue to operate according to the applicable emission limits and control requirements in the current NC DAQ air quality permits; therefore, the air quality impacts resulting from the No Action Alternative would be SMALL.

4.6.2 Proposed Action

Under the Proposed Action, a uranium-enrichment facility would be added to the Wilmington Site. New on-site air emission sources would operate at the Wilmington Site during the construction, operation, and decommissioning of the Proposed GLE Facility. The source types and the constituents and levels of the emissions to the atmosphere from the sources would vary over the life of the project. The use of air emissions control systems and the implementation of other planned mitigation measures for these on-site sources would reduce the levels of air emissions actually released to the atmosphere. Automobile and truck traffic traveling to and from the Proposed GLE Facility would incrementally add small quantities of air emissions to the total motor vehicle air emissions on a regional level (i.e., region of Brunswick, New Hanover, and Pender counties).

4.6.2.1 Site Preparation and Construction

The air quality impacts discussed in this section are based on the construction activities that would be conducted during the first 3 years of Facility construction before the Proposed GLE Facility start-up operations. The potential air emissions from the construction activities for the Proposed GLE Facility would be at the highest levels during this initial 3-year construction phase.

4.6.2.1.1 Site Preparation and Construction Air Emissions Sources

The primary source of on-site air emissions during the 3-year initial construction period would be fugitive dust. Fugitive dust is airborne particulate matter (PM) that is not emitted from a definable point source, such as a combustion unit stack or a process vent, but rather is emitted from natural and man-made area sources open to the atmosphere (e.g., exposed soils, unpaved roadways, material storage piles and handling operations, construction activities). Engine exhaust air emissions would be produced by heavy-duty, off-road construction equipment operated at the GLE Facility site. There would be no radioactive materials stored or used at the GLE Facility site during the initial 3-year construction phase. Small quantities of volatile organic compound (VOC) emissions would be released from the refueling and on-site maintenance of the off-road construction equipment used for construction. There is the potential for additional VOC emissions from certain painting and other construction-finishing activities, depending on the amounts of organic solvent-based paints and architectural coatings that would be used for the buildings and other structures. Air emissions from the automobiles and trucks traveling to and from the Proposed GLE Facility would be associated with the transportation impacts projected to occur from constructing the Proposed GLE Facility (discussed in **Section 4.2.2.1**, *Site Preparation and Construction*).

4.6.2.1.1.1 Fugitive Dust

Construction of large projects the scale of the Proposed GLE Facility commonly produce fugitive dust emissions. These PM emissions typically are produced by the operation of heavy-duty, off-road construction equipment at the construction site for land-clearing, ground excavation, grading, and foundation work. The level of fugitive dust emissions at a typical construction site will vary from day to day, depending on the specific construction activities conducted, soil types exposed to the air, and meteorological conditions (e.g., amount of recent precipitation, wind speed). Wind blowing over disturbed areas of a construction site and on-site building material storage piles is also a potential source of fugitive dust emissions.

The fugitive dust emissions from the GLE Facility site were estimated using the site-specific assumptions and standard fugitive dust emissions factors for construction activities, as described in **Appendix Q**, *Air Emissions from Proposed GLE Facility Construction Sources*. The estimated level of PM emissions resulting from fugitive dust is presented in **Table 4.6-1**. Actual fugitive dust emissions at the GLE Facility site are expected to be lower than the estimated values due to natural mitigation by the high annual precipitation for the area in which the Facility would be located (see **Section 3.6.2.2** of this Report, *Precipitation [Climate]*). In addition, regular use of water spray trucks and other fugitive-dust-suppression practices that would be used during the construction of the Proposed GLE Facility (see **Section 5.6** of this Report, *Air Quality [Mitigation Measures]*) would further mitigate fugitive-dust emissions at the GLE Facility site.

4.6.2.1.1.2 Off-Road Construction Equipment

In addition to fugitive-dust emissions generated by the movements of heavy, off-road construction equipment at the GLE Facility site, additional air emissions would be released from the exhaust of the diesel engines used to power this equipment. Different mixes of heavy-duty, off-road construction equipment would be used for GLE Facility site preparation and access road construction (e.g., dozers, graders, loaders) than would be used during the later construction stages involving erection of the buildings, installation of utilities, and other general construction activities (e.g., cranes, forklifts, aerial lifts). Exhaust air emissions from diesel-engine-powered, off-road equipment consist of carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), PM, and VOCs. The emissions from each type of off-road equipment are a function of equipment-specific factors, including engine horsepower, load factor, and hours of operation.

An estimate of the air emissions resulting from operation of the off-road construction equipment at the GLE Facility site was made using the site-specific assumptions and emission factors described in **Appendix Q**. The estimated air emissions for the off-road construction equipment used at the GLE Facility site are presented in **Table 4.6-1**.

4.6.2.1.1.3 Motor Vehicles

The motor vehicle traffic impacts projected to occur during the construction of the Proposed GLE Facility are discussed in **Section 4.2.2.1**, *Site Preparation and Construction*. Air emissions would be emitted from the individual automobiles, sport utility vehicles, vans, and pickup trucks that are used by construction workers for daily commuting to and from the GLE Facility site, by construction workers to move about the GLE Facility site, and by occasional visitors to the site. Additional vehicle emissions sources would be diesel-powered, heavy-haul trucks (e.g., dump trucks, concrete mixing trucks) and tractor-trailer trucks traveling to the GLE Facility site to deliver construction materials, supplies, and equipment or to haul construction debris from the site.

Based on the motor vehicle trip estimates for the Proposed GLE Facility construction phase presented in **Section 4.2.2.1**, *Site Preparation and Construction*, the air emissions resulting from these motor vehicle trips were estimated using the site-specific assumptions and emission factors described in **Appendix Q**. The estimated air emissions are presented in **Table 4.6-1**. Because motor vehicles are mobile sources, these emission estimates do not represent emissions to the atmosphere from any one specific location (e.g., the GLE construction site [i.e., GLE Facility site] or any other given point). Instead, the estimated emissions represent an incremental increase in total motor vehicle air emissions along the lengths of the roadway routes that would be used by the automobiles and trucks traveling to and from the GLE construction site.

4.6.2.1.2 Site Preparation and Construction Air Quality Impacts

Fugitive dust emissions from preparation and construction of the GLE Facility site potentially could create temporary impacts on local air quality in the vicinity of the site. On-site construction equipment and motor vehicles used for site preparation and construction of the Proposed GLE Facility would result in additional PM, CO, NO_x, VOC, and SO_2 emissions during the Proposed GLE Facility construction phase, as presented in **Table 4.6-1**. To assess the air quality impacts from these air emissions, dispersion modeling was performed using EPA's **AMS/EPA R**egulatory **Mod**el (AERMOD) to predict ground-level ambient air concentrations at locations outside of the GLE Facility site. The site-specific assumptions, meteorological data, receptor locations, and complete modeling results are described in **Appendix R**, *Air Emissions Dispersion Modeling for Construction Phase of Proposed GLE Facility Using AERMOD Model.*

The Proposed GLE Facility would be located in an attainment area with ambient air quality standards (see **Section 3.6.3.1** of this Report, *Applicable Air Quality Standards and Regulations*). Compliance with ambient air quality standards is determined by long-term ambient air quality monitoring at predetermined monitoring station locations using methods and analysis procedures established by the regulatory agencies. These ambient standards are not intended to be used for direct assessment of localized air quality impacts from individual temporary emission sources, such as construction projects; however, comparison of the predicted dispersion model ambient air concentrations with ambient air quality standards provides an order-of-magnitude measure of the potential incremental contribution to ambient pollutant levels in the vicinity of the Proposed GLE Facility from on-site construction activities.

Table 4.6-2 compares the maximum criteria pollutant concentrations predicted to occur along the Wilmington Site property boundary due to Proposed GLE Facility on-site construction activities with the applicable ambient air quality standards. The results of air modeling show that annual average and short-term ambient air concentrations from fugitive dust and on-site motor vehicle emissions produced by construction activities for the Proposed GLE Facility would be orders of magnitude below the level of the applicable ambient air quality standards. These incremental air quality impacts from the air emissions from preparation of the GLE Facility site and construction of the Proposed GLE Facility would not measurably change the existing ambient air quality in the vicinity of the Proposed GLE Facility; therefore, the air quality impacts resulting from the construction of the Proposed GLE Facility are anticipated to be SMALL.

4.6.2.2 Operation

4.6.2.2.1 Operation Air Emissions Sources

The Proposed GLE Facility would not be a major source of air emissions as defined under EPA or North Carolina Division of Air Quality (NC DAQ) air permitting requirements. The laser uranium-enrichment process would be conducted totally indoors inside the main GLE operations building. Most of the heat generated by the process lasers would be used for the building interior space heating and to meet other process-heat demands. The only stationary combustion sources planned to be installed at the Proposed GLE Facility would be auxiliary diesel generator units. The only other air emissions sources at the Proposed GLE Facility would be small, miscellaneous sources described later in this section.

Air emissions from the automobiles and trucks traveling to and from the Proposed GLE Facility would be associated with the transportation impacts projected to occur with operation of the Proposed GLE Facility (discussed in **Section 4.2.2.2**, *Operation [Proposed Action]*).

4.6.2.2.1.1 Process Vents

The laser uranium-enrichment technology that would be used for the Proposed GLE Facility is a closed process with no vents needed for routine venting of process gases. No CO, NO_x, SO_2, or VOC would be produced during Proposed GLE Facility operations. Some short-term gaseous releases potentially could occur inside the main GLE operations building during activities associated with operation of the enrichment process, such as the connection/disconnection of UF_6 cylinders to process equipment and equipment-maintenance activities. These gaseous releases would be contained within the main GLE operations building process areas and routed through the building's ventilation system. The air drawn into the ventilation potentially could contain uranium isotopes, gaseous hydrogen fluoride (HF), and uranyl fluoride (UO_2F_2), a solid particulate compound. The ventilation system air stream would pass through a series of emissions-control devices consisting of high-efficiency particulate arresting (HEPA) filters for removal of solid PM and then through activated carbon beds for adsorption of gases (described in **Section 5.6** of this Report, *Air Quality [Mitigation Measures]*). These control devices would be designed to achieve greater than 99.8% removal of particulates and greater than 99% removal of gaseous pollutants from the air stream. The exhaust air stream from these emissions controls would be vented through a single roof stack to the atmosphere.

Air emissions monitoring data for the FMO facility air emissions control system vent can be used to approximate the expected main GLE operations vent characteristics. The FMO facility has UF_6 cylinder-handling operations and is conducted inside a building that uses an emissions-control system with control performance comparable to the performance of the air emission control system planned to be used for the main GLE operations building; however, the FMO facility includes processes that would not be conducted in the Proposed GLE Facility (e.g., conversion of UF_6 to uranium dioxide [UO_2]–producing HF). Consequently, the actual uranium PM and individual uranium isotope emissions from the Proposed GLE Facility operations are expected to be lower than the levels measured for the FMO facility vents. To model the stack air emissions from the main GLE operations building, total uranium and individual uranium isotope emission rates for the GLE stack were selected through a review of the FMO facility stack monitoring data; the modeling source term was based on data from one of the various FMO stacks judged to be most similar to sources expected for Proposed GLE Facility operations. The selected emission rate is considered to be a conservative assumption (i.e., the uranium and uranium isotope emission rates used for the dispersion modeling are higher than the actual emissions expected from Proposed GLE Facility operations).

4.6.2.2.1.2 Auxiliary Diesel Generator Units

The Proposed GLE Facility is planned to have two 1,250 kW diesel-fuel-fired electrical generator units to provide backup electrical power in the event of a disruption in electrical power normally supplied by the local electric utility (e.g., due to load-shedding or in an emergency when there a utility power outage). Load-shedding is a program used by electric utilities to reduce the total system-wide electrical load during periods of peak demand by temporarily shutting down power to certain large electrical power industrial users under pre-arranged agreements. Under these situations, the diesel fuel-fired electrical generators would be started and operated until the utility restores electrical power from the grid to the Proposed GLE

Facility. Each generator unit would be operated by a 1,650-horsepower diesel engine that burns low-sulfur fuel oil.

Air emissions from operation of these diesel generator units were made using the site-specific assumptions and emissions-calculations spreadsheet developed by the NC DAQ, as described in **Appendix Q.** The estimated annual air emissions for the auxiliary diesel generator units are presented in **Table 4.6-3**. These estimates are based on the assumption that the units operate 1,320 hours per year (the maximum allowable number of operating hours per year that the existing FMO facility's load-shedding diesel generators are currently permitted to operate). The actual operating hours for the Proposed GLE Facility diesel generator units in any given year would vary depending on the number and duration of power disruptions and likely would be fewer than 1,320 hours per year. Consequently, the actual annual air emissions from these units are expected to be lower than the estimated levels presented in **Table 4.6-3**.

4.6.2.2.1.3 On-Site Miscellaneous Sources

Miscellaneous sources of air emissions from Proposed GLE Facility operations would be associated with the planned UF_6 cylinder-handling activities and with routine equipment maintenance. Dedicated vehicles powered by diesel engines (e.g., self-propelled gantry crane) would be used to transfer the UF_6 cylinders between the main GLE operations building dock area and the appropriate cylinder storage pads. These vehicles would be refueled and maintained on-site in an area located an extended distance away from the main GLE operations building. Alternatively, a refueling truck may be used to fuel vehicles near the pad locations, particularly the self-propelled gantry crane. Diesel fuel for operation of the vehicles and the auxiliary diesel generator units would be stored on-site in aboveground, outdoor tanks. Small quantities of organic solvents and lubricants would be used for vehicle maintenance, as well as for maintenance activities for certain process equipment components located inside the main GLE operations building.

Air emissions from on-site miscellaneous sources for the Proposed GLE Facility operations are expected to be low given the intermittent nature of the source-related-activities and the quantities of materials used. Diesel-powered vehicles used for UF_6-cylinder transfer would be used on as-needed basis and would not be in operation at other times. Diesel fuel would be stored in tanks that meet the applicable regulatory permit and code requirements for storage of diesel fuel. Organic solvents and lubricants would be stored in containers with tight-fitting covers.

4.6.2.2.1.4 Motor Vehicles

Air emissions would be emitted along the roadways traveled by automobiles and trucks to and from the Proposed GLE Facility. Based on the motor vehicle trip estimates during the Proposed GLE Facility operation phase presented in **Section 4.2.2.2**, *Operation (Proposed Action),* the air emissions resulting from these motor vehicle trips were estimated using the site-specific assumptions and emission factors described in **Appendix Q**. The estimated air emissions are presented in **Table 4.6-3**. These emission estimates represent the predicted incremental increase to total motor vehicle air emissions to the atmosphere along the entire roadway routes used by automobile and truck traffic traveling to and from the Proposed GLE Facility. Furthermore, the motor vehicle emission estimates presented in **Table 4.6-3** are based on emission factors developed to predict average automobile and truck emissions in the year 2010. Over the planned 40-year operating life of the Proposed GLE Facility, the proportion of lower-emitting motor vehicles in the general motor vehicle population would continually increase and the average per vehicle emission rates would continually decline due to the phasing in of more restrictive federal and State motor vehicle engine emissions standards. Thus, assuming that employment levels and transportation patterns remain constant for the operation phase of the Proposed GLE Facility, the incremental increase to total motor vehicle air emissions to the atmosphere along the entire roadway routes used by automobile and truck traffic traveling to and from the Proposed GLE Facility could be expected to decrease during the Facility's extended operating life.

4.6.2.2.2 Operation Air Quality Impacts

The laser uranium-enrichment technology used for the Proposed GLE Facility would not emit CO, NO_x, SO_2, or VOCs. There is a potential for small gaseous releases associated with operation of the process that could contain uranium isotopes, HF, and UO_2F_2. Any such gaseous releases would be contained with the main GLE operations building and routed to a high-efficiency, multi-stage emissions control system. The Proposed GLE Facility operations would also result in small amounts of nonradioactive air emissions consisting of CO, NO_x, PM, VOCs, and SO_2 from the intermittent use of auxiliary diesel electric generators (see **Table 4.6-3**) to supply electrical power to the Facility when power from the utility grid is not available, as well as from small miscellaneous air emissions sources primarily associated with building- and equipment-maintenance activities.

To assess the air quality impacts, air emissions dispersion modeling was performed using the DOE's XOQDOQ computer model to predict uranium isotopes ground-level ambient air concentrations resulting from Proposed GLE Facility operations at selected downwind receptor locations. The site-specific assumptions, metrological data, receptor sites, and complete modeling results are described in **Appendix S**, *Air Emissions Dispersion Modeling for Operation of the Proposed GLE Facility Using XOQDOQ Model.*

Table 4.6-4 presents predicted normalized concentration (χ/Q) and relative deposition rate (D/Q) for selected receptor locations downwind from Proposed GLE Facility. The maximum off-site uranium isotopes ground-level ambient air concentrations would occur at the Wilmington Site property boundary approximately 0.3 miles (0.5 km) to the northeast of the main GLE operations building vent stack, where the χ/Q value is 1.3×10^{-6} sec/m^3. The nearest existing resident lives at a location approximately 0.9 miles (1.5 km) to the east-southeast of the vent stack, where the predicted χ/Q value is 2.7×10^{-7} sec/m^3.

Table 4.6-5 presents, respectively, the predicted cumulative annual average ambient concentrations for selected receptor locations resulting from emissions of uranium isotopes from the Proposed GLE Facility operations with the FMO facility in operation. **Table 4.6-6** presents the corresponding predicted deposition rates for uranium isotopes from the Proposed GLE Facility and the existing FMO facility at the receptor locations. The predicted maximum total uranium air concentration of 8.4×10^{-13} μCi/m^3 occurs at a location approximately 528 ft (161 m) from the southern Wilmington Site property boundary south of the FMO facility location (see **Figure S-2** in **Appendix S**). The maximum combined deposition rate of uranium is predicted to be 4.1×10^{-7} microcuries per square meter per year (μCi/m^2/year), which is at a distance of 158 ft (42 m) south of the fenceline near the operating FMO facility. The public health and ecological impacts associated with exposure to the ambient air uranium isotope concentrations presented in **Table 4.6-5** are discussed respectively in **Section 4.12**, *Public and Occupational Health Impacts,* and **Section 4.5**, *Soils and Geological Impacts.*

The incremental air quality impacts from the air emissions from the Proposed GLE Facility would not measurably change the existing ambient air quality in the vicinity of the Proposed GLE Facility; therefore, the air quality impacts that would result from the Proposed GLE Facility operations would be SMALL.

4.6.2.3 Decommissioning

The plans for decommissioning of the Proposed GLE Facility are described in **Section 2.1.2.1.3** of this Report (*Decontamination and Decommissioning*). Activities required for the decontamination and removal of process equipment from inside of buildings are not expected to produce any significant levels of fugitive dust or other air emissions. Should decommissioning activities include the demolition of buildings and hard surface areas, then heavy-duty, off-road construction equipment would be required for the demolition of the structures and loading of demolition debris into trucks for off-site disposal. These demolition activities would produce fugitive dust emissions that could be mitigated using water sprays and other dust-suppression work practices. Shipping destinations for disposal of the demolition debris removed from the GLE Facility site would depend on the locations of the land disposal, recycling, or other facilities open and accepting material at the time of Facility closure.

The number of on-site workers required during the decommissioning of the Proposed GLE Facility is projected to decrease to approximately 200 workers. Truck traffic for the decommissioning phase would depend on the amounts of equipment, materials, and demolition debris to be removed and the individual destinations to which these materials are shipped. Automobile and truck air emissions for the Proposed GLE Facility decommissioning phase are expected to be lower than those estimated for the construction and operation phases because of lower-emitting motor vehicles being used in 2052 as result of more stringent federal emission standards in effect and new mobile vehicle technologies.

4.6.3 Visibility Impacts

Visibility impacts refer to the degradation in outdoor visibility on a regional basis (commonly referred to as haze). The emissions from man-made sources of fine PM and other pollutants that contribute to fine particle formation in the atmosphere (i.e., secondary organic aerosols) contribute to reduced visibility (i.e., increased haze). Visibility impacts are of special concern in scenic areas of the United States, such as national parks.

As discussed in **Section 4.6.2**, air emissions of the pollutants that contribute to haze formation are predicted to be low from the on-site air emission sources associated with the Proposed GLE Facility construction, operation, and decommissioning phases. Consequently, the air emissions from the Proposed GLE Facility are expected to have no measurable impact on regional visibility; therefore, the visibility impacts resulting from the construction, operation, and decommissioning of the Proposed GLE Facility would be SMALL.

4.6.4 Cumulative Impacts

The construction, operation, and decommissioning of the Proposed GLE Facility would result in emissions. The sources, pollutant constituents, and quantities of these air emissions would vary over the life of the project. Any air quality impacts resulting from the air emissions would not be cumulative over the construction, operation, and decommissioning phases of the Proposed Action.

Criteria pollutant emissions from the Proposed GLE Facility would be released from a limited number of non-major sources that operate or are conducted intermittently. Consequently, the total annual emissions from these sources would not add significantly to the current emission inventory for the existing Wilmington Site facilities. The cumulative air quality impacts of radionuclide emissions from both Proposed GLE Facility operations and the FMO facility are discussed in **Section 4.6.2.2.2**. There are no other facilities at or in the vicinity of the Wilmington Site that manufacture products using radioactive materials. Public health impacts associated with these air quality impacts are discussed in **Section 4.12**, *Public and Occupational Health Impacts*. Ecological resource impacts associated with the air quality impacts are discussed in **Section 4.5**, *Soils and Geological Impacts*.

Two other projects besides the Proposed GLE Facility that are currently planned for the Wilmington Site are the addition of the ATC II complex and the Tooling Development Center described in **Section 2.3** of this Report (*Cumulative Effects*). Neither the ATC II complex nor the Tooling Development Center would use radioactive materials or would include industrial manufacturing operations. Also, neither of the projects would be a major source of air emissions as defined under EPA or NC DAQ air-permitting requirements. Likely stationary combustion sources required for the projects would be limited to small natural gas-fired boilers for building space heating systems and, possibly, emergency diesel generators.

The Carolinas Cement Company project identified in **Section 2.3** (*Cumulative Effects*) includes a new Portland cement manufacturing facility. The air permit application for the project indicates that the project is considered a major source of air pollutants for air permitting purposes due to the project's estimated potential to emit levels for the criteria pollutants CO, NO_x, PM, SO_2, and VOCs (Carolinas Cement Company, 2008a). As discussed in **Section 4.6.2.2** , the Proposed GLE Facility would not be a major source of criteria pollutants. Therefore, any cumulative impact of the criteria air emissions from the Proposed GLE Facility with the allowable criteria pollutant emission levels established by the NC DAQ in the Carolinas Cement Company plant's air permit are expected to be SMALL. The Carolinas Cement Company plant's cement kiln would also emit fluorides as a result of trace amounts of fluoride compounds in raw materials processed in the kiln. The cumulative public health impact associated with exposure to the ambient fluoride concentrations are discussed in **Section 4.12**, *Public and Occupational Health Impacts,* and are expected to be SMALL.

The new River Bluffs residential and mixed-use project planned for the vicinity of the Wilmington Site and identified in **Section 2.3** (*Cumulative Effects*) would not include any stationary sources considered to be a major source of air pollutants for air permitting purposes. These projects, as well as the addition of the ATC II complex and the Tooling Development Center on the Wilmington Site, would increase the total motor vehicle traffic on NC 133 (Castle Hayne Road), I-140, and the connecting roadways (see **Section 4.2.4**, *Cumulative Impacts [Transportation Impacts]*). This additional motor vehicle traffic would increase automobile and truck air emissions in the vicinity of the Proposed GLE Facility. These projects would be located in a region for which the air quality is in attainment with ambient air quality standards. The cumulative air quality impacts from all of these projects are not expected to substantially change any air quality impact assessments already accounted by New Hanover County long-range regional land use and transportation-growth plans; therefore, the cumulative air quality impacts for the Proposed GLE Facility would be SMALL.

4.6.5 Control of Impacts

Air quality impacts resulting from the Proposed GLE Facility would be controlled by implementing a comprehensive program that incorporates the following air emissions-control components:

- Process design features to inherently lower the potential for air emissions
- Air emissions control systems to capture and remove air pollutants
- Monitoring and inspection programs to detect any air emissions from equipment malfunction so that corrective action can be taken promptly
- Work practices to prevent or reduce air emissions releases.

The air emissions-control measures that would be applied to the Proposed Action are further discussed in **Section 5.6** of this Report (*Air Quality [Mitigation Measures]*).

Tables

Table 4.6-1. Estimated Air Emissions for Proposed GLE Facility Site Preparation and Construction Sources[a]

Air Emission Source	Average Daily Construction Air Emissions Resulting from On-site Construction Activities				
	CO	NO_x	SO_2	VOC	PM
Fugitive dust					1,500 lb/day
Off-road construction equipment	188 lb/day	45 lb/day	0.2 lb/day	8 lb/day	30 lb/day
Air Emission Source	**Annual Construction Air Emissions Resulting from On-site Construction Activities**				
	CO	**NO_x**	**SO_2**	**VOC**	**PM**
Fugitive dust					194 ton/yr
Off-road construction equipment	41 ton/yr	5 ton/yr	< 0.1 ton/yr	0.8 ton/yr	4 ton/yr
Air Emission Source	**Average Daily Off-site Motor Vehicle Air Emissions Resulting from Construction Traffic to and from Proposed GLE Facility**				
	CO	**NO_x**	**SO_2**	**VOC**	**PM**
Automobiles	66 lb/day	11 lb/day	0.1 lb/day	12 lb/day	1 lb/day
Heavy-duty diesel trucks	36 lb/day	43 lb/day	0.2 lb/day	2 lb/day	5 lb/day

[a] Emission estimates for Proposed GLE Facility site preparation and construction sources based on assumptions and emission factors as described in **Appendix Q**.

Table 4.6-2. Predicted Maximum Fenceline Air Pollutant Concentrations Due to Proposed GLE Facility On-site Construction Activities

Air Pollutant	Averaging Time	Predicted Dispersion Model Maximum Fenceline Concentration (μg/m^3)	Corresponding Ambient Air Quality Standard[a,b] (μg/m^3)
Carbon monoxide (CO)	Annual average	0.6	No ambient standard[c]
	8-hour	34	10,000
	1-hour	158	40,000
Nitrogen dioxide (NO_2)	Annual average	0.1	100
Particulate matter (PM_{10})	Annual average	3.5	50
	24-hour	114	150
Sulfur dioxide (SO_2)	Annual average	0.0007	78
	24-hour	0.01	364
	3-hour	0.04	1,300
Volatile organic compounds (VOC)	Annual average	0.08	No ambient standard[d]

[a] Compliance with ambient air quality standards is determined by long term ambient air quality monitoring at predetermined monitoring station locations using methods and analysis procedures established by the regulatory agencies. These ambient standards are not intended to be used for direct assessment of localized ambient air pollutant concentrations from temporary emission sources such as construction projects. The comparison of the predicted air dispersion modeling ambient concentrations with ambient air quality standards presented in **Table 4.6-2** is intended only to provide an order-of-magnitude measure of the potential incremental contribution to ambient pollutant levels in the vicinity of the Proposed GLE Facility from on-site construction activities.

[b] Standards listed are the federal National Ambient Air Quality Standards (NAAQS), which the State of North Carolina has adopted as state standards with the exception of the annual average standard for PM. The federal annual average NAAQS for PM has been revoked, but the level is still maintained as a North Carolina state standard.

[c] No federal or State annual average air quality standard for this pollutant.

[d] No ambient air quality standards are established specifically for VOC. VOC is a precursor pollutant involve in the atmospheric photochemical formation of ozone for which ambient air quality standards have been established.

Table 4.6-3. Estimated Air Emissions from Proposed GLE Facility Operation Sources[a]

Air Emission Source	Annual On-site Operation Air Emissions Resulting from On-site Operation Activities (ton/yr)				
	CO	NO_x	SO_2	VOC	PM
Main GLE facility operations building stack vent	0	0	0	0	< 0.1[b]
Auxiliary diesel generator units	12	28	3.5	1.4	1.5
Air Emission Source	**Average Daily Off-site Motor Vehicle Air Emissions Resulting from Operation Traffic to and from Proposed GLE Facility (lb/day)**				
	CO	**NO_x**	**SO_2**	**VOC**	**PM**
Automobiles	42	5	0.1	8	0.6
Heavy-duty diesel trucks	36	43	0.2	2	5

[a] Emission estimates for Proposed GLE Facility operation sources based on assumptions and emission factors as described in **Appendix Q**

[b] Particulate matter constituents potentially could include uranium isotopes and uranyl fluoride (UO_2F_2) as discussed in **Section 4.6.2.2.1.1**, *Process Vents (Operation Air Emissions Sources)*.

Table 4.6-4. Predicted Normalized Concentrations and Relative Deposition Rates for Selected Receptor Locations Resulting from Proposed GLE Facility Operation Air Emissions[a]

Receptor Location	Direction From Main GLE Operations Building Vent Stack	Distance From Main GLE Operations Building Vent Stack	Normalized Concentration X/Q sec/m^3	Relative Deposition Rates D/Q $1/m^2$
Highest on-site impact	NE	0.25 mi (0.4 km)	1.3×10^{-6}	1.9×10^{-8}
Highest off-site impact (fenceline)	NE	0.3 mi (0.5 km)	1.3×10^{-6}	1.6×10^{-8}
Nearest resident[b]	ESE	0.9 mi (1.5 km)	2.7×10^{-7}	1.3×10^{-9}
Wrightsboro Elementary School	SSE	3.4 mi (5.4 km)	2.1×10^{-7}	1.8×10^{-10}
Emma B. Trask Middle School	ESE	4.7 mi (7.5 km)	9.0×10^{-8}	9.9×10^{-11}
Emsley A Laney High School	SE	5.2 mi (0.4 km)	9.6×10^{-8}	9.3×10^{-11}
New Hanover Regional Medical Center	S	9.0 mi (14.5 km)	1.9×10^{-7}	1.1×10^{-10}
Pender Memorial Hospital	N	14.9 mi (24.0 km)	6.9×10^{-8}	4.4×10^{-11}
Brunswick Community Hospital[b]	SW	29.8 mi (48.0 km)	2.0×10^{-8}	1.3×10^{-11}

[a] Concentrations and deposition rates calculated using assumptions and computer dispersion model as described in **Appendix S**.

[b] Not specified in model as a discrete receptor. Value calculated using GIS spatial averaging techniques.

4.6-5. Predicted Cumulative Annual Average Ambient Concentrations of Uranium Isotopes from the Proposed GLE Facility and Existing FMO Facility[a]

Receptor Location	Annual Average Uranium Isotope Concentration μCi/m³				
	Total U	^{234}U	^{235}U	^{236}U	^{238}U
Highest off-site point of impact	8.41E-13	7.11E-13	2.78E-14	3.16E-16	1.01E-13
Maximally impacted resident	7.60E-13	6.42E-13	2.51E-14	2.85E-16	9.13E-14
Resident closest to GLE stack	5.82E-13	4.29E-13	1.92E-14	2.18E-16	6.99E-14
Wrightsboro Elementary School	2.52E-13	2.13E-13	8.34E-15	9.43E-17	3.03E-14
Emma B. Trask Middle School	9.34E-14	7.90E-14	3.09E-15	3.49E-17	1.12E-14
Emsley A. Laney High School	9.29E-14	7.86E-14	3.07E-15	3.47E-17	1.12E-14
New Hanover Regional Medical Center	1.70E-13	1.44E-13	5.61E-15	6.35E-17	2.04E-14
Pender Memorial Hospital	5.52E-14	4.67E-14	1.83E-15	2.06E-17	6.63E-15
Brunswick Community Hospital	1.63E-14	1.37E-14	5.37E-16	6.08E-18	1.95E-15

[a] Concentrations calculated using assumptions and computer dispersion model as described in **Appendix S**.

4.6-6. Predicted Cumulative Annual Average Deposition Rates of Uranium Isotopes from the Proposed GLE Facility and Existing FMO Facility[a]

Receptor Location	Annual Average Uranium Isotope Deposition μCi/m²/yr				
	Total U	^{234}U	^{235}U	^{236}U	^{238}U
Highest off-site point of impact	4.06E-07	3.43E-07	1.34E-08	1.52E-10	4.88E-08
Maximally impacted resident	2.07E-07	1.75E-07	6.83E-09	7.73E-11	2.48E-08
Resident closest to GLE stack	1.49E-07	1.26E-07	4.92E-09	5.57E-11	1.79E-08
Wrightsboro Elementary School	9.68E-09	8.19E-09	3.20E-10	3.62E-12	1.16E-09
Emma B. Trask Middle School	3.77E-09	3.19E-09	1.25E-10	1.41E-12	4.53E-10
Emsley A. Laney High School	3.73E-09	3.16E-09	1.23E-10	1.39E-12	4.48E-10
New Hanover Regional Medical Center	3.53E-09	2.98E-09	1.17E-10	1.32E-12	4.24E-10
Pender Memorial Hospital	1.31E-09	1.10E-09	4.32E-11	4.86E-13	1.57E-10
Brunswick Community Hospital	3.64E-10	3.08E-10	1.20E-11	1.36E-13	4.37E-11

[a] Deposition rates calculated using assumptions and dispersion model as described in **Appendix S**.

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Section 4.7 – Noise Impacts

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4.7 Noise Impacts

This section discusses the analysis of noise impacts anticipated from the Proposed GLE Facility to the surrounding environment. **Appendix T** of this Environmental Report (*Facility-Specific Data Input and Assumptions Required for the Cadna/A® Noise Model*) provides descriptions of the acoustical terms that are referenced in this section.

4.7.1 Methods for Determining Impacts

4.7.1.1 Software Modeling

The stationary and mobile noise sources that are anticipated for the construction of the proposed North access road, preparation of the GLE Facility site, and operation of the Proposed GLE Facility were modeled using computer software to estimate the sound-level emissions to the environment. The software— Cadna/A® by DataKustik— uses internationally standardized algorithms to calculate the propagation of sounds to the surroundings. The software algorithms calculate the sound propagation from the anticipated noise sources over distance, accounting for the acoustical barrier effects provided by the topography and the existing and future buildings. Sound-level data for the planned equipment and vehicle traffic are entered into the model as line or point sources. The output of the sound modeling provides sound-level contour maps, along with the estimated sound levels (in A-weighted decibels [dBA]) for the contours and at the boundary of the Proposed GLE Facility.

In order to conduct the sound modeling using Cadna/A, a series of assumptions were made regarding the types of sound-generating elements that are anticipated to be associated with the construction (i.e., proposed North access road construction, GLE Facility site preparation, and Proposed GLE Facility construction), operation, and decommissioning of the Proposed GLE Facility. These elements and assumptions are listed in **Appendix T**.

The model has not been used to model the sound emission levels from the existing GNF-A facility. (Sound measurements of the noise generated by the existing facility are described in **Section 3.7** of this Report, *Noise.*) The cumulative effects due to sounds from the existing facility and environment coupled with the modeled results are discussed later in this Report.

The model has not been used to account for meteorological effects, such as wind. Wind diffracts sound downward, producing higher sound levels downwind from the sources. The magnitude of this effect varies and is dependent on many factors, including but not limited to wind speeds, wind elevations, and temperature variations (Beranek, 1988). For this reason, the software does not effectively account for the effect of wind in the model. The wind data in **Section 3.6** of this Report (*Meteorology, Climatology, and Air Quality*) indicates that the wind would influence sound levels to the community differently depending on the season of the year; a precise magnitude of such effects is not predictable.

4.7.1.2 Determination of Noise Impacts

The results from the software model are compared with the New Hanover County Noise Ordinance (New Hanover County, 2007) and EPA guidelines (U.S. EPA, 1974) for community noise impacts (see **Section 3.7**, *Noise*, for a more detailed description of these documents). Specifically, the estimated sound levels at the property line locations defined by Position A (i.e., nearest property line to the residential neighborhood Wooden Shoe subdivision), Position M (i.e., the nearest property line to the proposed North access road, used only in the software analysis) and Position N (i.e., the nearest property line to the Proposed GLE Facility, used only in the software analysis) are used for the impact assessment. Impacts are determined by a comparison, where the sound levels estimated by the software model exceed the sound levels of the ordinance or guideline.

4.7.2 No Action Alternative

The No Action Alternative would consist of not constructing the Proposed GLE Facility, and the operations of the existing facility would not change if this alternative was pursued. As a result, the sound-level emissions from the Wilmington Site would be expected to remain unchanged, and no new impacts are estimated for the No Action Alternative.

4.7.3 Proposed Action

The software estimated sound levels and sound contours from the five different phases of the Proposed Action: proposed North access road construction; site preparation; Facility construction; Facility operation; and Facility decommissioning.

The projected sound-level contours for the road-construction activities during daytime and average day-night sound levels (L_{DN}) are shown in **Figures 4.7-1 and 4.7-2**, respectively.

The projected sound level contours for the site preparation activities during daytime and average day-night sound levels (L_{DN}) are shown in **Figures 4.7-3 and 4.7-4**, respectively.

The projected sound-level contours for the Proposed GLE Facility operations during daytime, nighttime, and average day-night sound levels (L_{DN}) are shown in **Figures 4.7-5, 4.7-6, and 4.7-7**, respectively.

For studying the noise impact at specific locations around the Proposed GLE Facility, three specific positions are used. These locations include the following:

- **Position A** represents the property fenceline location where ambient sound-level measurements were conducted nearest the Wooden Shoe residential subdivision, which is accessed from McDougald Drive. Sound-level measurements conducted at Position A are described in **Section 3.7** of this Report (*Noise*).
- **Position M** represents the nearest property fenceline location to the proposed North access road. The nearest community use is the Wooden Shoe subdivision.
- **Position N** represents the nearest property line location to the Proposed GLE Facility. The nearest community use to Position N is the adjacent hunting club.

A summary of the existing ambient and estimated (modeled) sound levels that occur at Positions A, M, and N for the various phases of the Proposed Action are presented in **Table 4.7-1**. The noise impacts of each of these activities are described below.

<u>4.7.3.1 Impacts to Community</u>

The sound-sensitive areas in the community around the Wilmington Site, encompassing the GLE Study Area, are described in **Section 3.7** of this Report (*Noise*). The primary concern around the GLE Study Area is the Wooden Shoe subdivision. There is also a hunting area located off-site, north of the Proposed GLE Facility. There are no hospitals or schools in the nearby area around the GLE Study Area.

4.7.3.1.1 Road Construction

The sound-level estimates of the proposed North access road construction activities show that sound levels would temporarily exceed the daytime sound levels for the New Hanover County Noise Ordinance (New Hanover County, 2007) and EPA sound-level guidelines (U.S. EPA, 1974) due to the proximity of the heavy construction vehicles to the northern property line of the Site (i.e., the North Road portion of the GLE Study Area, which includes a proposed new road segment connecting the Proposed GLE Facility to NC 133 [Castle Hayne Road]). During road construction, the construction noise would progress westward along the northern Site property line and then due west into the Main portion of the GLE Study Area as the road develops and the heavy earth-moving equipment follows the progress. This movement of the construction progress would result in a temporary noise impact to the nearby residential subdivision.

MODERATE impacts are predicted when the construction activities occur in the proximity of the property line near the Wooden Shoe subdivision. This would be a temporary daytime impact to the adjacent community. Road construction would occur only during daytime hours, avoiding any adverse impacts to the residential subdivision during evening or nighttime hours. This impact is predicted to be a temporary impact that may require noise mitigation during the construction phase of the project.

4.7.3.1.2 Site Preparation

During preparation of the GLE Facility site, the majority of activity would occur away from the property line within the Main portion of the GLE Study Area and at a further distance from the nearest residences. This additional distance mitigates noise levels from the earth-moving equipment to the nearby residential community, resulting in significantly quieter sound levels than those that would occur during the proposed North access road construction. Current design plans for the Proposed Action also include paving of the existing gravel road within the South Road portion of the GLE Study Area and improving one existing stream crossing along that road. These activities also will occur away from the property line and at further distances from the nearest residences than the proposed North access road construction.

Hauling trucks would use the newly created road to deliver materials to and from the GLE Facility site during this phase. The sound levels of these hauling trucks would be significantly lower than the sound levels estimated during the road construction.

As with the road construction, preparation of the GLE Facility site would occur only during daytime hours, avoiding any adverse impacts to the Wooden Shoe subdivision during evening or nighttime hours. The model indicates that estimated sound levels from the GLE Facility site preparation would be below both the New Hanover County Noise Ordinance (New Hanover County, 2007) and EPA sound-level guidance (U.S. EPA, 1974); therefore, noise impacts during site preparation are anticipated to be SMALL. Daytime sound-level impacts to the hunting area are estimated to be MODERATE due to the proximity of the construction to the northern property line.

4.7.3.1.3 Facility Construction

After the road construction and preparation of the GLE Facility site are complete, there would be a lower average sound level while the buildings are erected. The building activities are likely to generate short duration noises, resulting from hauling equipment and handling or moving construction materials, which are typical of building construction. Smaller construction vehicles would be used around the Main portion of the GLE Study Area. Traffic accessing the construction site would increase, but the traffic would consist of smaller passenger or sport utility vehicle/pick-up truck-type vehicles, which are estimated to have a SMALL noise impact to the community.

Construction activities would continue to occur only during daytime hours. Impacts in the Wooden Shoe subdivision are anticipated to be SMALL.

4.7.3.1.4 Facility Operation

Operational noise from the Facility and the vehicular noise from Facility traffic are anticipated to have no adverse impact to the residential subdivision (i.e., a SMALL noise impact). Equipment to be used by the Proposed GLE Facility would primarily be housed within the main GLE operations building, with limited rooftop equipment planned. Various outbuildings are planned with exterior equipment, such as pumps, heat pumps, and transformers; these buildings and equipment would present limited noise impacts to the property line. The vehicular traffic would include passenger vehicles for workers employed at the Facility and hauling vehicles delivering materials on the proposed North access road, as well as hauling vehicles around the Facility and hauling vehicles on the existing South access road, which would connect the Proposed GLE Facility to the existing Wilmington Site facilities.

Facility operation sound levels estimated by the software model are below both the New Hanover County Noise Ordinance (New Hanover County, 2007) and EPA sound-level guidance (U.S. EPA, 1974). SMALL impacts are estimated to the surrounding residential and hunting areas near the Proposed GLE Facility from the operations phase of the Proposed Action.

4.7.3.1.5 Facility Decommissioning

Decommissioning of the Proposed GLE Facility would produce sound levels similar to or lower than those generated from the GLE Facility site preparation and Proposed GLE Facility construction activities. The majority of activities would involve decontaminating and deconstructing Facility equipment (see **Section 2.1.2.1.3** of this Report, *Decontamination and Decommissioning*) and hauling the materials off-site. As a result, the majority of the noise impacting the community would relate to the noise of hauling traffic. The anticipated noise emissions would be similar to those during the Facility construction phase and are therefore estimated to represent a SMALL noise impact.

4.7.3.2 Impacts to Wildlife

Although there has been significant research and findings related to noise impacts on wildlife (ASTM, 2003), there are no commonly accepted criteria for defining these noise impacts on wildlife. One reference (National Research Council, 1977) states that wildlife impacts are similar to human impacts; therefore, similar impacts to those described above are estimated for wildlife around the site during the various phases of the project.

4.7.4 Cumulative Noise Impacts to Community

Sound-level estimates of the cumulative impacts of proposed site traffic and proposed construction activity have already been factored into the analyses above. The various phases of the project would occur separately and, as a result, would not present a cumulative noise impact to the community.

There would be a cumulative effect of combining the existing ambient noise, noise from existing Wilmington Site facilities, and the noise from the Proposed GLE Facility. The cumulative effects of the existing sound levels measured at monitor Position A with the estimated sound levels from the model are presented in **Table 4.7-2**. Due to their distant location from the north Site property line and the general nature of their operations, the additional noise from the new facilities planned for the Wilmington Site (i.e., ATC II complex and Tooling Development Center), described in **Section 2.3** of this Report (*Cumulative Effects*), is not anticipated to have a noticeable impact on sound levels at Position A. Situated outside the 5-mile [8-km] radius of the Wilmington Site, noise from the new cement plant proposed by the Carolinas Cement Company (see **Section 2.3**) also is not anticipated to have a noticeable impact on sound levels at Position A.

These cumulative estimates indicate similar findings to the impacts described previously; no new adverse impacts are anticipated due to cumulative effects (i.e., the cumulative noise impacts are anticipated to be SMALL).

4.7.5 Control of Noise Impacts to Community

Although much of the analysis indicates that the anticipated SMALL to MODERATE impacts would only be temporary (i.e., only during the GLE Facility site preparation and construction phases), and no adverse noise impacts (i.e., SMALL impacts) are anticipated from the operation phase of the Proposed Action, noise mitigation would nevertheless be considered during the final planning and design phases of the project.

4.7.5.1 Construction Noise Control

As indicated in the analyses, there may be temporary noise impacts during road construction and site preparation. During this phase of the project, noise mitigation would focus on construction activities and related operations. There are various mitigation options that would be considered for application by the contractor. Examples of this mitigation (New York City Department of Environmental Protection, 2005) are listed below:

- Equipping construction equipment with the manufacturer's noise-control devices, and maintaining these devices in effective operating condition
- When possible, utilizing quiet equipment or methods to minimize noise emissions during an activity
- When possible and practical, operating equipment with internal combustion engines at the lowest operating speed to minimize noise emissions
- Closing engine housing doors during operation of the equipment to reduce noise emissions from the engine
- Avoiding equipment engine idling
- Utilizing quieter, less-tonal back-up alarms on construction equipment; these alarms should comply with all applicable safety restrictions, such as Occupational Safety and Health Administration (OSHA) standards.

It may be necessary to implement other noise mitigation, such as equipment-specific noise control or temporary noise barriers, if adverse impacts are observed as the project progresses.

4.7.5.2 Operation Noise Control

Although the analyses indicate that there are no adverse noise impacts estimated from the Proposed GLE Facility operations, noise control would be considered when possible to reduce sound-level impacts at the property line.

The exterior electrical substation would produce noise due to the cooling fans and the transformer core. Both the cooling fans and transformer core would produce tonal noises (transformer hum), which could be prominent amongst the broadband noise near the substation. The tonal noise may be audible at farther distances due to its unique aural signature. Options such as a high-efficiency transformer, which are typically several decibels quieter than standard models, or a noise barrier would be considered for this substation to reduce the transmission of this tonal noise to the property line.

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Tables

Table 4.7-1. Estimated Sound Levels (dBA) around Proposed GLE Facility

Site Use	Location	Average Day L_{EQ}	Average Night L_{EQ}	Average 24 Hr. L_{EQ}	L_{DN}
New Hanover County Ordinance	Residential	65	50	N/A	N/A
EPA Guidelines	Residential	N/A	N/A	55	55
Existing Ambient (Measured)	Position A	46	41	44	48
	Position M	N/A	N/A	N/A	N/A
	Position N	N/A	N/A	N/A	N/A
Road Construction (Modeled)	Position A	65	Ambient	62	62
	Position M	67	Ambient	64	64
	Position N	44	Ambient	41	41
Site Preparation (Modeled)	Position A	47	Ambient	44	44
	Position M	49	Ambient	46	46
	Position N	61	Ambient	58	58
Facility Operations (Modeled)	Position A	44	40	43	47
	Position M	47	43	46	50
	Position N	47	47	47	54

The "day" time period is between 7:00 a.m. and 10:00 p.m., while the "night" period is between 10:00 p.m. and 7:00 a.m.

"Ambient" is the existing sound levels documented in **Section 3.7**, *Noise*.

L_{DN} = day-night average sound levels.

L_{EQ} = energy equivalent sound levels.

Table 4.7-2. Estimated Cumulative Sound Levels (dBA) at Position A (Residential Monitor)

Site Use	Location	Average Day L_{EQ}	Average Night L_{EQ}	Average 24 Hr. L_{EQ}	L_{DN}
New Hanover County Ordinance	Residential	65	50	N/A	N/A
EPA Guidelines	Residential	N/A	N/A	55	55
Existing Ambient (Measured)	Position A	46	41	44	48
Road Construction (Modeled + Ambient)	Position A	65	41	62	62
Site Preparation (Modeled + Ambient)	Position A	50	41	47	50
Facility Operations (Modeled + Ambient)	Position A	48	44	47	51

The "day" time period is between 7:00 a.m. and 10:00 p.m., while the "night" period is between 10:00 p.m. and 7:00 a.m.

In this table, the estimated sound levels from the computer model were logarithmically added to the existing sound levels documented in **Section 3.7**, *Noise*.

L_{DN} = day-night average sound levels.

L_{EQ} = energy equivalent sound levels.

Figures

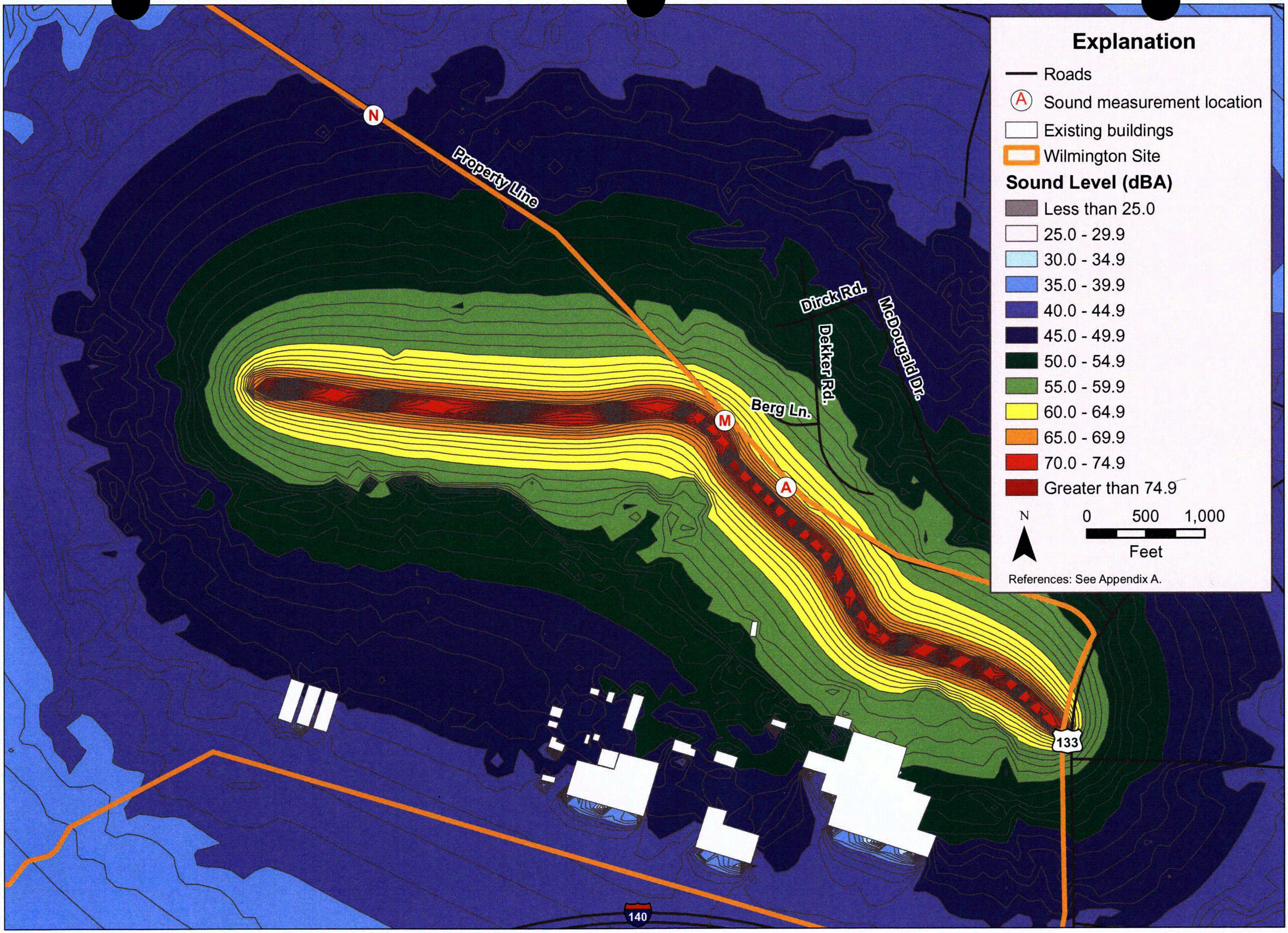

Figure 4.7-1. Estimated average daytime A-weighted sound levels (dBA) during road construction.

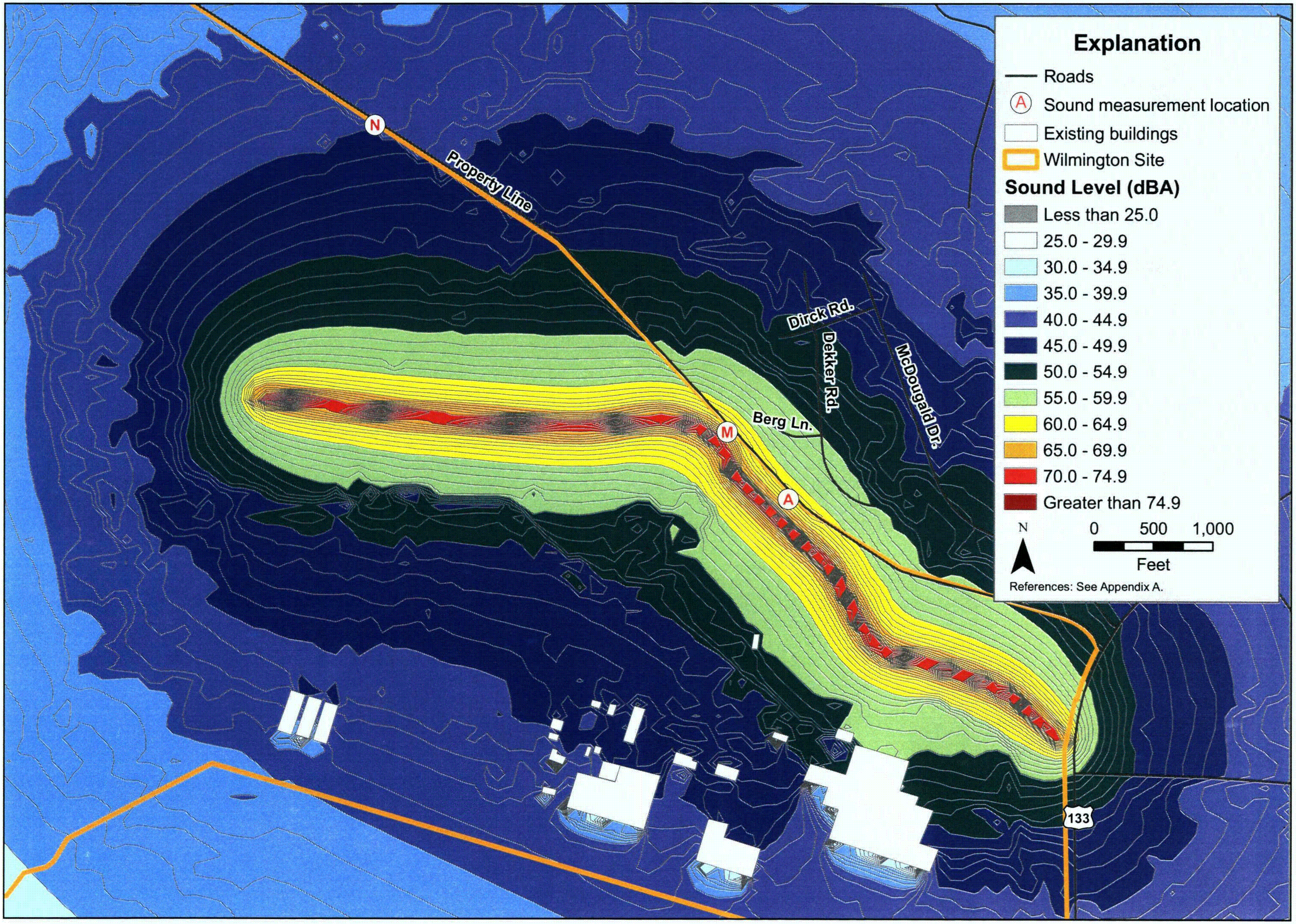

Figure 4.7-2. Estimated day-night average sound levels (L_{dn}, dBA) during road construction.

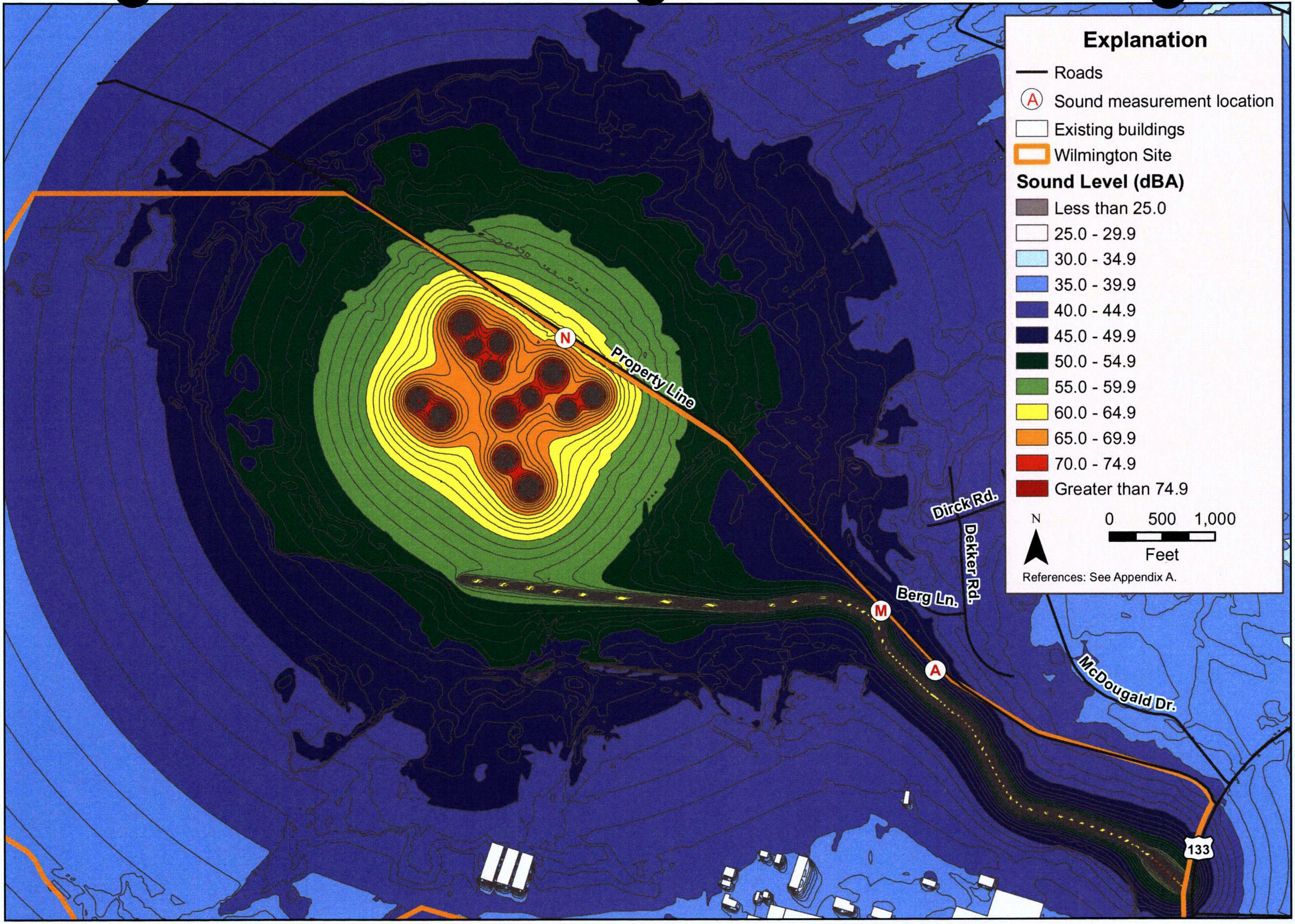

Figure 4.7-3. Estimated average daytime A-weighted sound levels (dBA) during GLE site preparation.

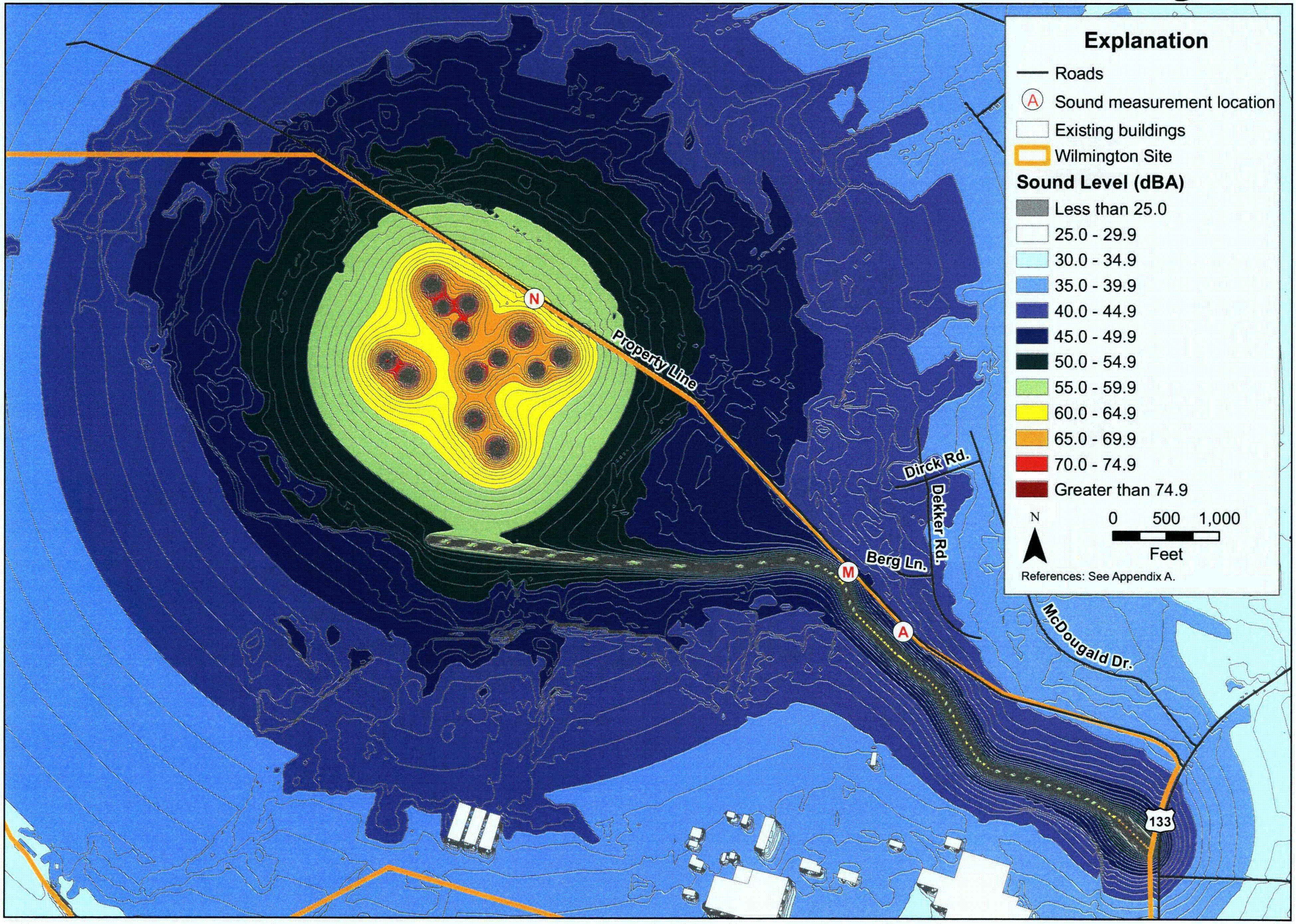

Figure 4.7-4. Estimated day-night average sound levels (L_{dn}, dBA) during GLE site preparation.

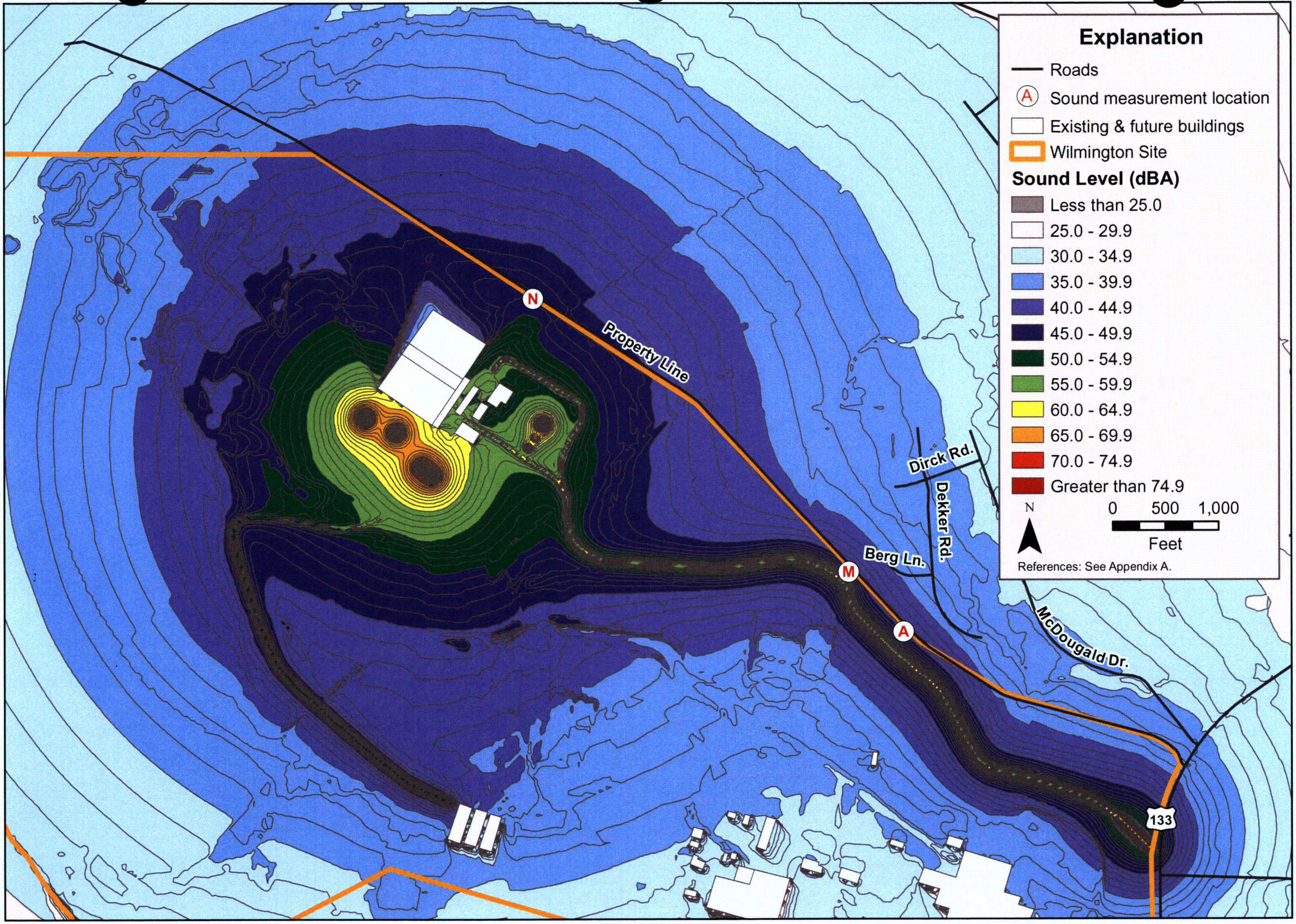

Figure 4.7-5. Estimated average daytime A-weighted sound levels (dBA) during Proposed GLE Facility operation.

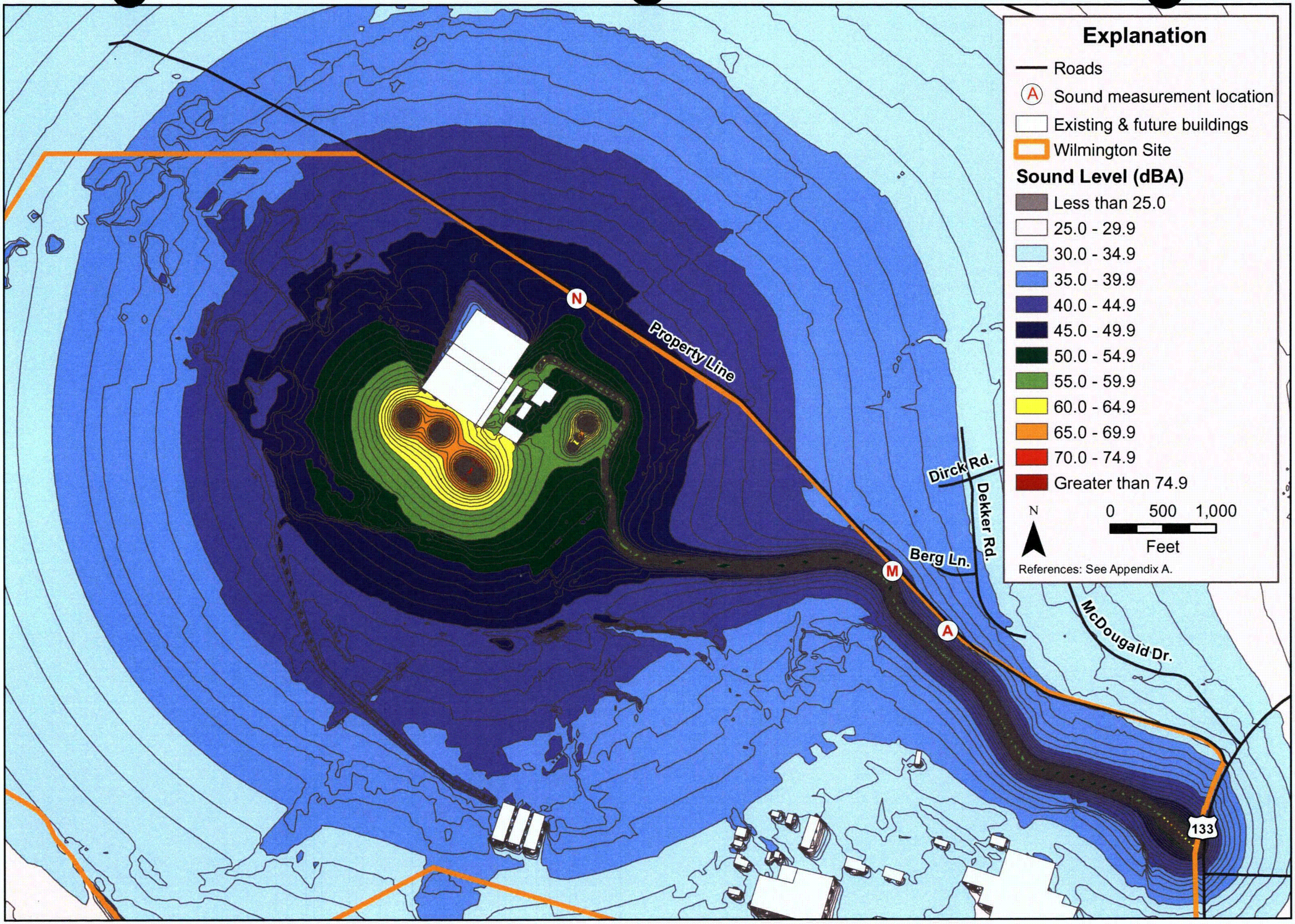

Figure 4.7-6. Estimated average nighttime A-weighted sound levels (dBA) during Proposed GLE Facility operation.

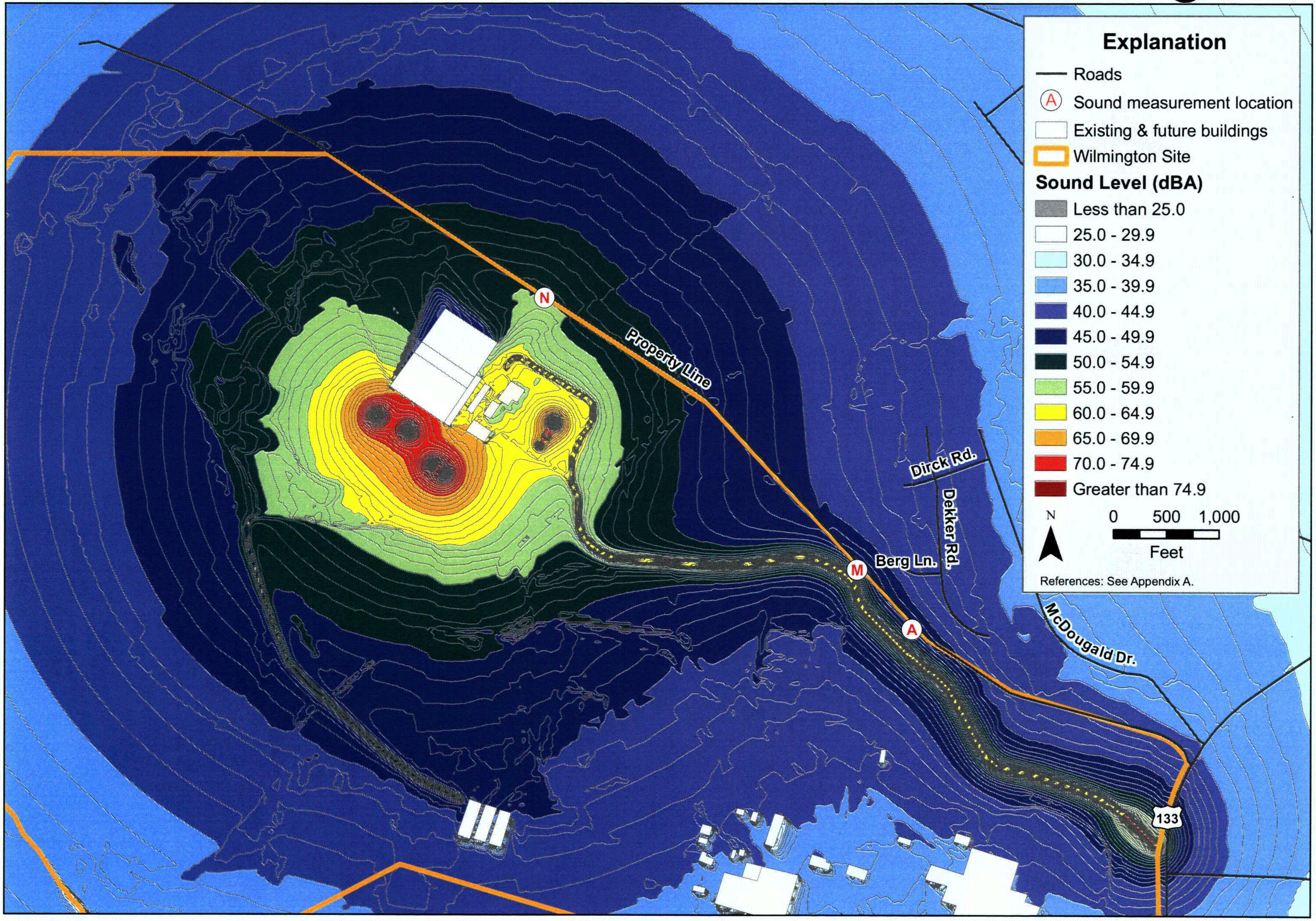

Figure 4.7-7. Estimated day-night average sound levels (L_{dn}, dBA) during Proposed GLE Facility operation.

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4.8 Impacts to Historical and Cultural Resources

As described in **Section 3.8** of this Report (*Historical and Cultural Resources*), two archaeological sites were identified within the 265-acre (107-ha) GLE Study Area. Archeological site 31NH800**[1], a historic-age site, and archaeological site 31NH801, a prehistoric site, are shown in **Figure 4.8-1**. No previously recorded archaeological sites fall within the GLE Study Area. (See Figure 4.1 in Appendix O of the Russ and Postlewaite report to the North Carolina State Historic Preservation Office [NC SHPO], *An Intensive Cultural Resource Investigation: Potential GE Expansion New Hanover County, North Carolina,*) Archaeological site 31NH800**, which is located in an area that would not be directly affected by the project, was determined not to be historically significant; however, detailed investigation indicated that archeological site 31NH801, a prehistoric site dating to the Middle Woodland period and that is located on the edge of a bluff overlooking the bottoms of the Northeast Cape Fear River, may qualify for inclusion in the National Register of Historic Places (NRHP). The rest of this section examines potential impacts of the project on archeological site 31NH801.

4.8.1 No Action Alternative

The No Action Alternative would leave existing conditions unchanged, and thus would result in no impacts to the archaeological site 31NH801.

4.8.2 Proposed Action

Current design plans for the Proposed Action include paving of the existing gravel road within the South Road portion of the GLE Study Area that runs along the western side of archaeological site 31NH801 and improving one existing stream crossing along that road. However, these activities would not involve widening of the road and would not encroach upon archaeological site 31NH801. The paved road, referred to as the proposed South access road, would connect the Proposed GLE Facility to the existing GNF-A FMO facility, and the Proposed Action would result a slight increase in use of this road.

4.8.2.1 Site Preparation and Construction

No changes to archaeological site 31NH801 are expected during the site preparation and construction phase of the project because the existing South access road of the GLE Study Area would not be widened and mitigation measures (see **Chapter 5** of this Report, *Mitigation Measures*) would be taken to protect archaeological site 31NH801 during paving and stream-crossing upgrade operations. Thus, construction impacts to the site are expected to be SMALL. As stated above, no other archeological sites have been identified in the area proposed for Proposed GLE Facility construction, nor have sites been identified within the North Road portion of the GLE Study Area, where widening of existing roads and construction of new road segments would occur.

4.8.2.2 Operation

Operation of the Proposed GLE Facility is not expected to result in impacts to archaeological site 31NH801 because the archaeological site would not be disturbed. For archaeological site 31NH801 to remain undisturbed, the conditions of the bank at the side of the road would remain unchanged from its current graded and vegetated state to help prevent erosion due to wind or rain. There would be a slight increase in traffic over the proposed South access road, as compared to current conditions, due to trucks transporting enriched uranium from the Proposed GLE Facility to the current FMO facility. The increased

[1] ** is a standard identifier used by the State Historic Preservation Office to designate historic archaeological sites in North Carolina.

traffic is not expected to affect conditions at archaeological site 31NH801; therefore, impacts of Proposed GLE Facility operations on the site are expected to be SMALL.

4.8.2.3 Decommissioning

As with construction and operation, decommissioning of the Proposed GLE Facility would not result in impacts to archaeological site 31NH801 because the proposed South access road would not be further modified and traffic would not increase beyond levels during Facility operation. Thus, decommissioning impacts on archaeological site 31NH801 are expected to be SMALL.

4.8.3 Cumulative Impacts

Considering that the existing service road within the South Road portion of the GLE Study Area would not be widened and the existing bank at the side of the road would remain properly graded and vegetated under the construction, operation, and decommissioning phases of the Proposed Action, the cumulative impacts on archaeological site 31NH801 would be SMALL when evaluating these three phases of the Proposed Action together. There are additional archaeological resources within 3,280 ft (1000 m) of the Wilmington Site concentrated to the northwest along the I-140 survey corridor and to the south along the east bank of the Northeast Cape Fear River. There are also a few historic-age structures within 3,280 ft (1000 m) of the GLE Study Area; however, there are no historic-age structures listed in the NHRP within this area. These resources are of interest because there are two other projects besides the Proposed GLE Facility that are currently planned for the Wilmington Site: the ATC II complex and the Tooling Development Center, as described in **Section 2.3** of this Report (*Cumulative Effects*). These projects are planned for locations where there are no known historical or cultural resources, and there is not anticipated to be any increased use of the road that borders archaeological site 31NH801 from these planned facilities, so the cumulative impacts of the Proposed Action and these other planned facilities are expected to be SMALL. In the immediate vicinity of the Wilmington Site, the River Bluffs retirement community development is planned for the undeveloped land parcel bounded by the Wilmington Site's southern property line, I-140, and the Northeast Cape Fear River. GE is unaware of any previously identified historical and cultural resources in the area where the River Bluffs development is planned. Depending on the permitting required for River Bluffs, its developers may be required to coordinate with the NC SHPO and perhaps conduct an assessment of the project's possible impacts to historical/cultural resources. If no additional historical or cultural resources are identified on that land parcel, the cumulative impacts on historical and cultural resources from the Proposed Action and the River Bluffs subdivision would be SMALL.

4.8.4 Control of Impacts

As stated above, to enable archaeological site 31NH801 to remain undisturbed and to help prevent erosion due to wind or rain, the conditions of the bank at the side of the existing gravel road that runs along the site's western side would remain unchanged from its current graded and vegetated state. Additional protective measures that would be employed during the construction phase of the Proposed Action are discussed in **Chapter 5** of this Report (*Mitigation Measures*).

Figure

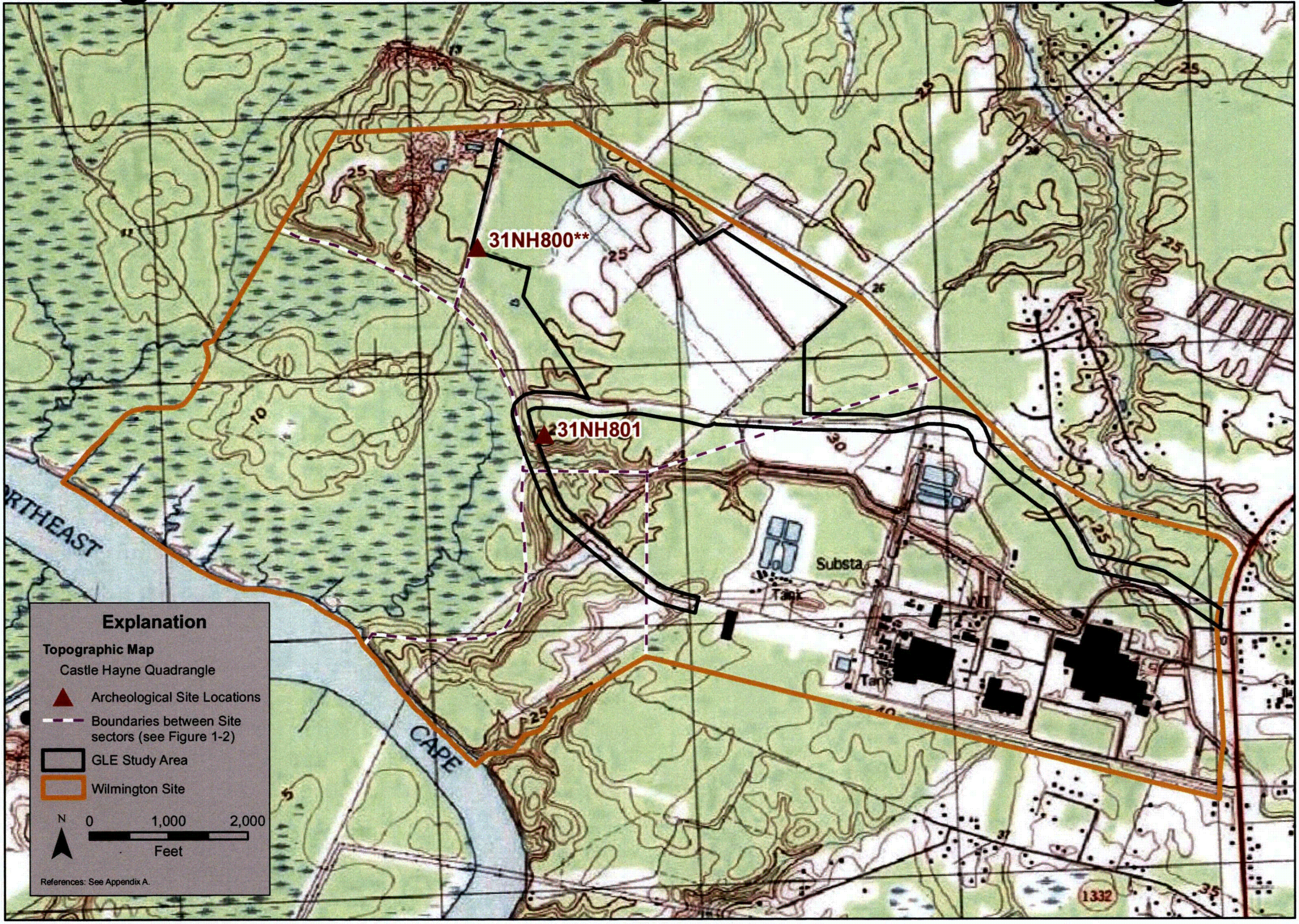

Figure 4.8-1. Location of two newly identified archaeological sites within the GLE Study Area.

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4.9 Visual/Scenic Resources Impacts

The visual and scenic characteristics of the Wilmington Site and its vicinity are described in **Section 3.9** of this Report (*Visual/Scenic Resources*), and photographs showing views of the Wilmington Site from different viewpoints are presented in **Figures 3.9-2 through 3.9-8** and discussed in **Section 3.9.2** (*Wilmington Site Photographs*). This section describes the potential visual/scenic resources impacts projected to result from the No Action Alternative (**Section 4.9.1**) and the Proposed Action (**Section 4.9.2**). A description of the projected cumulative visual/scenic resources impacts assuming implementation of the Proposed Action is presented in **Section 4.9.3**. Measures to mitigate the visual/scenic resources impacts for the Proposed Action are discussed in **Section 4.9.4.**

4.9.1 No Action Alternative

Under the No Action Alternative, a uranium-enrichment facility would not be added to the Wilmington Site, and the North-Central Site Sector of the Wilmington Site would remain undeveloped for the foreseeable future. Consequently, there would be no new visual/scenic resources impacts resulting from the No Action Alternative.

4.9.2 Proposed Action

Under the Proposed Action, a uranium-enrichment facility would be located in the North-Central Site Sector of the Wilmington Site. **Figure 1-3** of this Report shows a current aerial photograph of the Wilmington Site with the approximate overall footprint of the Proposed GLE Facility, located within the Main portion of the GLE Study Area. This figure also shows the North Road portion of the GLE Study Area, where existing gravel roads would be widened and new road segments would be constructed, and the South Road portion of the GLE Study Area, which contains an existing gravel road that would be paved and an existing stream crossing along this road that would be improved.

4.9.2.1 Site Preparation and Construction

The construction of the Proposed GLE Facility would require clearing of vegetation from areas in the interior of the Wilmington Site; however, the amount of trees and vegetation cleared would be limited, to the extent practicable, to the land area needed for the Proposed GLE Facility's operational, security, and utility requirements. As discussed in **Section 4.1.2.1**, *Site Preparation and Construction*, within the Main portion of the GLE Study Area, approximately 100 acres (40 ha) of land would be cleared for the Proposed GLE Facility and approximately an additional 13 acres (5 ha) adjacent to the 100-acre (40-ha) Proposed GLE Facility to the east would be cleared for ancillary structures. All utilities will be underground, with the exception of the aboveground electric power lines. A buffer of trees would remain between the GLE Facility site and the adjacent residential neighborhood to the east (the Wooden Shoe subdivision, situated north of the Northern Site Sector; see **Figure 3.9-9** in **Section 3.9**, *Visual/Scenic Resources*).

Temporary visual intrusions into the landscape may result from the use of construction cranes at the GLE Facility site for erecting building structures and installing equipment. No other visual/scenic resource impacts are expected to result from the activities performed for construction of the Proposed GLE Facility; therefore, the visual/scenic resource impacts resulting from construction of the Proposed GLE Facility would be SMALL.

4.9.2.2 Operation

The layout of the Proposed GLE Facility is described in **Section 2.1.2.1.1** of this Report (*Pre-Operational [Construction] Activities*). The dominant structure for Proposed GLE Facility that potentially could create visual intrusions into the landscape would be the main GLE operations building—an approximately

600,000-ft^2 (55,741-m^2) enclosed building. The side portions of this building would be approximately 50 ft (16 m) tall, and the center portion of this building would be an enclosed tower rising above the roof line of the side portions of the building. The height requirement for this tower section is dependent on process design and operation criteria. Depending on the final Facility design, the tower section could have a height up to 160 ft (49 m) abovegrade (110 ft [34 m]) above the building's main roof, with rectangular profiles of approximately 120-ft (37-m) wide from the front view and approximately 660-ft (201-m) wide from the side view. The tower section of the main GLE operations building would be the tallest structure at the Proposed GLE Facility and the Wilmington Site.

Around the main GLE operations building within the 100-acre (40-ha) Proposed GLE Facility and within the adjacent cleared areas to the east would be located smaller support buildings and ground-level physical facilities. Within the approximate 13 acres (5 ha) adjacent to the Proposed GLE Facility to the east to be cleared for ancillary structures, a new water tower required for the Proposed GLE Facility fire protection system would be erected. This water tower would be similar in height and size as the existing Wilmington Site water tower. Operation of the Proposed GLE Facility would not require the installation of utilities or new roadways outside of the Wilmington Site property boundaries.

4.9.2.2.1 BLM Visual Resource Management System Scenic Quality Rating

The Bureau of Land Management (BLM) Visual Resources Management System (VRMS) was originally developed to facilitate management decisions in the national parks and wilderness areas that are under the jurisdiction of the U.S. Department of the Interior (DOI). The VRMS provides general guidelines for assessing the aesthetic and scenic quality of an area. The central component of the inventory stage of the VRMS is the scenic-quality evaluation. A scenic-quality evaluation using the BLM VRMS methodology was performed for the Wilmington Site, as described in **Section 3.9.10.1** of this Report (*Scenic-Quality Evaluation [Aesthetic- and Scenic-Quality Rating]*). An overall score of 4 was assessed for the Wilmington Site, which corresponds to a low scenic-quality rating (Grade C). The scenic-quality evaluation results were combined with results of a sensitivity analysis and distance zones delineation assessment (see, respectively, **Section 3.9.10.2**, *Sensitivity-Level Analysis*, and **Section 3.9.10.3**, *Distance-Zones Delineation*) to assess which one of the BLM visual resource inventory classes is applicable to the Wilmington Site. The Proposed GLE Facility would be located in an area designated under the VRMS as Management Class IV (see **Section 3.9.10.4**, *Determination of Visual Resource Inventory Classes*). The BLM management objectives for Class IV areas allow for high levels of change, with the understanding that an attempt is made to minimize the visual impacts of the planned disturbance. The Proposed Action is compatible with the BLM's Class IV management objectives.

4.9.2.2.2 Potential Significant Visual Impact Features

The main GLE operations building tower section would be the highest structure at the Proposed GLE Facility. Assuming a maximum height of 160 ft (49 m) for the building tower section, it would be 30 ft (9 m) taller than the existing highest structure on the Wilmington Site, the 130-ft (40-m) water tower. The new water tower would be similar in height and appearance to the exiting Wilmington Site water tower. As discussed in **Section 3.9** of this Report (*Visual/Scenic Resources*), the existing Wilmington Site water tower can be seen approaching the Wilmington Site from either direction along the segments of I-140 and NC 133 (Castle Hayne Road) that are near the Wilmington Site, as well as from the neighborhoods in the vicinity of the Site south of I-140 (see **Figure 3.9-3**). The Proposed GLE Facility would add to the visual intrusions in the existing landscape. It is possible that the main GLE operations building tower section could alter the existing skyline from certain off-site viewpoints (primarily views from vehicles traveling on I-140). The height of the main GLE operations building tower section and the building elevation may make it visible from more off-site viewpoints than the current visibility of the on-site water tower. However, the locations of the main GLE operations building and new water tower in the North-Central Site Sector are further west on the Site than the existing Wilmington Site facilities' buildings, water tower, and other structures. These locations for the Proposed GLE Facility buildings and elevated structures are expected to mitigate some of the visual impacts from viewpoints south and east of the Site due to the increased distance from most viewpoints as compared to the distance to the existing Wilmington Site facilities. Regardless of the actual visibility of the Proposed GLE Facility to off-site observers, given the nature and scale of existing industrial manufacturing operations at the Wilmington Site and in its vicinity, adding two additional tall structures to the Wilmington Site would not be out of character with the visual elements and architectural features already at the Site.

The Proposed GLE Facility structures would not completely obstruct views of the existing landscape. The tower portion of the main GLE operations building could create a partial visual obstruction from some viewpoints, depending on the observer's location relative to the building and the final Facility design. The area immediately west of the Proposed GLE Facility is undeveloped, forested land within the Wilmington Site and is not accessible to the public. The off-site area immediately north of the Proposed GLE Facility (locally known as the Sledge Forest) currently is used for timber management and as a private hunting area (see **Section 3.1.6** of this Report, *Land Use in the Vicinity of the Wilmington Site*). Both of these areas are not expected to be developed in the foreseeable future, thus reducing the potential for visual/scenic resource impacts from the Proposed GLE Facility by limiting the accessibility of people to viewpoints in the area. The visual/scenic resource impacts for people living in residential developments to the east and south of the Proposed GLE Facility are expected to be SMALL. Pine trees on the Wilmington Site would provide a visual buffer for the residential area located north of the Eastern Site Sector. Also, areas in the vicinity of the Proposed GLE Facility predominately consist of one- and two-story homes and are not zoned for high-density residential uses. There are no high-rise residential buildings in the vicinity of the Proposed GLE Facility for which residents' views would be impacted by the main GLE operation building tower section rising above the tree line. No new aboveground electrical power lines would be required to be installed off-site for the Proposed GLE Facility.

The Proposed GLE Facility structures would not visually impact any known historical, archaeological, or cultural resources on or in the vicinity of the Wilmington Site, or impact the character of the Wilmington Site property. Also, the structures would not create visual, audible, or atmospheric elements that are out of character with the Wilmington Site vicinity or alter its existing mixed land use setting.

4.9.2.2.3 Compatibility and Compliance with Regulations, Ordinances, and Requirements

The Wilmington Site is zoned I-2 (Heavy Industrial). There are no height restrictions in the New Hanover County Zoning Ordinance for properties in the I-2 designation. Also, no visual compatibility compliance requirements were identified that would be applicable to the Proposed GLE Facility.

As is discussed in **Section 3.2.1.4** of this Report (*Airports [Regional Transportation Corridors]*), Wilmington International Airport is located southeast of the Wilmington Site (see **Figure 3.2-6**). The Federal Aviation Administration obstruction marking and lighting requirements specify that "any temporary or permanent structure, including all appurtenances, that exceeds an overall height of 200 feet (61 m) above ground level or exceeds any obstruction standard contained in 14 CFR part 77, should normally be marked and/or lighted" (FAA, 2007). The planned maximum structural height for the Proposed GLE Facility of no greater than 160 ft (49 m) would be below the 200-ft (61-m) threshold height required for marking and lighting a structure. Thus, the Proposed GLE Facility would not be required to have strobe or other types of marking lights that would cause nighttime visual impacts in the neighborhoods around the Wilmington Site.

4.9.2.2.4 Operation Impact Summary

The Proposed GLE Facility would be compatible with the Wilmington Site's BLM VRMS Management Class IV designation. The visual/scenic resource impacts of Proposed GLE Facility operations at viewpoints outside of the Wilmington Site property boundaries would be mitigated by the design and layout of buildings and other Proposed GLE Facility structures, their location in the North-Central Site Sector of the Wilmington Site, and the retention of a perimeter tree buffer. The only structures for the Proposed GLE Facility that are likely to have a visual impact to observers at some off-site viewpoints are the tower section of the main GLE operation building and the new water tower. Given the nature and scale of existing industrial manufacturing operations at the Wilmington Site and in its vicinity, adding these two additional tall structures to the Wilmington Site would not be out of character with the visual elements and architectural features already at the Site. The Proposed GLE Facility structures would neither visually impact any known historical, archaeological, or cultural resources on or in the vicinity of the Wilmington Site, nor create visual, audible, or atmospheric elements that are out of character with the Wilmington Site vicinity or alter its existing mixed land use setting; therefore, the visual/scenic resource impacts resulting from operation of the Proposed GLE Facility would be SMALL.

4.9.2.3 Decommissioning

The plans for decommissioning of the Proposed GLE Facility are described in **Section 2.1.2.1.3** of this Report (*Decontamination and Decommissioning [Description of the Proposed Action]*). Decommissioning of the Proposed GLE Facility would involve removal and decontamination of the used process equipment and materials from building interiors and from outdoor storage areas. Some of the structures, including the main GLE operations building, access roads, and utility lines built for the Proposed GLE Facility, could remain in place after closure. Thus, no additional changes to the visual/scenic resources impacts are expected due to the decommissioning of the Proposed GLE Facility, and the visual/scenic resource impacts resulting from decommissioning of the Proposed GLE Facility would be SMALL

4.9.3 Cumulative Impacts

The initial clearing of the land and construction of the Proposed GLE Facility makes the visual/scenic resources impacts of the project effectively permanent and, consequently, should be considered cumulative over the construction, operation, and decommissioning phases of the Proposed Action.

The Eastern Site Sector of the Wilmington Site is already developed and contains large manufacturing buildings and support structures similar in design and scale to those structures planned for the Proposed GLE Facility. Two other projects beside the Proposed GLE Facility currently planned for the Wilmington Site are the addition of the ATC II complex and the Tooling Development Center, as described in **Section 2.3** of this Report (*Cumulative Effects*). These projects would add additional large buildings to the Eastern Site Sector of the Wilmington Site. The cumulative visual/scenic resources impact of the Proposed GLE Facility with the existing Wilmington Site facilities and other planned projects would not represent a significant change in the overall visual character and value of the landscape in the vicinity of the Wilmington Site. No other new projects planned for development in the immediate vicinity of the Wilmington Site (discussed in **Section 4.1.3,** *Cumulative Impacts [Land Use Impacts]*) are known to include the use of towers, high-rise buildings, or other tall structures that could add to the visual intrusions in the existing landscape and skyline around the Site; therefore, it is expected that the cumulative visual/scenic resource impacts resulting from the Proposed GLE Facility would be SMALL.

4.9.4 Control of Impacts

Visual/scenic resource impacts resulting from the Proposed GLE Facility would be mitigated by measures that are planned to be incorporated into the Facility design. These mitigation measures include the following:

- Locate the Proposed GLE Facility in a sector of the Wilmington Site away from Site boundaries bordering existing development along NC 133 (Castle Hayne Road) and I-140

- Maintain, to the fullest width practicable, the existing tree buffer east of the Proposed GLE Facility and along the north property line of the Eastern Site Sector to limit visibility of the Proposed GLE Facility structures and access-road traffic from off-site viewpoints in nearby residential neighborhoods
- Use exterior building colors and facility landscaping to soften the visual impact.

Each of these visual/scenic resource impact mitigation measures for the Proposed GLE Facility is also discussed in **Section 5.9** of this Report (*Visual/Scenic Resources [Mitigation Measures]*).

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GLE Environmental Report

Section 4.10 – Socioeconomic Impacts

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4.10 Socioeconomic Impacts

The construction and operation of the Proposed GLE Facility would attract new individuals and income to southeastern North Carolina that would not otherwise have migrated to the area. As a result, the Proposed GLE Facility would impact population, economic, and social characteristics of the region over the course of its 40-year licensed operating term. The analysis examines the socioeconomic impacts of the Proposed GLE Facility over the period 2011 through 2057, under the assumption that the Facility would be decommissioned when its 40-year licensed operating term expires.

This section examines these impacts and is organized as follows: **Section 4.10.1** describes the No Action Alternative; **Section 4.10.2** discusses how installing and operating the Proposed GLE Facility would impact the population, economic, and social characteristics of the region and compares these changes to the no-action baseline; and **Section 4.10.3** provides a summary of the cumulative socioeconomic impacts of the Proposed GLE Facility.

4.10.1 No Action Alternative

The No Action Alternative is defined as the way in which the population, economy, and social structure of the Wilmington Site region would evolve over time in the absence of the Proposed GLE Facility. Under this alternative, any positive or adverse consequences of the Propose Action would not occur. As a result, it will serve as the baseline for measuring the Facility's potential impacts on the surrounding region. Because the No Action Alternative has, by definition, no changes from baseline, its impact on social and economic conditions in the region would be SMALL.

The region that is considered during this analysis includes the three counties that surround the Proposed GLE Facility: Brunswick, New Hanover, and Pender. These three counties constitute the Wilmington Metropolitan Statistical Area (MSA) and are expected to be the primary source of labor for both construction and operation of the Proposed GLE Facility.

If the Proposed GLE Facility is not constructed and no other action is taken, the population and employment in these three counties are expected to grow in accordance with current projections. Population projections for the region were obtained from the North Carolina State Demographics Unit of the Office of State Budget and Management (NC OSBM, 2007) and are reported for each year from 2000 to 2020 in **Table 4.10-1**. As data in this table indicate, total population in the region is projected to be approximately 368,000 in 2010 and 444,000 in 2020.

Employment projections for industries present in the region were obtained for the years 2004 and 2014 from the North Carolina Employment Security Commission (NC-ESC); however, these projections were not available for individual counties. Instead, the information was organized into groups of counties called Workforce Development Boards (WDBs). WDBs are regional entities designed to direct federal, State, and local funding to workforce-development programs as mandated by the U.S. Workforce Investment Act of 1998.

The WDB that encompasses the region is the Cape Fear WDB, which includes Brunswick, Columbus, New Hanover, and Pender counties. Total employment for this WDB is projected to grow approximately 1.72% per year, from 150,648 workers in 2004 to 178,714 workers in 2014. Assuming growth continues at this pace after 2014, total employment would reach 198,005 by the year 2020. A complete year-by-year breakdown of projected employment from 2004 to 2020 is provided in **Table 4.10-2**.

These projections may slightly overstate employment in the region for two reasons. First, the Cape Fear WDB projections include Columbus County, which is outside the region. This overstatement should be small because annual county-level employment estimates provided by the NC-ESC shows that Columbus County accounted for only 13% of total 2004 employment in the four counties that make up the Cape Fear WDB (Employment Security Commission of North Carolina, 2004).

Second, NC-ESC employment projections are projections of the number of jobs held in the region as opposed to a count of the number of people employed. Individuals that hold more than one job (multiple job holders) would be counted multiple times. This double-counting is not expected to distort the projections to a large degree because few workers hold multiple jobs; only 5.3% of employed individuals in North Carolina held more than one job in 2006 (U.S. Bureau of Labor Statistics, 2007).

In addition to population and employment projections, the social characteristics of the region are important for this analysis and are expected to change over time. The social characteristics examined included housing availability, school enrollment, availability of health service resources, and law enforcement and fire-fighting resources. However, future changes in these characteristics are difficult to quantify, and no projections of their future growth were available. As a result, the analysis used the most current, comprehensive data available to describe the baseline conditions associated with the No Action Alternative. Since data on current conditions do not account for future growth, the impacts of the Proposed Action measured relative to current conditions may be overstated.

4.10.2 Proposed Action

Under the Proposed Action, construction of the Proposed GLE Facility is assumed to begin in 2011 and last 7 years until 2017. The construction labor force present at the Wilmington Site is expected to vary from year to year, rapidly increasing between 2011 and 2012 and then gradually declining in subsequent years.

According to GLE estimates, annual construction employment would begin at approximately 290 workers in 2011. Annual construction employment would then peak in 2012 and 2013 at approximately 485 workers. After this peak, construction employment would gradually decline until 2017, when there would be approximately 136 construction workers on the site. The types of construction workers needed throughout the construction of the Facility is expected to include electricians, carpenters, pipe fitters, plumbers, and other skilled and unskilled workers.[1]

The Proposed GLE Facility would begin operation in 2013 while it is still under construction. Between 2013 and 2016, there would be a 4-year start-up process that gradually increases Facility production by approximately 1.2 million SWU per year. GLE estimates that approximately 550 workers may be required to operate the Facility and conduct start-up and operations activities during this 4-year time period.

In 2017, the Proposed GLE Facility is expected to be fully operational at 6 million SWU per year. From 2017 until 2050, GLE estimates that the Facility would earn more than $500 million in annual revenue and employ approximately 350 workers each year.[2] Unless the license is renewed, the plant would then be decommissioned.[3] The decommissioning process would involve removing equipment from the Facility, while leaving the building, parking area, and access roads in place (see **Section 2.1.2.4** of this Report, *Site and Facility Information [Proposed Action]*, for a more detailed description of the decommissioning phase). GLE estimates that this process would take 9 years, with the first 2 years of decommissioning overlapping the last 2 years of operations, and would require a workforce of approximately 50 full-time

[1] All employee estimates related directly to the Proposed GLE Facility have been rounded to the nearest multiple of 10, while all monetary values directly related to the Facility have been rounded to the nearest multiple of 1,000.
[2] For the purposes of this analysis, it is assumed that the Facility will be decommissioned in 2050. In reality, it is more likely that the license will be renewed and decommissioning would occur later than 2050.
[3] Revenue and payroll figures in this chapter are reported in terms of 2007 dollars.

employees. A summary of the work force required during each year of construction, operation, and decommissioning is provided in **Table 4.10-3**.

4.10.2.1 Population Impacts

4.10.2.1.1 Site Preparation and Construction

The direct population impact of constructing the Proposed GLE Facility would depend on how many workers are obtained from within Brunswick, New Hanover, and Pender counties. For example, if all site preparation and construction workers are obtained from within this region, then there would be no change in the region's total population; however, if any workers are introduced from outside these three counties, there would be potential impacts to regional demography.

To get a sense of how many workers would need to be obtained from outside the region, representatives from the Greater Wilmington Chamber of Commerce and Wilmington Industrial Development, Inc., were interviewed regarding the local availability of construction workers (Majure-Rhett, 2007; Satterfield, 2007; Herring, 2008). According to most of these representatives, the labor force in Brunswick, New Hanover, and Pender counties should be adequate to supply the vast majority of construction workers; however, one representative noted that many large construction firms have workers who routinely move around the country from one construction site to another. Under those circumstances, it is possible that a large construction project (such as the construction of the Proposed GLE Facility) could bring a substantial number of individuals into the region from other parts of the country.

Given the potential for migration of workers from outside the region, a range of population impacts are possible. This analysis assumes that 20% to 40% of the GLE Facility site preparation and construction labor force would be obtained from outside the region. These low and high ranges were chosen to reflect the underlying uncertainty about what share of the site preparation and construction labor force would come from outside the region.

Using these assumptions, approximately 100 to 200 workers would be expected to enter the region during the peak years of GLE Facility site preparation and construction employment (2012 to 2013). High and low estimates of the number of construction workers that would enter the region between 2011 and 2017 are reported in **Table 4.10-4**.

If site preparation and construction workers move into the region with families, then their total impact on the population level would be larger. Previous experience with nuclear-related construction projects indicates that approximately 65% of individuals that move into the region would bring their families, consisting, on average, of the worker, a spouse, and one school-aged child (NRC, 1994). Therefore, site preparation and construction is estimated to cause the population level to increase by approximately 220 to 450 individuals between 2012 and 2013. This would represent an increase in the total population of the region of 0.1% over baseline projections during those years (450 new individuals/382,890 baseline regional population in 2012). In subsequent years, the percentage increase in regional population due to the influx of construction workers and their families shrinks as GLE Facility site preparation and construction employment declines and the population continues to grow. No information is available about the ethnicity of new residents, but given that they would represent such a small share of the total population, they are not expected to significantly affect the demographic profile of the region.

Although the above analysis implies that new construction workers and their families would be spread throughout the region, it is possible they might concentrate in New Hanover County. First, it would likely be easier for families to find a home in New Hanover County because it has the most housing units for sale or rent (5,416, or 58%, of the region total in 2000) (see **Table 3.10-12**). Second, the Proposed GLE Facility is located in New Hanover County, making the county attractive for workers wanting to locate close to their work. Even if all 220 to 450 people locate in New Hanover County during the peak years of construction employment, this would, at most, increase the population by 0.2% over the 2012 baseline (450 new individuals/208,605 baseline New Hanover County population in 2012). No information is available about the ethnicity of new residents, but given that they would represent such a small share of the total population, they are not expected to significantly affect the demographic profile of New Hanover County.

These calculations suggest that the number of new individuals moving into the region during site preparation and construction would be small compared to the existing population. In addition, the impact these workers have on the population level primarily would be temporary because most new workers would likely leave the region after the construction project is completed in 2017. As a result, this analysis concludes that construction of the Proposed GLE Facility would have a SMALL impact on the regional population.

However, it is important to note that from 2013 to 2017, workers engaged in start-up and operation activities would also be working at the Proposed GLE Facility. As a result, the total population impact on the region and New Hanover County during these years would be the sum of population associated with construction, start-up, and operation activities. These total impacts have been estimated and are discussed in **Section 4.10.2.1.2**.

4.10.2.1.2 Operation

Operation of the Proposed GLE Facility is expected to begin in 2013 at 1.2 million SWU; then the Proposed GLE Facility's production capacity is expected to steadily increase until 2017, when Facility capacity would reach 6 million SWU. During the 4-year start-up period, GLE estimates that the Facility would employ 550 full-time equivalent employees (FTEs). Two hundred FTEs would be engaged in start-up activities, and 350 FTEs would be engaged in operating the Facility. Once start-up activities are completed, the 350 FTEs engaged in operation activities would remain at the Facility as the permanent workforce until the Proposed GLE Facility begins decommissioning in 2049.

To assess whether operation of the Proposed GLE Facility would introduce new individuals to the region, interviews were conducted with representatives from the Greater Wilmington Chamber of Commerce and Wilmington Industrial Development, Inc. According to these representatives, the labor force in the region should be adequate to supply the vast majority of operation workers. However, representatives from both organizations stated that engineers (comprising approximately 20% of both start-up and the operation labor force) might be difficult to obtain locally (Majure-Rhett, 2007; Satterfield, 2007); therefore, this analysis conservatively assumes that all of the engineers would be obtained from outside the region. This implies that approximately 110 workers would move into the region during the start-up phase of operation and 70 workers would remain when start-up is completed and the Facility is fully operational.

The families that these 110 workers bring into the area would also result in a higher population level. As described in the previous section, prior experience with nuclear-related construction projects indicates that 65% of all new construction workers moving into the region would bring families consisting of the worker, a spouse, and one school-aged child. If this assumption holds for operation and start-up workers, approximately 250 to 330 individuals would be added to the population of the region. In 2013, using the upper-bound estimate of 330 new residents, this would represent less than a 0.1% increase in the projected population level (330 new individuals/390,549 regional baseline population in 2013). If all 330 individuals are concentrated in New Hanover County, this would result in a 0.2% increase in that county's population in 2013 (330 new individuals/212,251 baseline New Hanover County population in 2013). However, no information is available from previous projects to assess whether the characteristics of operation workers entering the region would be similar to construction workers.

In addition to the workers engaged in start-up and operation activities, a number of construction workers would be present at the GLE Facility site from 2013 to 2017 while the Facility is being completed. The peak year of employment during this 5-year period is 2013, when approximately 485 construction workers would be employed at the Proposed GLE Facility. As discussed in **Section 4.10.2.1.1**, approximately 20% to 40% of the total construction labor force employed during this period would possibly be obtained from outside the region, and 65% of those workers would have families consisting of one child and one spouse.

As a result, the highest estimated number of new residents associated with construction activities in 2013 is 450. When combined with the maximum number of individuals that are expected to move into the region in 2013 (330 new residents), there would be a total population impact of 780 new residents. This would represent a 0.2% increase in baseline regional population in 2013 and a 0.4% increase in baseline New Hanover county population. No information is available about the ethnicity of new residents, but given that they would represent such a small share of the total population, they are not expected to significantly affect the demographic profile of the region.

Beginning in 2017, the Facility is expected to be fully operational and only employ an operational work force of 350 FTEs. Assuming that 20% of these permanent operation workers are from outside the region, this would represent a net increase of 70 operational workers. If 65 to 100% of these 70 new workers have families consisting of a spouse and one child, operation of the Facility is estimated to result in a population increase of, at most, 210 people. As a result, the region's population level would increase less than 0.1% over the 2017 No Action Alternative baseline (210 new residents/ 420,938 baseline regional population in 2017). If all of these 210 individuals settled in New Hanover County, this would represent less than a 0.1% increase in 2017 county population (210 new residents/226,720 baseline New Hanover county population in 2017).

This analysis demonstrates that the start-up and full operation phases of this project would result in only small increases in the region's population (less than 0.5%). No information is available about the ethnicity of new residents, but given that they would represent such a small share of the total population, they are not expected to significantly affect the demographic profile of the region. As a result, the analysis concludes that the impacts of operation of the Proposed GLE Facility on regional population would be SMALL.

4.10.2.1.3 Decommissioning

For this analysis, it is assumed that decommissioning of the Proposed GLE Facility would begin in 2049 and would last approximately 9 years, with the first 2 years being essentially a planning period that overlaps with the final 2 years of operations. The decommissioning process would consist of decontaminating and removing equipment from the Facility, while leaving the building, parking area, and access roads in place. (The plans for decommissioning of the Proposed GLE Facility are described in greater detail in **Section 2.1.2.4** of this Report, *Site and Facility Information [Proposed Action]*). GLE estimates that these activities would be carried out by an annual workforce of 50 FTEs. The impact these workers would have on the population level of the region is difficult to quantify for several reasons.

First, no reliable information could be obtained regarding labor market conditions over 40 years in the future; therefore, it is not apparent how many of the 50 jobs would be filled by individuals living in the region. Second, since operation of the Proposed GLE Facility would end in 2050 (unless its license is renewed), it is not clear what would happen to the approximately 350 workers employed for Facility operations. Some of them might choose to stay inside the region, whereas others may move to other parts of the country. If most of them chose to leave the region, the region's total population could decline even if all 50 decommissioning workers came from outside the region. Finally, population projections are not available past the year 2030; therefore, even if this analysis was able to accurately estimate the net population change during decommissioning, there would not be an appropriate baseline for comparison.

Despite these limitations, it seems likely that the impact of decommissioning on the regional population level would be minimal. For example, even if all 50 decommission-phase workers came from outside the region and brought one spouse and one child, this unlikely possibility would only result in a population increase of 150 individuals in 2049. Including the maximum of 210 new residents associated with ongoing operations, this implies, at most, 360 new residents in 2049 and 2050. A similarly sized population increase was discussed in **Section 4.10.2.1.2** for the year 2013. This increase in population resulted in less than a 0.1% increase in total population. Considering that population will likely continue to grow between 2013 and 2050, it is likely that the impact of introducing 150 additional individuals to the region during decommissioning would be even smaller. As a result, this analysis concludes that population impacts of decommissioning of the Proposed GLE Facility would be SMALL.

4.10.2.2 Economic Impacts

4.10.2.2.1 Site Preparation and Construction

Site preparation and construction of the Proposed GLE Facility is expected to last 7 years, from 2011 to 2017. The annual construction labor force would peak at approximately 485 workers in 2012 and 2013. This workforce would represent 4% of the 11,133 baseline construction jobs in the Cape Fear WDB projected for the year 2012 and is estimated to have, overall, a SMALL positive impact on the regional economy.

Because many construction workers would be hired from outside the region, building the Proposed GLE Facility would directly increase the number of construction workers employed in the region. This analysis estimates that approximately 100 to 200 construction workers could move into the region from outside Brunswick, New Hanover, and Pender counties during the peak years of construction employment (2012 to 2013). This influx of workers would represent a maximum increase of 2% over the projected number of regional construction jobs in 2012 (200 new workers /11,133 baseline construction employment in 2012).

GLE's estimated construction payroll for the 7-year period is more than $66 million. Considering only the 100 to 200 new construction workers estimated to move into the region to work on the Proposed GLE Facility construction, their estimated salaries would represent an increase of $3.4 million to $6.8 million in regional income per year.

In addition, the new workers in the region would generate State and local tax revenue that would not have been collected otherwise. GLE estimates construction workers would earn an average salary of $34,000. Assuming these workers file as single on their State income tax (without utilizing any deductions or tax credits), and are taxed at current income tax rates (see **Table 3.10-11**), this analysis estimates that each worker would have an average income tax payment of approximately $2,300, or approximately $223,000 to $446,000 of new State income tax revenue under current tax-rates during the peak years of construction employment ($2,300 x 100 to 200 workers). **Table 4.10-5** reports annual individual income tax impacts for workers by activity.

During the 2005 to 2006 fiscal year (FY), North Carolina state government collected $9.4 billion in revenue through individual income taxes (accounting for approximately 53% of total State revenue). As a result, the tax revenue generated solely by new construction workers entering the region from other parts of the country would not have a noticeable impact on State income tax revenues (NCDOR, 2007).

Additional tax revenue would also be directly generated by the money construction workers spend inside the region that is subject to State and local sales taxes (4.25% and 2.5%, respectively). Assuming that each of the 100 to 200 new construction workers employed in 2012 earn an average salary of $34,000, and that they spend 70% of that income on goods and services inside the region that are subject to State and local sales taxes, this analysis estimates that State sales tax revenue would increase between $101,000 and $202,000 per year and that local sales tax revenue would increase between $59,000 and $119,000 in 2012 (a combined total of $160,000 and $312,000).[4] **Table 4.10-6** reports the total (combined State and local) sales tax impacts of construction workers from 2011 to 2017.

During the 2005–2006 FY, North Carolina state government collected $4.8 billion of revenue from sales and use taxes. That same year, Brunswick County received $21 million as its share of local government sales taxes, New Hanover County received $51 million, and Pender received $9 million. Together, these counties received a total of $81 million in local sales tax revenue. As a result, the sales tax revenue generated by new site preparation and construction workers entering the region from other parts of the country is not noticeable (NCDOR, 2007).

Between 2011 and 2017, construction workers obtained from outside the region are expected to contribute a total of $1.5 to $3 million in income and sales tax revenue. However, this analysis understates the total tax impact of constructing the Proposed GLE Facility in three ways.

First, this analysis does not include the increased incomes or new tax revenues directly generated by construction workers who were already employed in the region, but may be earning higher wages working on the Proposed GLE Facility. This impact was excluded because, although it is likely GLE would have to offer higher salaries to attract workers from other projects, it is unclear how much higher these wages would be compared to similar alternative occupations in 2011–2012.

Second, the analysis does not account for additional indirect income and sales tax revenue that could be generated as GLE's direct local spending on constructing the Facility causes other businesses and households to increase their spending throughout the regional and State economies, creating new jobs and income. To measure how a construction project impacts an entire economy, regional planners often use input-output models "multipliers." For example, according to IMPLAN (MIG, 2006), the average employment multiplier for the region in 2004 was 2.2. This means that for every job created by a project in 2004, another 2.2 jobs were created elsewhere in the region's economy through the ripple or multiplier process. Because estimates of regional multipliers are based on historical data on the economy's structure, and this structure is likely to change substantially in coming years due to various factors such as technological change, quantifying the indirect and induced changes in income and employment becomes increasingly difficult for future years. Therefore, the analysis examines only the direct impacts of the GLE project on employment, income, and tax revenues.

Third, the analysis does not estimate property tax revenues that would be paid to New Hanover County as a result of the construction of the Proposed GLE Facility.

4.10.2.2.2 Operation

Operation of the Proposed GLE Facility is expected to begin in 2013. Productive capacity would be added over a 4-year start-up period, during which time approximately 550 FTEs would be employed. GLE estimates that approximately 350 of these FTEs would be engaged in operational activities and earn an annual payroll of $32.4 million (average salary of $92,000), whereas an additional 200 FTEs would be

[4] Using IMPLAN economic modeling software and 2004 data for the region, GLE assessed that private households spend approximately 86% of their total income inside the three counties. However, it is unlikely that all of this spending would be on goods that are subject to state and local sales taxes. Therefore, to be more conservative in calculating sales tax impacts, this analysis assumed that only 70% of household income would be subject to these taxes.

engaged in start-up activities, earning an annual payroll of $18.5 million (average salary of $93,000). This workforce would represent 6% of the total number of manufacturing jobs projected in the region in 2014 (see **Table 4.10-2**). In 2017, start-up activities would be completed and only 350 workers would remain at the Proposed GLE Facility, earning an annual payroll of $32.4 million (average salary of $92,000). Like the construction phase of the project, operation would also have SMALL positive impacts on the regional economy.

First, since some workers would be hired from outside the region, operation of the Proposed GLE Facility could impact the region's economy by increasing the number of manufacturing workers employed in the region. This analysis estimates that up to 20% of the start-up and operation labor forces could come from outside the region. This means that approximately 70 workers engaged in operation activities and 40 workers engaged in start-up activities would move into the area during the start-up period between 2013 and 2016. These 110 workers would represent a 1% increase in the region's projected manufacturing jobs in the year 2014 (110 workers/9,789 projected manufacturing jobs).

After start-up activities are completed and full operation of the Proposed GLE Facility begins in 2017, 70 permanent operation workers that have relocated to the region would remain at the Facility. This would represent a nearly 1% increase in the number of manufacturing jobs held in 2020 relative to baseline projections (70 new workers/9,552 projected manufacturing jobs).

The incomes earned by the workers moving into the area are estimated to increase the region's income by approximately $6.4 million annually. Between 2013 and 2016, during the start-up period, the 40 new workers engaged in start-up activities would be paid an average salary of $93,000, whereas the 70 new workers engaged in operations would be paid an average salary of $92,000.

In addition, new workers moving into the region would generate State and local tax revenue that would not otherwise have been collected. If each of these employees files as single on their State income tax (see **Table 3.10-11**) and does not utilize deductions or tax credits, the average individual State income tax payment of workers engaged in both activities would be $6,300 per FTE. As a result, the individual income tax revenue created by new Facility employees would be $693,000 per year ($6,300 x 110). In total, income received by new workers is expected to generate approximately $2.8 million in income taxes during the start-up period.

During the 2005–2006 FY, the North Carolina state government collected $9.4 billion in revenue through individual income taxes (accounting for approximately 53% of total State revenue). As a result, the tax revenue generated solely by new operation workers entering the region from other parts of the country would not have a noticeable impact on State income tax revenues (NCDOR, 2007).

The money new workers spend inside the region would also be subject to State and local sales taxes (4.25% and 2.5%, respectively). If the 40 new workers engaged in start-up activities earn $93,000 per year and the 70 new workers engaged in operation activities earn approximately $92,000, then these workers earn a total of $10 million annually. If these new workers spend 70% of their income on goods and services that are subject to State and local sales taxes, this analysis estimates the spending of these workers to generate $300,000 of annual State tax revenue and $180,000 of local tax revenue. As a result, $480,000 of sales tax revenue would be collected during each year of the start-up period for a cumulative total of $1.9 million over the start-up period.

During the 2005–2006 FY, North Carolina collected $4.8 billion of revenue from Sales and Use taxes. That same year, Brunswick County received $21 million as its share of local government sales taxes, New Hanover County received $51 million, and Pender received $9 million. Together, these counties received a total of $81 million in local sales tax revenue. As a result, the sales tax revenue generated by new operation workers entering the region from other parts of the country is not noticeable (NCDOR, 2007).

In 2017, the Proposed GLE Facility would be fully operational and employ 350 workers earning an average salary of approximately $92,000. This analysis anticipates that up to 70 of these workers may have relocated from outside the region. As a result, annual income tax contributions would fall to approximately $441,000 per year and annual sales tax contributions to approximately $300,000 per year. These revenues would be collected until Facility production ends in 2050, resulting in cumulative income tax collections of $15 million and sales tax collections of $10 million between 2017 and 2050.

However, as discussed in the previous section, this analysis likely understates the tax impact of operating the Proposed GLE Facility for two reasons. First, it does not include the new tax revenues generated by workers that are from the region, but earning a higher wage by working at the Proposed GLE Facility. Second, the analysis does not account for additional income and sales tax revenue that could be generated as the economic impact of operating the Facility "ripples" throughout the regional and State economies, creating new jobs and income. These impacts were excluded from the analysis due to a lack of reliable data on the future economic structure of the region.

Finally, the operation of the Proposed GLE Facility would create corporate income tax revenue for the State of North Carolina that would not be generated if the Facility were not operating. Throughout the operational life of the Facility, the estimated cumulative tax contribution is approximately $1.3 billion dollars.

Combining corporate income, individual income, and individual sales tax revenue, this analysis concludes that the construction and operation of the Proposed GLE Facility would directly generate approximately $1.5 billion in cumulative State and local tax revenue over 40 years. Averaging approximately $42 million per year, this represents a 0.2% of North Carolina's 2007–2008 General Fund, which could be considered a SMALL positive impact.

4.10.2.2.3 Decommissioning

For this analysis, it is assumed that decommissioning of the Proposed GLE Facility would begin in 2049 and would last approximately 9 years. During this period, GLE estimates that approximately 50 FTEs with an annual payroll of $4.8 million (average salary of $97,000) would be required. These employees would be tasked with decontaminating and removing equipment from the Facility, as well as other decommissioning activities. The plans for decommissioning of the Proposed GLE Facility are described in greater detail in **Section 2.1.2.4** of this Report (*Site and Facility Information [Proposed Action]*).

Like new construction and operation workers, workers moving into the region to work as part of the decommissioning labor force would generate State and local tax revenues that would not otherwise be created. However, as discussed in **Section 4.10.2.1.3**, it was not possible to determine the number of workers that would be required from outside the region. Therefore, the following analysis considers the scenario where all 50 workers are new to the region. This provides an approximation of the "maximum" amount of revenue that would be generated during this phase of the GLE project.

First, GLE estimates that each of the 50 workers is new to the area and is paid an average salary of $97,000, files as single on their State income tax (without utilizing any deductions or tax credits), and is taxed at current income tax rates (see **Table 3.10-11**); this analysis estimates that each worker would have an average income tax payment of $6,600. This would generate $330,000 in new State income tax revenue each year ($6,600 x 50 workers). Note that, for **Tables 4.10-4 through 4.10-6**, impacts of decommissioning are combined with those of operations for the years 2049 and 2050. Data shown in the

"Operation Workers" columns of these tables for the years 2051–2057 reflect impacts of decommissioning employment.

During the 2005–2006 FY, the North Carolina state government collected $9.4 billion in revenue through individual income taxes (accounting for approximately 53% of total State revenue). As a result, the tax revenue generated by decommissioning workers would not be noticeable (NCDOR, 2007).

Second, the money decommissioning workers spend inside the region on items that are subject to State and local sales taxes (4.25% and 2.5%, respectively) would also generate tax revenue. Assuming that decommissioning workers spend 70% of their income ($5 million x 70% = $3.4 million) on goods and services inside the region that are subject to State and local sales taxes, this analysis estimates that State tax revenue would increase $144,000 pear year and local tax revenue would increase $85,000 per year. This corresponds to a total of $229,000 in sales tax revenue per year.

During the 2005–2006 FY, North Carolina collected $4.8 billion of revenue from Sales and Use taxes. That same year, Brunswick County received $21 million as its share of local government sales taxes, New Hanover County received $51 million, and Pender received $9 million. Together, these counties received a total of $81 million in local sales tax revenue. As a result, the sales tax revenue contributed by decommissioning workers in the region is not noticeable (NCDOR, 2007).

Combining individual income and sales taxes, this analysis concludes that the decommissioning of the Proposed GLE Facility would directly generate approximately $560,000 per year. This corresponds to $5 million of cumulative State and local tax revenue over the 9-year decommissioning period.

Overall, the economic impacts of the decommissioning phase of the Proposed GLE Facility are estimated to be SMALL.

4.10.2.3 Social Impacts

4.10.2.3.1 Construction

The impact of constructing the Proposed GLE Facility on social resources and services would depend on how many workers are hired from within the region. Similar to population impacts, if all construction workers are obtained from within the region, then social services such as law enforcement and education would experience no increase in demand and, therefore, suffer no adverse impacts. On the other hand, a large influx of new residents could potentially affect the community's ability to provide the same level of services that it provides under the No Action Alternative. This analysis examines the impact that constructing the Proposed GLE Facility would have on housing, educational services, medical services, law enforcement, and fire and rescue services (impacts to transportation resources are discussed in **Section 4.2**, *Transportation Impacts*). Overall, social impacts of construction of the Proposed GLE Facility on the region are estimated to be SMALL.

4.10.2.3.1.1 Housing Impacts

The introduction of construction workers from outside the region would place new demands on available housing. The size of the annual construction labor force would peak between 2012 and 2013, when between 100 and 200 workers would enter from outside the region. If each of these workers represents a single household, this would account for 1% to 2% of the 9,291 housing units for sale or rent in the region (excluding units for seasonal or recreational use) in 2000 (see **Table 3.10-12**).

However, it is likely that most households would concentrate in New Hanover County for two reasons: first, the vast majority of housing units for sale or rent are located there (5,416, or 58% of the total in

2000), and second, the Proposed GLE Facility is located in that county. In the unlikely event that all new workers and their families settled in New Hanover County, this would still only represent, at most, 3.7% of all available housing units in the year 2000 during the peak years of construction employment.[5] The relative size of this impact would probably be even smaller given that the number of vacant housing units in 2012 and 2013 would likely increase proportionally as the total housing stock grows with the population. Considering these results, this analysis concludes that the temporary increase in demand for housing between 2012 and 2013 would not place noticeable stress on available housing.

As noted in previous sections, construction continues for another 5 years after the Facility begins operation in 2013. As a result, the impact of the Proposed GLE Facility on the availability of housing would be further increased by start-up and operation workers moving into the region. The total impact that constructing and operating the Proposed GLE Facility might have on regional housing availability is discussed in **Section 4.10.2.3.2.1**.

4.10.2.3.1.2 Educational Service Impacts

The introduction of new construction workers and their families to the region would place new demands on the region's educational services. In the section evaluating impacts of the Facility on regional population (**Section 4.10.2.1**), it was estimated that up to 130 school-age children could be introduced to the region during the peak years of construction employment—2012 to 2013 (see **Table 4.10-4**). Assuming these children were spread across grades K–12, this would represent less than a 0.5% increase in total region enrollment (43,457 students) as measured in the year 2000 (see **Table 3.10-15**). This relative increase would likely be even smaller in 2012 because enrollments would grow with population.

However, as discussed in the previous section, the vast majority of families would probably locate in New Hanover County due to the proximity to the GLE Facility site and the greater availability of vacant housing. But even if all 130 school-age children attended New Hanover County schools, this would still only result in an increase in New Hanover County school enrollment of at most 0.5%.[6] This small projected increase in total region enrollment is not expected to have an adverse impact on educational services in the region as a whole or in New Hanover County in particular.

These calculations suggest that the construction of the Proposed GLE Facility would not have a significant impact on the availability of educational services in the region or in New Hanover County. This conclusion is supported by correspondence with the Assistant Superintendent of Operations for New Hanover County's schools. During these discussions, it was revealed that New Hanover County is implementing a $123 million local bond referendum (Hance, 2007). The bond includes land acquisition, roof replacements, improvements in technology, renovation of seven elementary schools, and construction of a new middle and a new elementary school, both scheduled to open in 2009. The New Hanover County school system also has approximately 90 Mobile Classroom Units that can be relocated as necessary. Given these future developments, the Assistant Superintendent declared that New Hanover County Schools had the capacity to accommodate the expected number of students introduced to the area (Hance, 2007, 2008).

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[5] The potential impact on surrounding counties will vary if all 200 workers and their families seek homes outside New Hanover County. If all 200 workers settle in Brunswick County, this would only represent 6% the total available housing stock in 2000; however, if all 200 workers and their families settle in Pender County, this would represent 26% of the county's available housing stock. It is important to note that this scenario is extremely unlikely.

[6] In the unlikely event that all 130 students attended schools outside New Hanover County, the relative impact would still be small. If all 130 students attended school in Brunswick County, this would only represent an increase in 2000 K-12 enrollment of 1%. If all 130 students attended school in Pender County, this would only represent a 2% increase in 2000 K-12 enrollment.

4.10.2.3.1.3 Medical Services Impacts

To accurately reflect how the population influx during construction would affect the existing medical services infrastructure, this analysis considered several different measures. First, the number of healthcare workers that would be required to serve new individuals entering the region was measured. The populations in each county per healthcare personnel in 2005 are reported in **Table 3.10-14.** According to these data, New Hanover County has substantially more healthcare resources than any other county—788 people per primary care physician, 70 people per registered nurse, and 1,443 people per dentist. In 2005, there were 179,944 people living in New Hanover County (see **Table 4.10-1**). This implies that there were 228 physicians, 2,571 registered nurses, and 125 dentists in New Hanover County in 2005.

Although this could imply that fewer health resources are available to residents in other counties, it could also mean that there are a substantial number of Brunswick County and Pender County residents traveling to New Hanover County for medical care. As a result, this analysis used health resource ratios for New Hanover County as the reference case for this analysis to 1) provide "upper-bound" estimates of the number of doctors that would be required during construction and 2) to possibly account for underlying health services consumption patterns in the region.

In 2012 and 2013, the construction of the Proposed GLE Facility is expected to introduce approximately 220 to 450 new individuals to the region. The health-resource ratios for New Hanover County indicate that less than 1 primary care physician, up to 7 registered nurses, and less than 1 dentist would be required to provide construction workers and their families with the same level of medical services that the region's current residents receive. This amounts to less than a 1% increase in the total number of physicians, nurses, and dentists in New Hanover County in 2005.

A second measure considered by this analysis was the number of hospital beds that are empty at the end of an average day. This metric could potentially be considered a measure of the "excess capacity" in county hospitals. The closest hospital to the Proposed GLE Facility is the New Hanover Regional Medical Center. This medical facility has 628 licensed beds, 437 of which were being used each day on average in 2005. These data imply that, on an average day, New Hanover Regional Medical Center has 191 beds not being used. Considering that the hospital-use rate in New Hanover County was 103 individuals per 1,000 in 2005, one could expect approximately 22 to 45 people to be hospitalized during the peak years of construction employment (220 to 450 new individuals x 0.103). Assuming that these admissions were spread out across the year, it seems reasonable that the hospitalization needs of the population attracted to the GLE Study Area during construction of the Proposed GLE Facility could be easily handled by a single hospital.

A final measure of how medical services could be impacted during construction is the potential percentage change in baseline admissions. In 2005, New Hanover Regional Medical Center admitted 28,882 individuals. If the influx of population during construction results in 22 to 45 new annual hospitalizations in 2012 and 2013, this would not result in a noticeable change in baseline admissions.

Based on this analysis, it appears that the population increase associated with the construction of the Proposed GLE Facility between 2011 and 2013 would not have a measurable impact on medical services. However, in subsequent years while the GLE Facility is operational, additional population will be attracted to the Wilmington Site region. The total impact of construction and operation on the availability of medical services is discussed in **Section 4.10.2.3.2.3**.

4.10.2.3.1.4 Law Enforcement Impacts

How the population increase accompanying the construction of the Proposed GLE Facility impacts law enforcement resources would depend on how that population is distributed. As discussed in previous sections, it is likely that the vast majority of workers and their families would be located in New Hanover County, which is primarily policed by the New Hanover County Sheriff's Office (serving 185 of the county's 207 mi^2 [536 km^2]) (NHCSO, 2007). This agency provided law enforcement services to 72,971 people living in unincorporated portions of New Hanover County in 2006 (NC SBI, 2007).

In the unlikely event that all people introduced to the region during construction of the Proposed GLE Facility settled in the communities of unincorporated New Hanover County, the expected increase in the population served would be approximately 0.1% during the peak years of construction employment (2012 and 2013). The impacts on the Sheriff's Office (as well as other law enforcement agencies) would likely be even smaller because 1) the population would be spread across Brunswick, New Hanover, and Pender counties and 2) more resources would be devoted to law enforcement in the future to accommodate population increases. As a result, construction of the Proposed GLE Facility is not expected to adversely affect law enforcement agencies in the region.

4.10.2.3.1.5 Fire and Rescue Service Impact

By introducing new households to the region, construction of the Proposed GLE Facility could potentially impact the ability of fire and rescue departments to deliver the same level of services. In **Section 4.10.2.1**, it was demonstrated that construction would introduce up to 450 individuals during its peak years of employment between 2012 and 2013, which would result in a 0.1% increase in the region's projected 2012 baseline population. If all of these individuals located themselves in New Hanover County, this would still only result in a 0.2% population increase in 2012. This suggests that current fire and rescue departments would not face a significant increase in the population they serve.

This conclusion is supported by correspondence with Fire Marshalls in Brunswick and New Hanover counties, which contain the majority of available housing in the region and would therefore be likely to absorb the largest population increases. According to these Fire Marshalls, the region is currently undergoing a period of significant growth, and county fire and rescue services are being scaled up to meet future demand. As a result, they did not believe that population increases of this magnitude would significantly stress these future resources (Garner, 2007; Griswold, 2007).

4.10.2.3.2 Operation

By introducing new people to the region, operation of the Proposed GLE Facility would also affect housing, educational, medical, law enforcement, and fire services that this analysis considered (impacts on transportation resources are discussed in **Section 4.2**, *Transportation Impacts*). This analysis estimates that, overall, the social impact of operation of the Proposed GLE Facility would be SMALL.

4.10.2.3.2.1 Housing Impact

Between 2013 and 2016, approximately 550 FTEs would be required to operate the Facility and to complete start-up activities. This analysis estimates that approximately 20% of these workers (110 FTEs) would be obtained from outside the region. Assuming each new worker represents a single household, this would represent approximately 1% of the 9,291 housing units for sale or rent in 2000 (see **Table 3.10-12**). However, as during construction, it is likely that the majority of these households would concentrate in New Hanover County due to both the location of the Proposed GLE Facility in that county, as well as the greater availability of housing. If all 96 households locate in New Hanover County, this would represent 2% of the 5,416 housing units for sale or rent in 2000 in that county.

In addition to the workers engaged in start-up and operation activities, a number of construction workers would be present at the Wilmington Site from 2013 to 2017 while the Proposed GLE Facility is being completed. The peak year of employment during this 5-year period is 2013, when approximately 485 construction workers would be employed at the Proposed GLE Facility. As discussed in **Section**

4.10.2.1.1, approximately 20 to 40% of the total construction labor force would be obtained from outside the region. As a result, assuming that each worker represents a household, the maximum number of new households associated with construction workers in 2013 is 194. When combined with the maximum number of new households associated with operation activities that are expected to move into the region in 2013 (110 new workers), there would be a total population impact of 304 new households. This would represent a 3.3% increase in baseline regional vacant housing stock as measured in 2000 and a 5.6% increase in baseline New Hanover County vacant housing stock. These impacts would shrink in subsequent years as construction employment declines.[7]

After 2017, this analysis expects a net increase of 70 new workers to remain in the region. Assuming each new worker represents a single household, this would represent less than 1% of the 9,291 housing units for sale or rent in 2000 (see **Table 3.10-12**). If all 70 households locate in New Hanover County, this would represent slightly more than 1% of the 5,416 housing units for sale or rent in 2000.

Given that demand for housing during Proposed GLE Facility operation represents a small fraction of the available housing stock in 2000, and may represent an even smaller fraction in the future as the housing stock grows, this analysis concludes that operation of the Facility would have no noticeable impact on the availability of housing in the region.

4.10.2.3.2.2 Educational Service Impact

In the section evaluating impacts of the Facility on regional population (see **Table 4.10-4**), this analysis assumed that 65% to 100% of the 550 FTEs needed during the start-up period (2013–2018) would have one school-age child. This corresponds to a total of 70 to 110 new students being introduced to the region during start-up activities.

Assuming these children were spread across grades K–12, total region enrollment (43,457 students) would increase less than 0.3% over the baseline measured in 2000 (see **Table 3.10-15**). However, as previously discussed, it is likely that a majority of students may be concentrated in New Hanover County. Even if all 70 to 110 children attended schools in New Hanover County, this would represent less than a 0.5% increase over the county's 2000 K–12 enrollment of 24,410 students.

In addition to the school children accompanying workers from outside the region engaged in start-up and operation activities, a number of construction workers and their families would be present at the GLE Facility site from 2013 to 2017 while the Facility is being completed. The peak year of employment during this 5-year period is 2013, when up to approximately 485 construction workers would be employed at the Proposed GLE Facility. These workers are associated with up to 126 school-age children (see **Table 4.10-4**). When combined with the highest estimated number of school-age children associated with operation activities that are expected to move into the region in 2013 (110 children), there would be a total impact on school enrollment of 236 new school-age children. This would represent less than a 0.6% increase in baseline regional K–12 school enrollment as measured in 2000 and less than a 1%

[7] The potential impact on surrounding counties would vary if all 190 workers and their families seek homes outside New Hanover County. If all 190 workers settle in Brunswick County, this would only represent 6% the total available housing stock in 2000; however, if all 190 workers and their families settle in Pender County, this would represent 25% of the county's available housing stock. It is important to note that this scenario is extremely unlikely.

increase in baseline New Hanover county K–12 school enrollment. These impacts would shrink in subsequent years as construction concludes and workers and their families start to leave the area.[8]

In 2017, the start-up period would be complete and only 350 permanent operation employees would remain at the Proposed GLE Facility. If 20% of this labor force is acquired from outside the region, 70 workers and their families would be from outside the region. Assuming 65% to 100% of these families had one school-age child, this would correspond to 50 to 70 new students being introduced to the region, or less than a 0.2% increase in total region enrollment. If all of these students were concentrated in New Hanover County, this would still result in less than a 0.3% increase in county enrollment over the 2000 baseline.

Considering both the fact that the number of new students was small relative to total enrollment in the year 2000, and that there are plans to expand educational facilities in the near future (as previously discussed), this analysis concludes that the affected school systems would be able to accommodate the increased school enrollment associated with the Proposed GLE Facility's operation.

4.10.2.3.2.3 Medical Service Impact

As with construction, this analysis used several different measures to assess the impact that operating the Proposed GLE Facility would have on the availability of medical services in the region.

First, it considers that the number of healthcare personnel that would be required to serve new individuals entering the region was calculated using data collected by the North Carolina Department of Health and Human Services (NC DHHS) (**Table 4.10-6**). As discussed previously, according to this data, New Hanover County has substantially more healthcare resources than any other county—788 people per primary care physician, 70 people per registered nurse, and 1,443 people per dentist. Although this could imply that fewer health resources are available to residents in other counties, it could also mean that there are a substantial number of Brunswick County and Pender County residents traveling to New Hanover County for medical care. As a result, the analysis used health resource ratios for New Hanover County as the reference case for this analysis to provide "upper-bound" estimates of the number of doctors that would be required during operation and to possibly account for underlying health consumption patterns in the region.

Between 2013 and 2016, 250 to 330 new individuals would be expected to be introduced to the region as start-up activities are conducted. Based on the data collected from NC DHHS, less than 1 primary care physician, up to 5 registered nurses, and less than 1 dentist would be required to provide workers and their families with the same level of medical services that current region residents receive. This amounts to less than a 1% increase in the total number of physicians, nurses, and dentists in New Hanover County in 2005.

In addition to the population introduced by workers associated with start-up activities, a number of construction workers would be present at the Wilmington Site from 2013 to 2017 while the Facility is being completed. The peak year of employment during this 5-year period is 2013, when approximately 485 construction workers would be employed at the Proposed GLE Facility. As discussed in **Section 4.10.2.1.1**, approximately 20% to 40% of the total construction labor force employed during this period would possibly be obtained from outside the region, and 65% of those workers would have a child and spouse. As a result, construction of the Proposed GLE Facility is expected to possibly increase total

[8] In the unlikely event that all 160 students attended schools outside New Hanover County, the relative impact would still be small. If all 160 students attended school in Brunswick County, this would only represent an increase in 2000 K-12 enrollment of 1%. If all 160 students attended school in Pender County, this would only represent a 2% increase in 2000 K–12 enrollment.

regional population by 450 individuals. When combined with the 330 new individuals introduced to the area by start-up activities, this analysis estimates a maximum total population impact of 780 new residents in 2013. To provide these workers and their families with the same level of medical services available to residents in 2005, they would require less than 1 primary care physician, 7 registered nurses, and less than 1 dentist. This would represent less than a 1% increase in the total number of health care personnel in New Hanover County in 2005. In subsequent years, fewer personnel would be required as construction employment decreases.

After 2017, construction and start-up activities would be completed, and the Proposed GLE Facility would be fully operational. During this period, the region's population is estimated to be 170 to 210 higher than at baseline. The healthcare ratios imply that that less than 1 primary care physician, 3 registered nurses, and less than 1 dentist would be required to provide workers and their families with the same level of medical services that current region residents receive. This would also represent less than a 1% increase in the total number of healthcare personnel in New Hanover County in 2005.

A second measure to consider is the number of hospital beds that are empty at the end of an average day, which could be considered a measure of the "excess capacity" of county hospitals. The closest hospital to the Proposed GLE Facility is the New Hanover Regional Medical Center. This medical facility has 628 licensed beds, 437 of which were being used each day on average in 2005. These statistics indicate that New Hanover Regional Medical Center has 191 unoccupied beds on an average day.

Considering that the hospital-use rate in New Hanover County was 103 individuals per 1,000 in 2005, it is expected that approximately 26 to 34 of the 250 to 330 new individuals attracted to the region by start-up activities would be hospitalized each year, at most 78 of the 780 new individuals introduced by start-up and construction activities in 2013, and 17 to 21 of 160 to 210 new individuals introduced during the full operation period to be hospitalized per year. As a result, it is apparent that a single hospital is equipped to handle the entire influx of population during Facility operation.

A final measure of how medical services could be impacted during operation is the potential percent change in baseline admissions. In 2005, New Hanover Regional Medical Center admitted 28,882 individuals. As a result, the increase in regional population would result in an estimated 17 to 78 new hospitalizations per year, which is not a noticeable change in baseline admissions. Therefore, it appears that a single facility could be expected to handle the hospitalization services of the entire Proposed GLE Facility operation-related population, and the combined services of all the existing hospitals in the region would be even better able to provide these services.

Since the new individuals introduced to the region during start-up and full operation of the Proposed GLE Facility would not require a large number of medical personnel and would not result in a significant number of hospitalizations compared to 2005 baselines (which likely underestimate the availability of health resources in the future), this analysis concludes that operation of the Proposed GLE Facility would not significantly stress the region's existing medical services.

4.10.2.3.2.4 Law Enforcement Impacts

As discussed in previous sections, between 250 and 330 new individuals are expected to be introduced to the region during start-up activities and operation of the Proposed GLE Facility. Once the Facility becomes fully operational in 2017, the number of operations' employees entering the region from other parts of the country would be 160 to 210 individuals. The extent to which the population increases associated with operating the Proposed GLE Facility impact law enforcement resources would depend on how that population is distributed.

Earlier, this analysis suggested that it was likely that the majority of workers and their families would locate in New Hanover County. This county is primarily served by the New Hanover County Sheriff's Office, which polices 185 of the county's 207 mi^2 (536 km^2). This agency provided law enforcement services to 72,971 people living in unincorporated portions of New Hanover County in 2006. In the unlikely event that all people introduced to the region during operation were to settle in the communities of unincorporated New Hanover County, it is not expected that an increase in the population served would be more than 0.5% over this 2006 baseline during the Facility's start-up phase, followed by a shrinking impact when the Facility becomes fully operational in 2017 and reduces its workforce.

The impacts on the New Hanover County Sheriff's Office (as well as other law enforcement agencies) would likely be even smaller than this measure suggests due to the fact that 1) the population would at least be partially spread across Brunswick, New Hanover, and Pender counties and 2) more resources would be devoted to law enforcement in the future to accommodate population increases. Based on this information, this analysis concludes that operation of the Proposed GLE Facility would not be expected to adversely affect law enforcement agencies in the region.

4.10.2.3.2.5 Fire and Rescue Service Impacts

As the Proposed GLE Facility is completed and operations begin, the influx of workers and their families could potentially impact the ability of fire and rescue departments to deliver the same level of services. In **Section 4.10.2.1**, it was demonstrated that the Facility's population impact would peak during this period in 2013, when approximately 480 to 780 individuals would be introduced to this region. This would result in a 0.2% increase in the region's projected 2013 baseline population. If all of these individuals located themselves in New Hanover County, this would still only result in a 0.4% population increase in 2013. This suggests that current fire and rescue departments would not face a significantly large increase over the population they are already expected to serve.

This conclusion is supported by correspondence with Fire Marshalls in Brunswick and New Hanover counties, which contain the majority of available housing in the region and would therefore be likely to absorb the largest population increases. According to these Fire Marshalls, the region is currently undergoing a period of significant growth, and county fire and rescue services are being scaled up to meet future demand. As a result, the Fire Marshalls did not believe that population increases of this magnitude would significantly stress these future resources (Garner, 2007; Griswold, 2007).

4.10.2.3.3 Decommissioning

As with construction and operation of the Proposed GLE Facility, decommissioning could impact the provision of social services by introducing new individuals to the region. However, as discussed in **Section 4.10.2.1.3**, it is unclear how decommissioning would impact the net population level. First, there are no reliable data available regarding how much labor within Brunswick, New Hanover, and Pender counties would be available to fill the approximately 50 jobs that would be created during the Facility's decommissioning in 2049. Second, after the Proposed GLE Facility has ceased operation, it is possible that many of the 350 workers formerly employed there would move to other areas of the country in search of work. If a large enough portion of these workers leave the region, the level of population in Brunswick, New Hanover, and Pender counties would actually decrease.

However, there are several reasons to believe that the decommissioning of the Proposed GLE Facility would not adversely affect the social infrastructure of the region. First, since the decommissioning of the Proposed GLE Facility is relatively far into the future, economic planners and community leaders would have time to prepare for its potential impacts. Second, decommissioning would last a relatively short amount of time—approximately 9 years. As a result, supporting this activity should not require a permanent adjustment in social infrastructure, such as building new hospitals or schools. Finally, the analysis of the social impacts of construction and operation suggest that regional housing, education, and medical services would not be adversely impacted by other large, temporary increases in population. For example, peak population impact is reached in 2013 when 780 individuals are introduced to the area, which is more than 10 times larger than total decommissioning annual employment. Based on these factors, this analysis concludes that decommissioning would have a SMALL impact on the provision of social services in the region.

4.10.2.4 Cumulative Socioeconomic Impacts

While employment and social impacts are not additive across the assumed 47 years of site preparation and construction, startup and operation, and decommissioning, other impacts such as tax receipts can be added over time to estimate cumulative impacts of the Proposed GLE Facility. These cumulative impacts are shown in **Tables 4.10-5, 4.10-6, and 4.10-7**.

In addition to the Proposed GLE Facility, two other projects are currently planned for the Wilmington Site that could generate socioeconomic impacts. The first is the ATC II complex, which will be located near the south entrance of the Wilmington Site. This complex is currently under construction and is anticipated to begin operation within the next year. GLE expects the complex to employ an annual workforce of approximately 500 workers.

The second project is the Tooling Development Center, which will be located in the southwestern portion of the Eastern Site Sector. Construction on the Center will begin within the next 10 years and will be composed of five year-long stages. GLE also estimates that the Center will employ an annual workforce of approximately 500 workers when it becomes fully operational.

Since construction of the ATC II complex will be completed before construction of the Proposed GLE Facility begins, this analysis does not expect ATC's construction efforts to affect the construction of the Proposed GLE Facility; however, constructing the Tooling Development Center may cause impacts depending on when the Center is built and how many workers will be required.

The extent to which the operations of these two facilities add to cumulative socioeconomic impacts will likewise depend on when they begin operations and the number of employees they attract from outside the region; however, for the incremental impact of these projects to lead to adverse impacts on population, housing, education, and medical services, a great deal of their labor force would have to be obtained from outside the region. This is because the Proposed GLE Facility already has such a small impact on the demographics and social infrastructure of the region (the majority of Proposed GLE Facility's impacts on these four factors were less than a 1% increase over baseline). Therefore, we expect the cumulative socioeconomic impacts of GLE's planned projects on the Wilmington Site to be SMALL to MODERATE, depending on the timing of their construction and operation.

In addition to other projects planned for the Wilmington Site, Carolinas Cement Company LLC (a subsidiary of Titan America LLC) is proposing to construct a cement plant in an unincorporated northeastern portion of New Hanover County, outside the 5-mile (8-km) radius of Wilmington Site. The project would entail a 3-year construction phase employing approximately 800 workers, with operation expected to begin in late 2011 or early 2012 (Carolinas Cement Company, 2008).

Since construction on the Proposed GLE Facility is expected to begin in 2011, a slight overlap with the construction phase of the Carolinas Cement Company project is implied. No information was readily available on how many construction workers Carolinas Cement Company would require from outside the region and how many of those workers would bring families. Therefore, the assumptions that were made for the construction of the Proposed GLE Facility were used to analyze how the simultaneous construction of both facilities may impact the vicinity.

Assuming that all 800 employees would be needed throughout the Carolinas Cement Company project construction period; that 20% to 40% of the construction work force would be obtained from outside the region (160–320 workers); and that 65% of these new workers would be accompanied by one spouse and one child (104–208 spouses and 104–208 children), approximately 368 to 736 new people would be added to the region in 2011 during the last year of construction of the Carolinas Cement Company project. This increase would be added on top of the 133–267 people that would be introduced by the first year of construction on the Proposed GLE Facility, which combined would result in a population increase of between 500 and 1003.

How this population increase would impact the region would depend largely on how it is distributed. In the unlikely event that all construction workers involved in both projects settle in New Hanover County, they would increase county population by less than 1% and account for 4% to 8% of available housing as reported in the 2000 census (218 to 436 households across 5,416 vacant housing units). In addition, their children would represent at most a 0.6% to 1.2% increase in county school enrollment (142 to 283 children added to 24,410 enrolled children in 2000). The 142 to 283 new students would likely be a smaller share of enrollment in 2010 because New Hanover County's population is projected to grow.

The relatively small increase in population indicates that this population increase would not place noticeable strain on services such as medical care and public safety. The increased demands for housing and educational services, while small, may be noticeable. When assessing what this demand implies for the magnitude of the socioeconomic impact for both projects in 2011, it is recognized that 1) these impacts would be temporary because construction workers and their families would likely leave when the cement plant is completed, and 2) the cement facility would have already been under construction for 2 years, meaning the region's social and economic infrastructure would have had time to absorb them. In addition, New Hanover County's housing stock growth trends and new school construction plans (see **Section 4.10.2.3.1.1**, *Social Impacts – Construction* [*Housing*], and **Section 4.10.2.3.1.2**, *Social Impacts – Construction* [*Educational Service*]) suggest that the additional demands resulting from the Carolinas Cement Company construction employees could be met without further adjustment. Although there is limited data for the construction of the Carolinas Cement Company project, and the validity of the assumptions that were applied to the construction of the Proposed GLE Facility remains uncertain, the temporary cumulative socioeconomic impact of the construction of the Proposed GLE Facility and the Carolinas Cement Company plant are nevertheless anticipated to be SMALL to MODERATE.

When operational, the Carolinas Cement Company plant is projected to employ 161 full time workers averaging $72,100 in wages (Coletta, 2008). The parent company, Titan America, LLC, has indicated that they "plan to source these jobs locally" (Carolinas Cement Company, 2008). Therefore, to the extent that these workers are obtained from inside the region, they would not contribute to an increase in population or represent new demand for housing, schools, healthcare, or public safety. As a result, the cumulative socioeconomic impact from simultaneous operation of the Carolinas Cement Company facility, the Proposed GLE Facility, and other future Wilmington Site projects described in **Section 2.3** of this Report (*Cumulative Effects*) would be SMALL.

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Tables

Table 4.10-1. Regional Population Projections (2000 to 2020)

Year	Brunswick	New Hanover	Pender	Total
2000	73,143	160,307	41,082	274,532
2001	76,676	163,711	42,038	282,425
2002	79,227	166,054	43,178	288,459
2003	81,817	168,977	43,706	294,500
2004	85,060	174,217	45,060	304,337
2005	89,481	179,944	46,599	316,024
2006	94,964	184,120	48,724	327,808
2007	100,107	188,206	50,757	339,070
2008	104,485	192,925	52,456	349,866
2009	108,178	197,578	53,981	359,737
2010	111,076	201,313	55,185	367,574
2011	113,885	204,959	56,387	375,231
2012	116,695	208,605	57,590	382,890
2013	119,504	212,251	58,794	390,549
2014	122,313	215,898	59,997	398,208
2015	125,107	219,531	61,200	405,838
2016	127,857	223,125	62,405	413,387
2017	130,607	226,720	63,611	420,938
2018	133,357	230,314	64,817	428,488
2019	136,107	233,909	66,022	436,038
2020	138,826	237,476	67,217	443,519

Reference: U.S. Census Bureau, 2000; NC OSBM, 2007.

Table 4.10-2. Cape Fear Workforce Development Board[a] Employment Projections (2004 to 2014)

NAICS	Major Industry Group	Total Employment																	Annualized Growth RateRate
		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
11	Agriculture	451	449	446	444	441	439	436	434	432	429	427	425	422	420	418	415	413	-0.55%
21	Mining (except Oil and Gas)	75	74	72	71	70	69	68	66	65	64	63	62	61	60	59	58	57	-1.73%
22	Utilities	1,387	1,369	1,350	1,332	1,315	1,297	1,280	1,263	1,246	1,229	1,213	1,197	1,181	1,165	1,150	1,134	1,119	-1.33%
23	Construction	9,659	9,832	10,008	10,188	10,370	10,556	10,745	10,938	11,133	11,333	11,536	11,743	11,953	12,167	12,385	12,607	12,833	1.79%
31-33	Manufacturing	10,197	10,155	10,114	10,073	10,032	9,991	9,950	9,910	9,869	9,829	9,789	9,749	9,709	9,670	9,630	9,591	9,552	-0.41%
42	Wholesale Trade	4,755	4,836	4,919	5,002	5,088	5,174	5,263	5,352	5,444	5,537	5,631	5,727	5,825	5,924	6,025	6,128	6,232	1.71%
44-45	Retail Trade	20,439	20,809	21,186	21,569	21,960	22,357	22,762	23,174	23,594	24,021	24,456	24,899	25,350	25,809	26,276	26,752	27,236	1.81%
48-49	Transportation and Warehousing	3,907	3,935	3,963	3,991	4,019	4,048	4,077	4,106	4,135	4,164	4,194	4,224	4,254	4,284	4,315	4,345	4,376	0.71%
51	Information	1,862	1,883	1,905	1,926	1,948	1,970	1,993	2,015	2,038	2,062	2,085	2,109	2,133	2,157	2,182	2,206	2,231	1.14%
52-53	Financial activities	6,716	6,848	6,984	7,121	7,262	7,405	7,551	7,700	7,852	8,007	8,165	8,326	8,490	8,658	8,829	9,003	9,180	1.97%
54	Professional, Scientific, and Technical Services	6,299	6,424	6,552	6,682	6,814	6,949	7,087	7,228	7,371	7,518	7,667	7,819	7,974	8,133	8,294	8,459	8,627	1.98%
55	Management of Companies and Enterprises	1,110	1,121	1,133	1,144	1,156	1,168	1,179	1,191	1,203	1,216	1,228	1,240	1,253	1,266	1,279	1,292	1,305	1.02%
56	Administrative and Support and Waste Management and Remediation Services	6,749	6,913	7,081	7,253	7,429	7,610	7,794	7,984	8,178	8,376	8,580	8,788	9,002	9,221	9,445	9,674	9,909	2.43%
61	Educational Services	12,138	12,430	12,729	13,035	13,349	13,670	13,999	14,335	14,680	15,033	15,395	15,765	16,145	16,533	16,931	17,338	17,755	2.41%
62	Health	18,605	19,075	19,557	20,051	20,558	21,078	21,610	22,156	22,716	23,290	23,879	24,482	25,101	25,735	26,386	27,053	27,736	2.53%
71	Arts, Entertainment, and Recreation	2,998	3,061	3,126	3,192	3,259	3,327	3,398	3,469	3,542	3,617	3,693	3,771	3,850	3,931	4,014	4,099	4,185	2.11%
72	Accomodation and Food Services	16,053	16,469	16,897	17,335	17,784	18,246	18,719	19,205	19,703	20,214	20,738	21,276	21,828	22,394	22,975	23,571	24,182	2.59%
81	Other Services (Except Government)	5,395	5,456	5,518	5,580	5,643	5,707	5,772	5,837	5,903	5,970	6,037	6,105	6,174	6,244	6,315	6,386	6,458	1.13%
92	Government	9,957	10,061	10,165	10,271	10,378	10,486	10,596	10,706	10,817	10,930	11,044	11,159	11,275	11,393	11,511	11,631	11,752	1.04%
	Self-Employed and Other Non-Classified	11,896	12,043	12,181	12,309	12,427	12,535	12,631	12,715	12,788	12,847	12,894	12,927	12,945	12,949	12,937	12,909	12,865	1.77%
TOTAL		**150,648**	**153,244**	**155,884**	**158,570**	**161,303**	**164,082**	**166,909**	**169,785**	**172,711**	**175,687**	**178,714**	**181,793**	**184,926**	**188,112**	**191,354**	**194,651**	**198,005**	**1.72%**

Reference: Employment Security Commission of North Carolina, 2007.

[a] The Cape Fear Workforce Development Board (WDB) includes Brunswick, Columbus, New Hanover, and Pender counties, North Carolina.

NAICS = North American Industry Classification System.

Note: NC-ESC employment projections only included data for the years 2004 and 2014 by industry. To estimate employment between these years and after 2014, RTI computed an annualized growth rate for each industry based on the 2004 and 2014 data, and then assumed that these industries would grow at that constant rate.

Table 4.10-3. Proposed GLE Facility Operation, Construction and Decommissioning Employment

Year	Construction	Start-up	Operation	Decommissioning	Total
2011	290				290
2012	485				485
2013	485	200	350		1,035
2014	213	200	350		763
2015	174	200	350		724
2016	155	200	350		705
2017	136		350		486
2018–2048			350		350
2049–2050			350	50	400
2051–2057				50	50

Table 4.10-4. Change in Regional Population Due to Construction and Operation of Proposed GLE Facility

Total Number of Workers Per Year By Activity								
Year	Construction Worker		Start-up Workers		Operation Workers		Total	
	Low	High	Low	High	Low	High	Low	High
2011	290	290					290	290
2012	485	485					485	485
2013	485	485	200	200	350	350	1035	1035
2014	213	213	200	200	350	350	763	763
2015	174	174	200	200	350	350	724	724
2016	155	155	200	200	350	350	705	705
2017	136	136			350	350	486	486
2018–2048					350	350	350	350
2049–2050					400	400	400	400
2051–2057					50	50	50	50
Number of New Workers to the Region per Year by Type of Worker								
Year	Construction Worker		Start-up Workers		Operation Workers		Total	
	Low	High	Low	High	Low	High	Low	High
2011	58	116					58	116
2012	97	194					97	194
2013	97	194	40	40	70	70	207	304
2014	43	85	40	40	70	70	153	195
2015	35	70	40	40	70	70	145	180
2016	31	62	40	40	70	70	141	172
2017	27	54			70	70	97	124
2018–2048					70	70	70	70
2049–2050					120	120	120	120
2051–2057					50	50	50	50

(continued)

Table 4.10-4. Change in Regional Population Due to Construction and Operation of Proposed GLE Facility

School-Age Children Members Introduced to the Region by Influx of New Workers								
Year	Construction Worker		Start-up Workers		Operation Workers		Total	
	Low	High	Low	High	Low	High	Low	High
2011	38	75					38	75
2012	63	126					63	126
2013	63	126	26	40	46	70	135	236
2014	28	55	26	40	46	70	99	165
2015	23	45	26	40	46	70	94	155
2016	20	40	26	40	46	70	92	150
2017	18	35			46	70	63	105
2018–2048					46	70	46	70
2049–2050					78	120	78	120
2051–2057					33	50	33	50
Spouses Introduced to the Region by Influx of New Workers								
Year	Construction Worker		Start-up Workers		Operation Workers		Total	
	Low	High	Low	High	Low	High	Low	High
2011	38	75					38	75
2012	63	126					63	126
2013	63	126	26	40	46	70	135	236
2014	28	55	26	40	46	70	99	165
2015	23	45	26	40	46	70	94	155
2016	20	40	26	40	46	70	92	150
2017	18	35			46	70	63	105
2018–2048					46	70	46	70
2049–2050					78	120	78	120
2051–2057					33	50	33	50

(continued)

Table 4.10-4. Change in Regional Population Due to Construction and Operation of Proposed GLE Facility

Total Population Increase by Year								
Year	Construction Worker		Start-up Workers		Operation Workers		Total	
	Low	High	Low	High	Low	High	Low	High
2011	133	267					133	267
2012	223	446					223	446
2013	223	446	92	120	161	210	476	776
2014	98	196	92	120	161	210	351	526
2015	80	160	92	120	161	210	333	490
2016	71	143	92	120	161	210	324	473
2017	63	125			161	210	224	335
2018–2048					161	210	161	210
2049–2050					276	360	276	360
2051–2057					115	150	115	150

Table 4.10-5. Annual Individual Income Tax Impacts by Year and Type of Worker ($2007)

Year	Construction Worker		Start-up Workers	Operation Workers	Total	
	Low	High			Low	High
2011	$133,400	$266,800			$133,400	$266,800
2012	$223,100	$446,200			$223,100	$446,200
2013	$223,100	$446,200	$252,000	$441,000	$916,100	$1,139,200
2014	$97,980	$195,960	$252,000	$441,000	$790,980	$888,960
2015	$80,040	$160,080	$252,000	$441,000	$773,040	$853,080
2016	$71,300	$142,600	$252,000	$441,000	$764,300	$835,600
2017	$62,560	$125,120		$441,000	$503,560	$566,120
2018–2048				$441,000	$441,000	$441,000
2049–2050				$756,000	$756,000	$756,000
2051–2057				$330,000	$330,000	$330,000
Cumulative Impact	$891,480	$1,782,960	$1,008,000	$19,698,000	$21,597,480	$22,488,960

Table 4.10-6. Annual Sales Tax Impacts by Year and Type of Worker ($2007)

Year	Construction Worker		Start-up Workers	Operation Workers	Total	
	Min	Max			Min	Max
2011	$93,000	$187,000			$93,000	$187,000
2012	$156,000	$312,000			$156,000	$312,000
2013	$156,000	$312,000	$175,000	$306,000	$637,000	$793,000
2014	$69,000	$137,000	$175,000	$306,000	$550,000	$618,000
2015	$56,000	$112,000	$175,000	$306,000	$537,000	$593,000
2016	$50,000	$100,000	$175,000	$306,000	$531,000	$581,000
2017	$44,000	$88,000		$306,000	$350,000	$394,000
2018–2048				$306,000	$306,000	$306,000
2049–2050				$524,000	$524,000	$524,000
2051–2057				$229,000	$229,000	$229,000
Cumulative Impact	$624,000	$1,248,000	$700,000	$13,667,000	$14,991,000	$15,615,000

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4.11 Environmental Justice

Environmental justice refers to a federal policy under which each agency identifies and addresses disproportionately high and adverse human health or environmental effects of agency policies and activities, including licensing actions, on minority or low-income populations. This section evaluates whether the construction, operation, or decommissioning of the Proposed GLE Facility could have a significant and disproportionately high and adverse impact on the minority and low-income communities living within a 50-mi^2 (129.5 km^2) area surrounding the Wilmington Site.

4.11.1 Environmental Justice Evaluation Methods

The guidelines and procedures set forth in Appendix C to NUREG-1748 (*Environmental Review Guidance for Licensing Actions Associated with NMSS (Nuclear Material Safety and Safeguards) Programs*; NRC, 2003) and the NRC's *Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions* (NRC, 2004) were used to evaluate whether environmental justice concerns exist for the minority and low-income populations surrounding the Proposed GLE Facility. According to these procedures, the applicant should first collect demographic data for communities living within 4 miles (6.44 km) of the proposed site (a 50-mi^2 [129.5 km^2] area) and then use that data and the suggested criteria to make an initial assessment of the potential presence of significant minority and low-income populations.

Demographic data on minority and low-income households were obtained from the 2000 Decennial Census for each Census Block Group (CBG) in the 4-mile (6.4 km) radius surrounding the Proposed GLE Facility. These data included the total population, total population of each minority group (e.g., African American, Hispanic, Native American), and total number of households living below the U.S. Census Bureau-specified poverty level (defined in NUREG-1748 as low-income households). Although more recent demographic information may be available for larger areas, data on CBGs are only collected and published in the decennial census, so these are the data used for the evaluations presented in this Report. Even though these data are now several years old, they are the best available to address demographic characteristics of the area surrounding the Wilmington Site. These data are summarized in **Section 3.10.2** of this Report (*Economic Characteristics [Socioeconomic Environment]*) and in **Tables 3.10-3 and 3.10-4**, and are illustrated in **Figures 3.10-2 and 3.10-6**.

After these data were collected, the percentage of the population that is minority and the percentage of the population with incomes below the poverty level were computed for each CBG; these percentages were then compared with similar data for the State and the counties in which each CBG is located (summarized in **Tables 3.10-3 and 3.10-4**). This was done to determine whether the minority and low-income populations in each CBG significantly exceeded the minority and low-income population percentages of the State or county. Appendix C of NUREG-1748 and the NRC's *Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions* state that the share of minority and low-income individuals in each CBG is significantly higher than the rest of their respective State or county if the CBG

- Contained a minority population group, aggregate minority population, or low-income household percentage that exceeded its county or State percentages by more than 20 percentage points
- Had a population that was more than 50% minority (either by individual group or in aggregate) or low-income households (NRC, 2003, 2004).

Tables 3.10-3 and 3.10-4 reveal that there are CBGs that meet these criteria within a 4-mile (6.4-km) radius of the Proposed GLE Facility. With respect to aggregate minority populations, two CBGs have aggregate minority populations that exceed 50%, as well as exceed county and State populations by more than 20 percentage points (NC Census Tract 980600, CBG 1, in Pender County, and NC Census Tract 011500, CBG 5, in New Hanover County). With respect to the number of individuals living in poverty, there is one CBG that has low-income population exceeding county and State population percentages by 20 percentage points (NC Census Tract 980600, CBG 1, in Pender County). Although the CBG within which the Proposed GLE Facility is located (NC Census Tract 011500, CBG 1) has moderate levels of minority population and a relatively small low-income population, there are small neighborhoods within the CBG that have higher percentages of minority and/or low-income populations.

Because the screening assessment identified two CBGs with a significant population of minority and/or low-income residents located within a radius of 4 miles (6.4 km) of the Proposed GLE Facility, a more detailed analysis is needed to assess whether the Facility would impose disproportionately high and adverse environmental impacts on those communities, or on smaller neighborhoods within other CBGs.

4.11.2 Environmental Justice Impacts

4.11.2.1 No Action Alternative

Under the No Action Alternative, the analysis expects that the population of the region will grow as projected by the North Carolina Demography Office (see **Table 3.10-2**). In the absence of additional information, the analysis assumes that the demographic characteristics of the population would remain unchanged. Thus, the CBGs described previously would be expected to continue to have significant population percentages of minority and low-income residents. Over the estimated 40-year period that the Facility would be in operation, population and employment are projected to increase in the region, so some changes in air quality and water quality could be experienced in the CBGs as a function of baseline conditions. Without the Proposed GLE Facility, however, any environmental impacts associated with Wilmington Site preparation and construction, operation, or decommissioning of the Facility would not occur.

4.11.2.2 Proposed Action Alternative

If the Proposed Action is undertaken, construction of the Proposed GLE Facility would begin in 2011 and continue to 2017. In 2013, operation of the Facility would begin with a 4-year start-up period. By 2017, the Proposed GLE Facility is expected to be fully operational at the 6 million SWU per year level.

4.11.2.2.1 Site Preparation and Construction

Site preparation and construction of the Proposed GLE Facility may require a labor force of as many as 485 employees; construction employment is projected to vary depending on the site preparation and construction activities under way at any given time. Preparation of the GLE Facility site and construction of the Proposed GLE Facility is projected to take approximately 7 years, beginning in 2011 and ending in 2017. During the site preparation and construction phase of the project, environmental impacts (discussed in detail in the sections noted in parentheses) may include the following:

- Increased truck and car traffic associated with construction materials and labor (see **Section 4.2**, *Transportation Impacts*)
- Air quality impacts from both construction traffic and operation of construction equipment (see **Section 4.6**, *Air Quality Impacts*)
- Indirect surface water quality impacts caused by stormwater runoff from the GLE Facility site (see **Section 4.4.2**, *Surface Water Impacts*)
- Increased noise associated with the operation of construction machinery (see **Section 4.7**, *Noise Impacts*).

The environmental impacts associated with site preparation and construction of the Proposed GLE Facility are generally estimated to be SMALL, and generally would be mitigated. Any remaining environmental impacts are projected to most directly affect residents in the immediate area of the Proposed GLE Facility. The only MODERATE impacts involve occasional noise from construction equipment, and increased traffic congestion on NC 133 (Castle Hayne Road) between the proposed new dedicated GLE facility entrance and the I-140 interchange, especially during peak hours. These impacts will mainly affect residents living in the area between the town of Castle Hayne and I-140, or near the NC 133/I-140 interchange. The Proposed GLE Facility is located in NC Census Tract 011500, CBG 1, which has minority residents comprising 18.3% of its population and low-income residents that account for only 7% of its population. These percentages are below both county and State percentages and are among the lowest in the 50 mi^2 (129.5 km^2) area being analyzed. The neighborhood immediately surrounding the Proposed GLE Facility includes a mix of minority and non-minority residents, as well as a mix of low-income and more well-to-do residents. Because impacts are generally SMALL, and because the greatest impact is expected to occur in the immediate vicinity of the Proposed GLE Facility in an area with a mix of ethnicities and income levels, construction of the Facility would not be expected to result in disproportionately high or adverse impacts on low-income or minority residents. Thus, it is not expected that construction of the Facility would give rise to environmental justice concerns.

4.11.2.2.2 Operation

Operation of the Proposed GLE Facility would be expected to begin with a start-up period lasting 4 years, reaching full facility production of 6 million SWU in 2017. During this start-up period, the Facility is projected to employ as many as 200 FTEs engaged in start-up activities and 350 FTEs engaged in Facility operations. During the operation phase of the project, potential environmental impacts (discussed in detail in the sections in parentheses) may include the following:

- Increased truck and car traffic associated with transportation of materials and product, as well as employees, to and from the Proposed GLE Facility (see **Section 4.2**, *Transportation Impacts*)
- Air emissions associated with both vehicle exhaust and operation of the Facility (see **Section 4.6**, *Air Quality Impacts*)
- Indirect surface water quality impacts caused by stormwater from the Wilmington Site and treated wastewater effluent discharges to the effluent channel (see **Section 4.4.2**, *Surface Water Impacts*)
- Trace radiological releases (see **Section 4.12**, *Waste Management Impacts*)
- Increased noise associated with the operation of the Facility (see **Section 4.7**, *Noise Impacts*).

As was the case for construction, the environmental impacts associated with the operation phase of the Proposed Action would be most likely to affect residents in the immediate area of the Proposed GLE Facility, which would be located in NC Census Tract 011500, Census Block Group 1. This CBG has minority residents comprising 18.3% of its population and low-income residents that account for only 7% of its population. These percentages are below both county and State percentages and are among the lowest in the 50-mi^2 (129.5-km^2) area being analyzed. The area immediately surrounding the Proposed GLE Facility includes both minority and non-minority residents, as well as both low-income and middle-income residents. Environmental impacts of Facility operations are projected to be SMALL, and no adverse health impacts are expected. The only MODERATE impacts anticipated involve increased traffic congestion on NC 133 (Castle Hayne Road) between the proposed new dedicated GLE facility entrance and the I-140 interchange, and these impacts will mainly affect residents living in the area between Castle Hayne and I-140, or near the interchange. Because the greatest impact is expected to occur in an area with a mix of ethnicities and income levels, the operation phase of the Proposed Action is not expected to result in disproportionately high or adverse impacts on low-income or minority residents; thus, the operation of the Facility is not expected to give rise to environmental justice concerns.

It should be noted that even where environmental impacts are generally SMALL, the behaviors of some subpopulations may lead to disproportionate exposure through inhalation or ingestion (e.g., higher participation in outdoor recreation, home gardening, subsistence fishing). The analysis does not indicate the likelihood of any such disproportionate exposures near the Proposed GLE Facility. Specifically, special attention was paid to potential for indirect exposure to radiological material due to releases and subsequent uptake by fish. NC Census Tract 011500, CBG 5, 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. If radiation was released, these residents could face some increased risk of exposure due to their fish-consumption patterns; however, the releases of total uranium and UF_6 are projected to be extremely low (see **Section 4.12.2.2**, *Radiological Impacts*, and **Section 4.13.2.2.1**, *Wastewaters*), and indirect exposure through fish consumption would be even lower. Soil and vegetation samples from the Wilmington Site and from a mile away show no impact from current GNF-A operations. As discussed in **Section 4.12.2.2.2.2**, *Public and Occupational Exposure*, the radiological doses to the nearest residents resulting from operations of the Proposed GLE Facility and the current GNF-A operations are projected to be well below the EPA 10 millirem (mrem; .1 milliSieverts [mSv]) per year standard (20 CFR 190) and the NRC total effective dose equivalent (TEDE) 100 mrem (1 mSv) per year limit (10 CFR 20, *Standards for Protection Against Radiation*). Therefore, operations of the Proposed GLE Facility are not expected to result in disproportionately high or adverse impacts on minority or low-income populations.

4.11.2.2.3 Decommissioning

Decommissioning of the Proposed GLE Facility is projected to begin in 2049; as discussed in **Section 2.3** of this Report (*Cumulative Effects*), decommissioning is projected to consist of removal of equipment from the Facility, but the building, parking area, and access roads are projected to remain in place. Decommissioning would be expected to employ 50 FTEs and result in a reduction in environmental impacts relative to construction and operation of the Facility, but slightly higher than baseline. Again, impacts are expected to be concentrated in the vicinity of the Proposed GLE Facility; thus, NC Census Tract 011500, CBG 1, would experience a higher share of any environmental impacts than would CBGs located farther from the Facility. Because the CBG in which the Facility is located has relatively low percentages of minority and low-income residents, decommissioning of the Facility is not expected to result in disproportionately high or adverse impacts on minority or low-income populations and thus, is not expected to pose environmental justice concerns.

4.11.2.3 Cumulative Impacts

All phases of the Proposed GLE Facility have the potential to generate environmental impacts on the areas surrounding the Facility, including a CBG with relatively high proportion of minority residents and one with relatively high minority and low-income population shares. However, the results of the analysis indicate that the cumulative environmental impacts experienced by residents from the construction, operation, and decommissioning phases of the Proposed Action would be SMALL, and any adverse health impacts would be SMALL. The only MODERATE impacts estimated are increased traffic congestion on NC 133 (Castle Hayne Road) between the proposed new dedicated GLE facility entrance and the I-140 interchange, especially during peak hours, and these impacts will mainly affect residents living the area between the town of Castle Hayne and I-140 or near the interchange.

In addition to the Proposed GLE Facility, two other projects are planned for the Wilmington Site: the ATC II complex, which is currently under construction, and the Tooling Development Center, which is expected to begin construction within the next 10 years. These two projects would, together, employ approximately 1000 workers, increasing the traffic in the area of the Wilmington Site and also increasing traffic-related air emissions. The projects would increase water use and discharge of treated wastewater effluents; however, the environmental impacts of the projects are projected to be SMALL, with the exception of MODERATE local traffic congestion at peak hours. Combining the impacts of these two on-site projects with those of the Proposed Action, the cumulative impacts are anticipated to be SMALL, again with the exception of MODERATE local traffic congestion at peak hours. These cumulative impacts are not expected to disproportionately affect either minority or low-income residents of the area.

Two other off-site projects are identified in **Section 2.3** (*Cumulative Effects*): the River Bluffs retirement community project planned for a parcel adjacent to and south of the Wilmington Site, and a new cement plant proposed by the Carolinas Cement Company, which would be outside the 5-mile [8-km] radius of Wilmington Site in the unincorporated northeastern portion of New Hanover County. The Carolinas Cement Company project is not expected to significantly affect local vehicle traffic patterns on the segment of NC 133 (Castle Hayne Road) in the immediate vicinity of the Wilmington Site (see **Section 4.2.4**, *Cumulative Impacts [Transportation]*). The River Bluffs project, however, is projected to add an estimated several thousand average daily vehicle trips to the area. Considering these off-site projects, cumulative environmental impacts are estimated to be SMALL, with the exception of MODERATE local traffic congestion at peak hours.

In addition to the potential environmental impacts associated with construction, operation, and decommissioning of the Proposed GLE Facility, there are projected to be substantial positive economic impacts for the area, including increased employment and income. During construction, it is projected that up to 485 employees would be needed; during Facility start-up, up to 550 employees would be needed; during regular Facility operations, approximately 350 employees would be required; and during decommissioning, approximately 50 employees would be required. The majority of the workers, especially for operations, are expected to be hired from within the region. A wide range of skills and education levels would be needed; thus, there would be employment opportunities available to the residents of all CBGs surrounding the Facility, including those with relatively high percentages of minority and low-income residents.

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GLE Environmental Report

Section 4.12 – Public and Occupational Health Impacts

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4.12 Public and Occupational Health

Potential impacts to air quality and surface and groundwater quality were assessed to evaluate exposure pathways to the public and workers at the Proposed GLE Facility. Potential human health impacts due to exposures from permitted emissions and accidental releases from the Proposed GLE Facility were estimated for chemical and radiological gaseous emissions and liquid effluents.

4.12.1 No Action Alternative

Under the No Action Alternative, ongoing Wilmington Site activities would continue and potential health impacts would be expected to remain unchanged. The No Action Alternative would not contribute any additional non-radiological or radiological emissions to the environment; therefore, any impacts on public or occupational health at the Wilmington Site are expected to remain SMALL.

4.12.2 Proposed Action

There is the potential for impacts to public and worker health due to construction, operation, and decommissioning of the Proposed GLE Facility. Exposure pathways relevant to the public and workers associated with the Proposed Action were assessed to evaluate potential impacts. Potential human health impacts due to exposures from construction activities, permitted emissions, and accidental releases were estimated for non-radiological and radiological chemical emissions. Conservative accident scenarios were postulated and evaluated for potential impacts on human health.

4.12.2.1 Non-Radiological Impacts

Figure 4.12-1 illustrates the layout of the Wilmington Site and the locations of the Proposed GLE Facility, proposed GLE vent stack, and potential receptors of interest, including the nearest Site boundary, full-time resident, and sensitive receptors (e.g., schools). The full-time resident located nearest to the Proposed GLE Facility has been identified at 0.9 miles (1.5 km) east-southeast of the Proposed GLE Facility vent stack location. Three schools are located within a 5-mile (8-km) radius (Wrightsboro Elementary School, Emma B. Trask Elementary School, and Emsley A. Laney High School, as shown in **Figure 4.12-1**). Three hospitals serve the greater Wilmington area, but are located further away (New Hanover Regional Medical Center, 9.0 miles [14.5 km] south; Pender Memorial Hospital, 14.9 miles [24.0 km] north; and Brunswick Community Hospital, 29.8 miles [48.0 km] southwest of the Proposed GLE Facility). There are no public drinking-water intakes on surface waterbodies within 5 miles (8 km) of the Proposed GLE Facility.

New projects that are initiated on the Wilmington Site, including the operations at the Proposed GLE Facility, have to be approved by the Industrial Hygiene and Safety (IHS) manager to ensure that appropriate industrial safety measures are implemented. Work environments that present the potential for exposure to chemical, biological, or physical agents are evaluated, and appropriate safety controls are implemented and/or safety equipment is assigned to workers. The Industrial Safety Program is evaluated on an annual basis (GNF-A, 2007b).

4.12.2.1.1 Site Preparation and Construction

Construction of the Proposed GLE Facility would result in fugitive dust emissions (from construction activities and vehicular traffic along unpaved roads) and vehicle emissions. PM with aerodynamic diameter less than 10 μm (PM_{10}), CO, NO_x, SO_2, and VOC emissions were evaluated for potential human health impacts from construction activities and associated vehicle emissions (see also **Appendix R** for details on air quality impacts). Fugitive dust emissions from excavation and grading during construction would be controlled using BMPs and dust-suppression methods (e.g., water sprays and speed limits on unpaved roadways). Only SMALL impacts on air quality are expected. Emissions from heavy construction equipment and vehicles generally would not affect ambient air quality, but could result in a temporary local increase in VOC emissions.

Precautions would be taken during construction to avoid accidental discharges of fuel, waste, and sewage. These precautions, including the use of safety procedures, spill controls, spill-response plans, countermeasures plans, and spill-response equipment in accordance with federal and State laws, would minimize the likelihood and magnitude of impacts from accidental discharges, should they occur. If a spill occurs, trained qualified professionals would promptly deploy spill clean-up methods. Affected soils and water would be sampled, analyzed, and managed according to State and federal requirements.

Impacts to surface water quality from soil erosion would be SMALL during construction because preventative measures would be taken to prevent the removal and erosion of soils. Engineering controls and best management and construction practices would be implemented to minimize the extent of excavations and grading. Standard soil-erosion and sedimentation-control methods (e.g., silt fencing) would be used to minimize or prevent runoff from disturbed areas into any nearby waterbodies. These procedures would be implemented according to the Erosion and Sedimentation Control Plan as requirements of the NPDES construction permit. Construction wastes (e.g., discarded building materials, concrete truck washout, chemicals, litter, sanitary waste) would be strictly controlled to prevent impacts to water quality.

Construction activities for the Proposed GLE Facility would involve the addition of 1,970 FTEs over a 7-year period, with, at most, 490 FTEs on-site at a given time; the peak in construction activity would occur during the first 3 years. Construction activities would be subject to OSHA construction regulations (29 CFR 1926, *Safety and Health Regulations for Construction*) and any local ordinances.

4.12.2.1.1.1 Construction Impacts from Air Quality

Fugitive Emissions. The EPA's AERMOD was used to estimate concentrations of PM_{10}, CO, NO_x, SO_2, and VOCs emitted due to construction activities (see **Appendix R** of this Report, *Air Emissions Dispersion Modeling for Construction Phase of Proposed GLE Facility Using AERMOD Model*, for additional details). The maximum off-site annual average concentration of PM_{10} due to construction activities of the Proposed GLE Facility, including fugitive dust and vehicle emissions, is estimated at 0.5 micrograms per cubic meter ($\mu g/m^3$), which would occur at the fenceline to the northeast (45°) of the GLE Facility site centroid. The maximum on-site annual average concentration of PM_{10} is estimated to be somewhat higher at 2.1 $\mu g/m^3$. There is no current annual NAAQS for PM_{10} (U.S. EPA, 2007) due to the lack of evidence that long-term exposure to coarse particle pollution causes health problems (prior to being revoked in 2006, the limit had been 50 $\mu g/m^3$). Assuming that approximately 40% of the emitted fugitive dust would be $PM_{2.5}$ (U.S. EPA, 1999), the fine PM annual average concentration on-site would be estimated to be 0.8 $\mu g/m^3$ (and lower at the fenceline), which is well below the annual average standard for $PM_{2.5}$ of 15 $\mu g/m^3$. No adverse health impacts to nearby residents or workers are expected to result from annual average PM emissions related to construction.

Acute (24-hour average) exposures to high levels of fine particles can cause respiratory problems for sensitive subpopulations (e.g., asthmatics). The highest off-site 24-hour average concentration value for PM_{10} was estimated to be 35.4 $\mu g/m^3$, which occurred to the northeast (52.5°) and is significantly lower than the 24-hour average PM_{10} NAAQS of 150 $\mu g/m^3$ (U.S. EPA, 2007). The maximum on-site 24-hour average value was estimated to be 80.9 $\mu g/m^3$, which is also lower than the 24-hour average PM_{10} NAAQS. Assuming that approximately 40% of the emitted material is $PM_{2.5}$, the highest on-site 24-hour average $PM_{2.5}$ concentration of 32.4 $\mu g/m^3$ (and lower at the fenceline) would be below the $PM_{2.5}$ NAAQS

24-hour standard of 35 μg/m^3 (U.S. EPA, 2007). No adverse health impacts to nearby residents or workers are expected to result from short-term PM emissions related to construction.

Vehicle Emissions. Impacts were estimated for the major pollutants emitted by vehicles, including CO, NO_x, PM_{10}, SO_2, and VOCs. NAAQS and other air quality standards for these pollutants were used as benchmarks for comparison. The estimated maximum annual average concentrations of these pollutants at the Facility fenceline were extremely low. CO, which does not have an annual NAAQS, had a maximum annual average concentration of 0.2 μg/m^3. NO_x had a maximum estimated annual average concentration of 0.1 μg/m^3 (annual average NAAQS, as NO_2, is 100 μg/m^3). The vehicle emissions contribution to PM_{10} had a maximum annual average concentration at the fenceline of 0.01 μg/m^3. SO_2 had a maximum annual average fenceline concentration of 2.0E-04 μg/m^3 (annual average NAAQS is 80 μg/m^3). Finally, VOCs were estimated at a maximum annual average concentration of 0.02 μg/m^3. **Table R-2** presents the estimated concentrations of vehicle emission pollutants in relation to the corresponding NAAQS standards. No adverse health impacts to nearby residents or workers are expected to result from long-term exposures to construction vehicle emissions.

Estimated short-term CO concentration levels were extremely low when compared to the short-term NAAQS for CO. The maximum 8-hour average value for CO at the fenceline was 26.8 μg/m^3 (NAAQS 8-hour average standard is 10,000 μg/m^3), and the highest 1-hour average concentration was 129.5 μg/m^3 (NAAQS 1-hour average standard is 40,000 μg/m^3). PM_{10} concentration levels were also extremely low when compared to the 24-hour average NAAQS of 150 μg/m^3. The maximum 24-hour average fenceline concentration for PM_{10} was estimated to be 1 μg/m^3. SO_2 concentrations were also extremely low when compared to the 24-hour NAAQS standard for SO_2 of 365 μg/m^3. The maximum 24-hour average fenceline concentration for SO_2 was estimated to be 2.8E-03 μg/m^3. No adverse health impacts to nearby residents or workers are expected to result from short-term exposures to construction vehicle emissions.

The above impacts were assessed conservatively assuming the absence of BMPs; however, BMPs (e.g., watering unpaved roadways, speed limits on unpaved roadways, covering soil- or debris-carrying truck loads, regular maintenance on construction vehicles) would be implemented during construction of the Proposed GLE Facility, further reducing these SMALL air exposure impacts to residents and on-site workers.

4.12.2.1.1.2 Construction Impacts on Water Quality

The Northeast Cape Fear River and its tributaries are not used for drinking water purposes; therefore, no adverse health impacts to nearby residents or workers are expected due to impacts on water quality, which are anticipated to be SMALL. Off-site residential groundwater wells are used for drinking water supply, and the Wilmington Site potable wells are located on the east side of NC 133 (Castle Hayne Road). Direct or indirect impacts to drinking water quality are anticipated to be SMALL during the construction of the Proposed GLE Facility. The accidental release of oil and grease from construction vehicles and machinery and sediment runoff could occur and would be controlled wherever possible through the use of best management and construction practices (see **Section 4.4.2.3.1.1**, *Site Preparation and Construction [Impacts to Surface Water Quality (Receiving Waters)]*). Construction activities would not introduce any contaminants (e.g., oil, grease) in amounts that could potentially leach to groundwater and impact groundwater quality.

4.12.2.1.1.3 Construction Accidents

Construction activities are subject to OSHA construction regulations (29 CFR 1926). During construction, there would be an increased potential for construction vehicle accidents, material-handling accidents, lacerations, trips, and falls that could result in injuries. First aid or further medical attention would be provided promptly as warranted by the situation. As a result of construction activities, it is expected that there could be an increase in the incidence of OSHA-recordable injuries and illnesses over the pre-construction incidence rate.

4.12.2.1.2 Operation

Operation of the Proposed GLE Facility would employ approximately 550 additional personnel during a 6-year start-up phase and then would drop to 350 personnel when fully operational. During the first 5 years of the start-up phase, there would be up to 200 construction workers at the GLE Facility site. The increased number of employees is likely to result in an increase in the incidence of OSHA-recordable injuries and illnesses. Industrial activities would be subject to OSHA's industrial regulations (29 CFR 1910, *Occupational Safety and Health Standards*), as well as site licenses and permits.

Worker health and safety at the Proposed GLE Facility will be addressed by the GLE Nuclear Safety Program and the Industrial Safety Program. These programs comply with all applicable State, NRC (10 CFR 20, *Standards for Protection Against Radiation*), and OSHA (29 CFR 1910) requirements. The IHS manager is responsible for implementing the Industrial Safety Program. New projects that are initiated on the Wilmington Site, including the operations at the Proposed GLE Facility, have to be approved by the IHS manager to ensure that appropriate industrial safety measures are implemented. Work environments that present the potential for exposure to chemical, biological, or physical agents (e.g., radiation, noise, heat/cold, vibration) are evaluated, and appropriate safety controls are implemented and/or safety equipment is assigned to workers. PPE requirements are based on the nature of the work and chemical and/or radiological hazards present. The Industrial Safety Program is evaluated on an annual basis (GNF-A, 2007b).

The fire protection installation and testing at the Proposed GLE Facility will comply with National Fire Protection Association Standards, North Carolina State Building Code system, and Factory Mutual requirements. Fire alarm initiating devices and signaling devices are controlled and monitored through the fire alarm system (GNF-A, 2007b, 2007c).

Some chemicals would be used at the Proposed GLE Facility only in laboratory or cleaning agent quantities; however, other materials (e.g., fuels, oils) common to industrial processes would be used in larger quantities. A detailed list of the chemical and gaseous materials that can be expected to be used at the Proposed GLE Facility is provided in **Table 2.1-2**. Chemicals used at the Proposed GLE Facility would be used in accordance with the manufacturer's recommendations and health and safety regulations, and under formal procedures implemented by the Industrial Safety Program. GLE would investigate the use of alternative, less-toxic solvents and/or apply control technologies as reasonable. Other chemicals not listed may be used in *de minimis* levels or are nonhazardous by nature.

In the following sections, the sources of potential non-radiological exposure to the public and Facility workers associated with the operation of the Proposed GLE Facility are characterized. The human health impacts associated with potential non-radiological exposures to operational gaseous emissions and liquid effluents are anticipated to be SMALL. Also described are preventive and mitigative measures regarding non-radiological operational accident scenarios.

4.12.2.1.2.1 Operational Gaseous Emissions

The Proposed GLE Facility would operate a proprietary, non-combustion, closed-system process inside the main GLE operations building. No gaseous criteria air pollutants (e.g., CO, NO_x, SO_2, VOCs) would be produced by this process. Existing air quality at the Wilmington Site is currently in attainment with all NAAQS for criteria air pollutants. The Wilmington MSA is currently in attainment for ozone. Any regulated non-radiological gaseous emissions would be below NC DAQ permit limits, and the Proposed

Action would not significantly impact air quality or increase potential exposures to gaseous emissions. For airborne releases, off-site concentrations from normal operations of the Proposed GLE Facility are expected to be too low to present problems to public health through inhalation, ingestion, or dermal exposure pathways.

Worker exposure to in-facility gaseous emissions would not exceed OSHA's occupational safety and health standards for toxic and hazardous substances, in accordance with 29 CFR 1920, Subpart Z (*Toxic and Hazardous Substances [Federal OSHA Regulations for General Industry]*). Laboratory and maintenance activities involving hazardous fumes would be conducted with ventilation control (e.g., fume hoods) and/or with the use of respiratory protection as required by the Industrial Safety Program.

Some intermittent gaseous releases may occur inside the GLE process building due to the connecting and disconnecting of the UF_6 cylinders on the front end and back end of the operations and process equipment and repair activities. These releases would contain UF_6 gas (see **Section 4.12.2.2.2.1**), which releases HF when it dissociates. HF emissions and controls are regulated by the NC DAQ as the toxic air pollutant, fluoride. A building ventilation system would maintain the majority of the interior of the process building under sub-atmospheric pressure. This would prevent air emission releases that occur inside the process building from being directly vented to outside the building. The controls on the process are designed to isolate the leak and shut down the process to prevent damage to the equipment. Exhaust gases from the emission control system would be vented to the atmosphere through a single rooftop stack. The design control efficiency for the emission control system would be at least 99% (by weight) removal for fluoride. The process that would be used by the Proposed GLE Facility has yet to be commercially deployed at any location; therefore, there are no source test data available for quantifying the level of air emissions. Estimated air emission levels used in this analysis are based on the FMO facility's process operations data, which are expected to be higher than actual air emissions levels will be for the Proposed GLE Facility's process operations (see **Section 4.6.2.2.1.1**, *Process Vents [Operation Air Emissions Sources]*).

The primary non-radiological hazardous air effluent associated with the Proposed GLE Facility would be HF; however, airborne concentrations of HF from the Proposed GLE Facility would be significantly lower than those currently emitted from the FMO facility due to the differences in manufacturing practices. The use of air emission control systems and the implementation of mitigation measures would reduce the levels of air emissions released to the atmosphere. Fluoride monitors on the vent stacks would be employed to detect incidental releases. To measure fluoride releases to the atmosphere, an in-stack filter will be analyzed for fluoride content either daily or weekly. An air quality permit from the NC DAQ would be required for the operation of the Proposed GLE Facility. Total fluoride emissions are expected to be well below permitted levels, which would be protective of human health. No adverse health impacts to nearby residents are expected.

4.12.2.1.2.2 Operational Liquid Effluent

Under the Proposed Action, process wastewater would be pumped to the existing Wilmington Site final process lagoon facility for treatment. Sanitary wastewater (e.g., originating from washrooms) from the Proposed GLE Facility would be pumped to the existing Wilmington Site sanitary wastewater treatment facility for treatment and industrial re-use as process water (see **Section 2.3** of this Report, *Cumulative Effects*). This effluent re-use has resulted in the elimination of discharge of treated sanitary wastewater effluent to the effluent channel. Treated process wastewater effluent from the final process lagoon facility is discharged to the on-site effluent channel via NPDES-permitted Outfall 001 (see **Figure 3.12-1**). The effluent channel flows to Unnamed Tributary #1 to Northeast Cape Fear River. The quality of the GLE process wastewater effluents are anticipated to be similar to those currently being treated at the existing final process lagoon facility. With the addition of the Proposed Action, process wastewater quantity and quality would remain within NPDES-permitted levels, and therefore, the environmental impacts associated with these treated wastewater effluents are anticipated to be SMALL (see **Section 4.4.2**, *Surface Water Impacts*, and **Section 4.13.2.2.1.3**, *Sanitary Waste Management [Wastewaters, Proposed Action]*).

Portions of the GLE process area (separator areas) would be Moderator-Restricted, meaning that no water would be allowed in the processing areas, whereas other GLE process areas (e.g., vaporizer hallway, cylinder dock) would be Moderator-Controlled, meaning that small quantities of water would be allowed, but could not pool. There will be a limited amount of liquids used for cleaning purposes, such as acetone and other organics for wiping down equipment. Liquid wastes may include industrial cleaning solvents and waste oils. These wastes would be sent to off-site facilities for appropriate management, as determined by the waste characteristics and regulatory status (e.g., recycling facility, Resource and Recovery Act [RCRA] hazardous waste treatment or disposal facility). Minor spills would be remediated in accordance with the Industrial Safety Program described in **Section 3.11.4.2** of this Report, *Occupational Exposure (Historical Exposure to Radioactive Materials).*

In accordance with 29 CFR 1920, worker exposure to in-facility liquid effluents would be minimal. The handling of chemicals and wastes would be conducted in accordance with the Industrial Safety Program, which would specify the use of appropriate engineering controls and PPE to minimize potential chemical impacts.

4.12.2.1.2.3 Non-Radiological Impacts Accident Analysis

Accident analyses were performed for potential on-site accidents as part of the Integrated Safety Analysis (ISA) and documented in the *ISA Summary for the Proposed GLE Facility* (GLE, 2009). As part of these analyses, off-site consequences from non-radiological and radiological hazards were evaluated, and Items Relied On For Safety (IROFS) were identified to prevent or mitigate those accidents exceeding the criteria in 10 CFR 70.61 (*Performance requirements [Domestic Licensing of Special Nuclear Material]*). Considering both non-radiological and radiological events, the bounding accidents fall into three general classes: nuclear criticality, UF_6 release, and hydrogen gas (H_2) explosion. The first two types of accidents are described in **Section 4.12.2.2.2.3**.

For non-radiological accidents, the most likely scenario is fire/explosion within the Proposed GLE Facility resulting from laser equipment malfunctions or air in-leakage, leading to an explosive mixture of H_2 and air. Should this type of explosion occur, the explosive force could damage additional laser equipment and wall structures and potentially propagate into a UF_6 process or handling area. The propagated material could impinge upon and breach UF_6 process lines and equipment, causing a UF_6 release inside the building.

For this accident sequence, preventive and mitigative measures within the Facility would include 1) fire alarm and detection systems, which provide alert and, where applicable, suppression capability; 2) inherently designed fire barriers, which meet applicable codes and standards that prevent propagation of fire in and out of areas containing uranic material; 3) system and component design features that isolate combustible material and/or shutdown systems of concern; 4) continuous hydrogen detection within the laser systems, which provides for automatic isolation of hydrogen-containing pipes upon high readings; and 5) structural design features that ensure peak explosive blast loads eliminate or minimize propagation of structural material into a UF_6 process or handling area.

4.12.2.2 Radiological Impacts

The existing Wilmington Site Nuclear Safety Program and the Industrial Safety Program would be expanded to protect workers at the Proposed GLE Facility. The expanded Nuclear Safety Program would comply with applicable state, NRC (10 CFR 20), and OSHA requirements (29 CFR 1910). The Nuclear

Safety Function at the Wilmington Site would continue to be responsible for implementing the Nuclear Safety Program and preventing criticality and maintaining radiological safety for all aspects of the nuclear fuel processes, including radioactive material receipt, enrichment, conversion, fabrication, storage, and shipment of products. The Radiation Protection group within the Nuclear Safety Function would continue to provide support to operations, manage nuclear instrumentation, inventory radioactive material, and monitor State and federal radiation programs to ensure that worker dose is maintained in accordance with ALARA practices. Exposure monitoring would be conducted on GLE radiation workers to evaluate their potential for personal exposure; if personal monitoring is not feasible, work area monitoring would be used to represent personal exposure. Time-weighted average and peak exposure doses would be determined. Exposure monitoring records would be maintained for a minimum of 30 years.

As is the case at existing Wilmington Site facilities, GLE operations would be conducted under procedures that are written, reviewed, and verified by appropriate individuals in the Nuclear Safety Function to ensure that worker dose is ALARA. Any operational changes would be reviewed to ensure that safe conditions are maintained (GNF-A, 2007c). PPE requirements would be based on the nature of the work and chemical and/or radiological hazards present (GNF-A, 2007b).

Standard operating procedures (SOPs) to be used at the Proposed GLE Facility would specify the confinement of uranium to process equipment, containers, or ventilated enclosures. Hoods and other localized ventilation designs would be utilized to minimize personnel exposure to airborne uranium. The Radiation Protection group would determine the appropriate PPE requirements for routine and non-routine tasks involving radiological hazards. Operators would wear appropriate PPE when working in radiological areas, including anti-contamination clothing, gloves, shoe covers, and hats. As applicable, spill cleanup procedures currently enforced by the Radiation Protection group at the FMO facility would be enforced at the Proposed GLE Facility. At the FMO facility, operators are required to wear respirators when cleaning up a spill of uranium or when opening a hood, enclosure, or primary containment. If a large uranium spill occurs, procedures direct operators to isolate the spill area, evacuate the area, and contact the Radiological Protection group. If a small uranium spill occurs, procedures direct operators to clean up the spill immediately.

The Radiation Protection group would perform GLE surveys, checks, and audits as currently are conducted at existing Wilmington Site facilities. The Radiation Protection group currently performs contamination surveys (swipes) of work areas each week. Workers are required to self-monitor for contamination before exiting a radiological area. The Radiation Protection group performs a random contamination survey of workers exiting radiological areas. Operations involving radiological material likely to create airborne contamination are conducted inside a glove box or enclosure that provides containment. Airflow face velocity at all openings on glove boxes and enclosures is periodically measured to ensure adequate air flow. Building ventilation maintains all areas in which uranium is handled or processed at a negative pressure to prevent releases outside of the building. Direction of air flow between areas is checked monthly or after significant changes to the ventilation system. Periodically scheduled audits of processing areas are performed, and stationary air samplers are located at processing stations and are monitored each shift. Stacks are continuously sampled (GNF-A, 2007b, 2007c).

A combination of effluent monitoring and environmental monitoring/sampling programs would provide data to identify and assess the Proposed GLE Facility's contribution to environmental uranium and radiation at and near the Wilmington Site. Where applicable, the existing GNF-A Environmental Monitoring Program (GNF-A, 2007a) would be expanded to include monitoring required for the Proposed Action.

The expanded radiological environmental monitoring program would include monitoring of direct radiation, air (at the main GLE operations building stack, the Proposed GLE Facility controlled access area perimeter, and ambient [background] conditions), groundwater, stormwater, surface water, sediment, treated sanitary wastewater effluent, and treated process wastewater effluent. Several of these media also would be monitored for non-radiological parameters. The monitoring programs have been designed to provide comprehensive data to demonstrate that impact on the environment from Facility operations are SMALL. In addition to supporting the requested GLE license from the NRC, the environmental monitoring programs are in part required by other State and federal regulations and/or permits, and some of the monitoring activities are conducted by NC DAQ and the NCDENR Radioactive Materials Branch. **Chapter 6** of this Report (*Environmental Measurement and Monitoring Programs*) provides additional descriptions of the monitoring programs.

In the sections below, sources of potential radiological exposure to the public and Facility workers associated with the construction, operation, and decommissioning of the Proposed GLE Facility are characterized. The impacts associated with potential radiological exposures from the Proposed Action are anticipated to be SMALL. Also described below are preventive and mitigative measures regarding radiological operational accident scenarios.

4.12.2.2.1 Site Preparation and Construction

Radiological impacts to nearby residents or on-site workers are anticipated to be SMALL as a result of construction. Radiological materials would not be brought on-site and handled during GLE Facility site preparation and initial Facility construction. Therefore, no radiological materials would be available for release from the Proposed GLE Facility and/or exposure during this initial construction phase. The existing FMO has been operating and will continue to operate for many years, even during the construction of the Proposed GLE Facility. As described in **Section 3.11.2** of this Report (*Current Sources and Levels of Exposure to Radioactive Materials*), only very low concentrations of uranium have been detected in soil samples collected from the Wilmington Site, indicating that no significant radiological exposures from previous and current FMO facility activities would result among construction workers or the public through the disturbance of soils.

4.12.2.2.2 Operation

4.12.2.2.2.1 Pathway Assessment

The chemicals involved in the main Proposed GLE Facility process would be in a gaseous form. A building evacuation system would maintain the majority of the interior of the process building under sub-atmospheric pressure. Exhaust gases from the emission control system would be vented to the atmosphere through a single stack. Nearly all of the airborne uranium would be removed through filtration prior to the discharge of gaseous emissions to the atmosphere. The design control efficiency for the emission control system would be at least 99.98% removal (by weight) for uranium particles (the level currently being achieved at the existing FMO facility).

Small amounts of radiation and radiological materials may be released from routine operations to the environment via gaseous emissions, liquid effluent, and/or direct irradiation. The route of exposure for the general public would be via gaseous emissions to the atmosphere through a rooftop vent stack. Uranium concentrations in effluents from the Proposed GLE Facility are expected to be very low because of the process employed, engineered controls, and treatment processes prior to discharge. There are no publicly available source test data available for quantifying the level of air emissions from the GLE laser-enrichment process; however, as a conservative assumption, 2006 air emissions monitoring data for a subset of the FMO facility process vents were used to approximate the Proposed GLE Facility operations vent characteristics, and the actual uranium PM and uranium isotope emissions from the Proposed GLE Facility operations are expected to be lower than estimated and lower than the levels measured for the FMO facility vents (see **Section 4.6.2.2.1.1**, *Process Vents [Operation Air Emissions Sources]*).

There are four potential exposure pathways to the general public associated with gaseous emissions: inhalation; immersion in a passing effluent plume; direct radiation due to deposited radioactivity on the ground surface (ground plane exposure); and ingestion of contaminated food products. Inhalation exposures, although very low, are expected to be the predominant exposure pathway at locations near the Wilmington Site.

Direct irradiation of the public from the Proposed GLE Facility is not expected because alpha radiation exposure levels would be lower than those from the FMO facility. Alpha radiation exposure levels measured at the Site boundary resulting from the FMO activities are at background levels (GNF-A, 2007a), and the Proposed GLE Facility is located a roughly equivalent distance to the nearest fenceline as the FMO facility is to its nearest fenceline.

With respect to ingestion pathways, there is little agricultural land in the immediate vicinity of the Wilmington Site—much of the area is undeveloped forests and marshlands. Available vegetation samples collected from locations near the Wilmington Site (approximately 1 mile [1.6 km] north and 1 mile [1.6 km] south) indicate no radiological impact from the FMO facility activities, given the very low gross alpha activity concentrations measured (GNF-A, 2007a). Based on these data, no radiological impact on agricultural products from the Proposed GLE Facility would be expected.

Under the Proposed Action, a treatment system would be operated at the Proposed GLE Facility for radioactive liquid wastewaters, similar to the existing system operated at FMO facility. The effluent from the Proposed GLE Facility liquid effluent treatment system, along with other Facility process wastewater (i.e., cooling tower blowdown), would be pumped to the existing Wilmington Site final process lagoon facility for additional treatment. The existing Wilmington Site final process lagoon facility currently receives effluents from the FMO facility liquid effluent treatment system and other Wilmington Site facilities that do not handle radioactive materials. Treated wastewater effluent from the final process lagoon facility is discharged to the on-site effluent channel via NPDES-permitted Outfall 001. Sanitary wastewaters from the Proposed GLE Facility would be treated and re-used as process water as described in **Section 4.12.2.1.2.2** and **Section 2.3**, *Cumulative Effects*, of this Report. The existing monitoring program for these treated effluents would apply during the Proposed Action, and this program includes monitoring for radiation to ensure that radiation levels are acceptable. Any impacts on human health to nearby residents or on-site workers from these effluents or from the receiving waters are anticipated to be SMALL due to the treatment processes used and monitoring systems implemented.

The cumulative radiological impact of uranium emissions from the Proposed GLE Facility and the existing FMO facility at the Wilmington Site was evaluated, rather than the impact of the Proposed GLE Facility alone, because this presents the most realistic scenario, and limits on radiation doses are based on contributions from all sources.

Airborne uranium concentrations present in gaseous emissions released from the rooftop vent of the main GLE process building monotonically decrease with distance from the release point. The greatest off-site radiological impact from all sources (GLE and FMO facilities) is expected to be near the southern Site boundary location because of the larger contribution of radiation from the FMO facility. The resident located nearest to the Proposed GLE Facility has been identified at 0.9 miles (1.5 km) east-southeast of the Proposed GLE stack vent location. Other important receptor locations, such as schools, have also been identified within a 5-mile (8-km) radius of the Proposed GLE Facility, as well as all hospitals in the

Wilmington region. **Figure 4.12-2** illustrates the layout of the Wilmington Site and the locations of the Proposed GLE Facility, proposed GLE vent stack, existing FMO facility, and Site boundary, as well as receptors of interest, including the nearest Site boundary, nearest full-time resident, highest off-site point of impact (i.e., maximum exposed individual [MEI][1]), and nearest sensitive receptors (e.g., schools).

The radiological impacts on nearby residents are expected to be only small fractions of the radiological impacts that have been estimated for the combined sources (GLE and FMO facilities) near the southern Site boundary location because of the low uranium concentrations in the gaseous emissions and the high degree of dispersion that takes place as the gaseous emissions are transported.

4.12.2.2.2.2 Public and Occupational Exposure

The potential off-site radiological impacts to key receptors from routine effluent releases were assessed through calculations estimating the annual committed effective dose equivalent (CEDE). The term "dose equivalent" refers to a 50-year committed dose equivalent. The sum of the effluent-related doses and direct dose equivalents provides an estimate of the total effective dose equivalent (TEDE) associated with the combined Wilmington Site operations (Proposed GLE Facility + existing FMO facility). The calculated annual dose equivalents were then compared to regulatory (EPA and NRC) radiation exposure standards as a way of illustrating the magnitude of potential impacts. The key receptors (critical populations) evaluated were the resident nearest to the Proposed GLE Facility and the MEI (located just south of the southern Site boundary near the FMO facility, as shown in **Figure 4.12-2**). The MEI is a hypothetical person living at the point of highest projected total uranium concentrations near the Site boundary. The impact was evaluated for the dose from inhalation and cloud plume immersion and for the direct dose from ground plane deposition resulting from gaseous emissions. The dietary contribution of radiological dose from consuming locally produced meats, vegetables, and dairy was not considered based on the very low concentrations measured in nearby vegetation resulting from FMO facility activities. Similarly, no radiological contamination of drinking water is anticipated or considered in the analysis. The analysis included dose equivalent assessments for four age groups (i.e., adults, teens, children, and infants) for these pathways..

Doses were calculated using GENII (version 2.06), which was developed for EPA to provide a set of programs for calculating radiation dose and risk from radionuclides released to the environment. GENII implements dosimetry models recommended by the International Commission on Radiological Protection (ICRP) in Publications 26, 30, 48, and 56 through 72, and the related risk factors published in Federal Guidance Report 13. The option to calculate doses and/or risks using ICRP-30 and IRCP-48 factors (Federal Guidance Reports 11 and 12) was selected because these methods have been approved by the DOE. The ICRP dosimetry and risk models are considered to be state-of-the-art by the international radiation protection community and have been adopted by most national and international organizations as their standard dosimetry methodology (Napier, 2007). The NRC's XOQDOQ air dispersion model was used to estimate the off-site airborne concentrations of uranium and doses of radiation averaged for 1 year of emissions (details of the atmospheric dispersion modeling and meteorological data can be found in **Appendix S** of this Report, *Air Emissions Dispersion Modeling for Operation of the Proposed GLE Facility Using XOQDOQ Model*).

Dose equivalents for the MEI and the nearest resident were calculated by pathway for the total body in adults, teens, children, and infants, and are presented in **Tables 4.12-1 and 4.12-2**, respectively. The

[1] The MEI is the location assessed to have the greatest potential off-site impact, regardless of whether an individual currently occupies the location or is likely in the future to occupy the location. In this case, the MEI shown in **Figure 4.12-2** happens to fall within the I-140 corridor.

CEDE for the adult MEI (which results in the highest CEDE as compared to the CEDEs calculated for the younger MEIs shown on these tables) from the combined FMO and Proposed GLE Facility emissions was calculated to be 9.2E-6 mSv (9.2E-4 mrem) per year. For the adult full-time resident nearest to the Proposed GLE Facility, the CEDE from the combined FMO and GLE facility emissions was calculated to be 5.6E-6 mSv (5.6E-4 mrem) per year. For the fenceline nearest to the Proposed GLE Facility, the CEDE for an adult from the combined FMO and GLE facility emissions was calculated to be 5.3E-6 mSv (5.3E-4 mrem) per year. These doses are well below the EPA 10 mrem per year standard (40 CFR 190, *Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle, Final Environmental Statement, Volume 1*) and the NRC TEDE 100 mrem per year limit (10 CFR 20). Therefore, radiological impacts to off-site receptors from routine combined effluent releases from the FMO and Proposed GLE Facility are anticipated to remain SMALL. Doses for public receptors at other sites of interest (e.g., schools and hospitals) would be lower than the MEI because the airborne concentrations of uranium are lower at these more distant locations.

4.12.2.2.2.3 Radiological Impacts Accident Analysis

As discussed in **Section 4.12.2.1.2.3**, the bounding radiological accidents identified in the ISA are UF_6 release and criticality. A radiological accident inside the GLE process building would be quickly detected, isolated, and contained. Mitigating measures within the Proposed GLE Facility would include 1) radiation detection systems designed to quickly alert personnel and isolate systems when parameters exceed expected limits; 2) physical separation of areas within the Facility designed to prevent or reduce exposure; 3) controlled positive or negative air pressures within designated areas to assist in either preventing or maintaining leakage between Facility areas; 4) carbon adsorbers, HEPA filters, and, where necessary, automatic trips for ventilation systems servicing applicable areas to help minimize the potential for a release outside the area; and 5) limited building leakage paths to the outside environment as a result of appropriate door and building design. These mitigating measures are designed to contain UF_6 gas within specified building areas and attenuate any release to the environment.

The ISA identified the doses to workers from a nuclear criticality accident exceed the criteria in 70.61; therefore, IROFS are necessary to reduce the likelihood for this event (GLE, 2008). The possibility of a nuclear criticality accident at a low-enrichment uranium (LEU) facility is remote. Achievement of criticality with LEU requires unique conditions, as described below. The process is analyzed during the conceptual stage, design phase, and operations to prevent the occurrence of those unique conditions and an accidental criticality. Preventive controls for the nuclear criticality scenario would include maintaining safe geometry of all vessels, containers, and equipment that contain fissile material and ensuring that the concentration and/or mass of fissile material in these vessels is limited to a specified amount. Mitigative controls would include criticality monitoring and alarm systems and emergency-response training.

The bounding UF_6 release scenario involves a fire under a breached cylinder, most likely occurring outside the Facility, where cylinders are transported and stored on concrete pads. The heat from a fire could cause the solid UF_6 to vaporize, and a portion of the contents of the cylinder would be released to the atmosphere. In the event of a release to air, UF_6 rapidly reacts with water vapor and forms uranyl fluoride (UO_2F_2) and HF. The potential health effects to workers and the public are predominantly determined by the quantity of UF_6 released, the duration and rate of release, the meteorological conditions associated with the release, the physical state of UF_6 when released, and the plume exposure time to workers and the public. The ISA identified that the breach of one cylinder due to fire would have unacceptable consequences to workers and the public and therefore needs to be prevented.

The primary IROFS to prevent this accident is limiting the amount of combustibles in the outside areas where 48Y cylinders are stored. Other preventive measures include design of the UF_6 pad to inhibit pooling of fuel, establishing safe standoff distances between UF_6 cylinders and vehicles and other fuel-powered equipment, maintaining the integrity of the cylinder-hauling equipment, and controlling certain activities near UF_6 cylinders (e.g., cutting, welding, grinding). Mitigative measures include prompt response from emergency planning personnel and appropriate training for operators on transporting, processing, and storage of UF_6 cylinders. With implementation of these measures, the likelihood of occupational or public health impacts from a UF_6 release accident is low.

4.12.3 Decommissioning

Decommissioning and closure activities for the Proposed Action (see **Section 2.1.2.1.3** of this Report, *Decontamination and Decommissioning [Proposed Action]*, for further details) would include the cleaning and removal of radioactive and hazardous waste contamination that may be present on materials, equipment, and structures. GLE anticipates that the majority of radioactive material would be recovered from the Proposed GLE Facility upon completion of the operation; however, the material would be dispersed through the components and piping. GNF-A has developed a Decommissioning Plan for decommissioning and closure activities, which would be adapted to the Proposed GLE Facility (GNF-A, 2007d).

During decommissioning and closure activities, worker exposures and potential release pathways would be controlled and monitored in accordance with internal procedures, license conditions, and regulatory requirements. Many aspects of current programs used for production by the FMO would be maintained.

The criticality monitoring system, which provides real-time monitoring wherever bulk quantities of uranium are handled or stored on the Site, would continue to be operationally maintained to assure that the system would provide an alarm in the unlikely event a criticality occurs. The system will provide remote readout capability at the Emergency Control Center that would remain active as long as the monitoring system is needed.

A centralized air sampling system would be used to monitor airborne uranium concentrations in controlled areas. This system would be modified as appropriate and used to monitor routine and abnormal activities as necessary. Removal of this system would be delayed as long as practical. After removal, portable systems would be used as necessary for work area monitoring.

Another safety system that would be essential during decontamination activities (such as cutting, dismantling, and non-routine trash accumulation) is the fire alarm system, with fire alarm boxes strategically placed throughout the Site. Once triggered, the system would send out a coded alarm that identifies the area of the fire, ensuring prompt attention.

Necessary environmental monitoring programs established during the operation of the Proposed GLE Facility will continue during the decommissioning and closure activities to assure that potential contaminants are being contained. Samples would continue to be taken at the stack release points, as well as from soil and wells around the Site. These samples would be analyzed for specific contaminants.

Fluids generated from decontamination procedures would be properly contained for appropriate treatment. The GLE liquid effluent treatment system would remain operational to pre-treat radioactive decontamination solutions, with the treated effluent routed to the existing Wilmington Site final process lagoon facility for further treatment, monitoring, and discharge, in accordance with the NPDES permit conditions.

Radiation exposure to employees would be monitored through existing programs, such as issuance of personnel monitoring devices, air sampling of airborne contamination, and routine bioassays. These programs would continue to be maintained to meet the regulatory requirements specified in 10 CFR 20.

Consistent with the policy during Proposed GLE Facility operation, the policy during decommissioning is to reduce individual and collective occupational radiation exposure in accordance with the ALARA principles.

With implementation of the procedures described above, the impacts associated with Proposed GLE Facility decontamination and decommissioning activities are anticipated to be SMALL.

4.12.4 Cumulative Effects

The cumulative effects of construction, operation, and decommissioning of the Proposed GLE Facility on public and occupational health are anticipated to be SMALL. The non-radiological chemicals (e.g., HF) potentially released from the Proposed GLE Facility are not persistent and would not accumulate in the environment or cause cumulative health effects. The cumulative impact on public or occupational health from the use, release, and disposal of radiological materials during operation and decommissioning is expected to be SMALL, but would be managed according to BMPs and ALARA principles, as well as through the Nuclear Safety Program and the Industrial Safety Program.

Cumulative non-radiological impacts from the Proposed GLE Facility and existing FMO facility operations would be managed through strict adherence to fluoride-emission permit levels (which are protective of human health and account for all area sources) by each facility. As part of the NC DAQ air permitting process for the proposed Carolinas Cement Company Portland cement plant, the NC DAQ required air dispersion modeling of the fluoride emissions. Modeling results available for the proposed project (Carolinas Cement Company, 2008) indicate that the kiln would not emit fluorides in quantities that cause or contribute beyond that project site (adjacent property boundary) to any significant ambient air concentration that may adversely affect human health as determined by the Acceptable Ambient Level (AAL) established by the State of North Carolina (State of North Carolina, 2007). Considering these modeling results for the Carolinas Cement Company project, the distance separating the Proposed GLE Facility and Carolinas Cement Company project of over 5 miles (8 km), and the fact that fluoride emissions from the Proposed GLE Facility and existing FMO facility would be limited by their respective air permit conditions to protect public health, the cumulative impacts from these potential fluoride emission sources are expected to be SMALL.

Cumulative radiological impacts from the Proposed GLE Facility and existing FMO facility have been considered throughout **Section 4.12.2.2**, and any public health impacts are expected to be SMALL because the predicted CEDE for the MEI is well below the EPA and NRC annual limits. The public health impacts would be even lower at areas other than the location identified as the MEI, including the River Bluffs continuing care retirement community, which is planned for the land parcel south of the Wilmington Site's southern property line, as further described in **Section 2.3** of this Report (*Cumulative Effects*). The other planned projects discussed in **Section 2.3** (e.g., ATC II complex, Tooling Development Center) will be constructed outside the 100-acre (40-ha) GLE Facility site, and cumulative impacts from the Proposed Action and these other construction projects would be SMALL. Any increase in the number of workers at the Wilmington Site during the construction or operation of these facilities may contribute to an increase in the number of recordable injuries and illnesses among workers. These projects would not affect the radiological impacts of the Proposed GLE Facility because they would not contribute any additional radiological materials to the environment or in the workplace. Any non-radiological impacts to worker or public health would be SMALL and would be managed by process and emission controls.

4.12.5 Control of Impacts

An essential component of GLE's strategy to avoid human health impacts is to control and minimize potential exposures to workers and the public through BMPs and ALARA practices. Mitigation measures would be in place to minimize the release of non-radiological and radiological effluents and to stay below regulatory limits. A building ventilation system would maintain the majority of the interior of the process building under constant sub-atmospheric pressure. This would prevent any air effluent releases that occur inside the process building from being directly vented to outside the building. The controls on the process are designed to isolate the leak and shut down the process to prevent damage to the equipment. Exhaust gases from the emission control system would be vented to the atmosphere through a single rooftop stack. A combination of effluent and environmental media monitoring programs would provide data to identify and assess the Proposed GLE Facility's contribution to environmental radiation and fluoride emissions near the Wilmington Site.

Worker health and safety at the Proposed GLE Facility would be protected by the Nuclear Safety Program and the Industrial Safety Program. These programs would comply with applicable State, NRC (10 CFR 20), and OSHA (29 CFR 1910) requirements. Work environments that present the potential for exposure to chemical, biological, or physical agents (e.g., radiation, noise, heat/cold, vibration) would be evaluated, and appropriate safety controls would be implemented and/or safety equipment would be assigned to workers. PPE requirements would be based on the nature of the work and chemical and/or radiological hazards present and would be a key component of minimizing exposure to chemical and radiological agents. Exposure monitoring would be conducted on radiation workers to evaluate their potential for personal exposure; if personal monitoring is not feasible, work area monitoring would be used to represent personal exposure.

Tables

Table 4.12-1. Annual and Committed Dose Equivalents for Exposures to the MEI from Gaseous Effluents

Source	Units	Infant EDE	Child EDE	Teen EDE	Adult EDE
Cloud immersion	mSv	2.41E-13	2.41E-13	2.41E-13	2.41E-13
	mrem	2.41E-11	2.41E-11	2.41E-11	2.41E-11
Inhalation	mSv	2.15E-06	6.34E-06	8.30E-06	9.17E-06
	mrem	2.15E-04	6.34E-04	8.30E-04	9.17E-04
Ground plane exposure	mSv	3.84E-09	3.84E-09	3.84E-09	3.84E-09
	mrem	3.84E-07	3.84E-07	3.84E-07	3.84E-07
Sum Total	mSv	2.15E-06	6.34E-06	8.31E-06	9.17E-06
	mrem	2.15E-04	6.34E-04	8.31E-04	9.17E-04

MEI = Maximum exposed individual.
EDE = Effective dose equivalent.
mSv = milliSieverts.
mrem = millirem.

Table 4.12-2. Annual and Committed Dose Equivalents for Exposures to the Nearest Resident from Gaseous Effluents

Source	Units	Infant EDE	Child EDE	Teen EDE	Adult EDE
Cloud immersion	mSv	1.66E-13	1.66E-13	1.66E-13	1.66E-13
	mrem	1.66E-11	1.66E-11	1.66E-11	1.66E-11
Inhalation	mSv	1.31E-06	3.86E-06	5.07E-06	5.61E-06
	mrem	1.31E-04	3.86E-04	5.07E-04	5.61E-04
Ground plane exposure	mSv	1.63E-09	1.63E-09	1.63E-09	1.63E-09
	mrem	1.63E-07	1.63E-07	1.63E-07	1.63E-07
Sum Total	mSv	1.31E-06	3.87E-06	5.07E-06	5.61E-06
	mrem	1.31E-04	3.87E-04	5.07E-04	5.61E-04

EDE = Effective dose equivalent.
mSv = milliSieverts.
mrem = millirem.

Figures

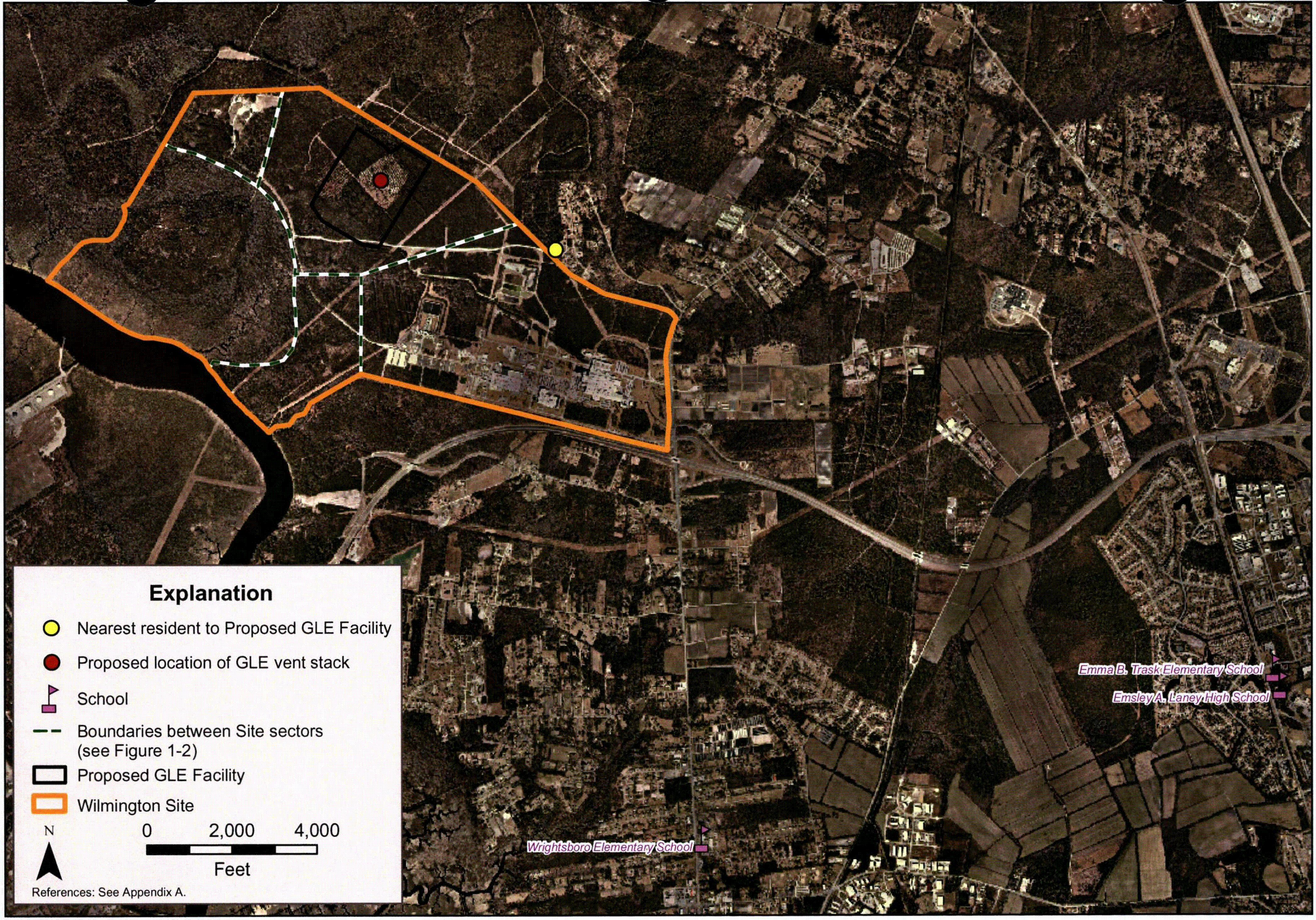

Figure 4.12-1. Wilmington Site layout – non-radiological points of interest and potential receptors.

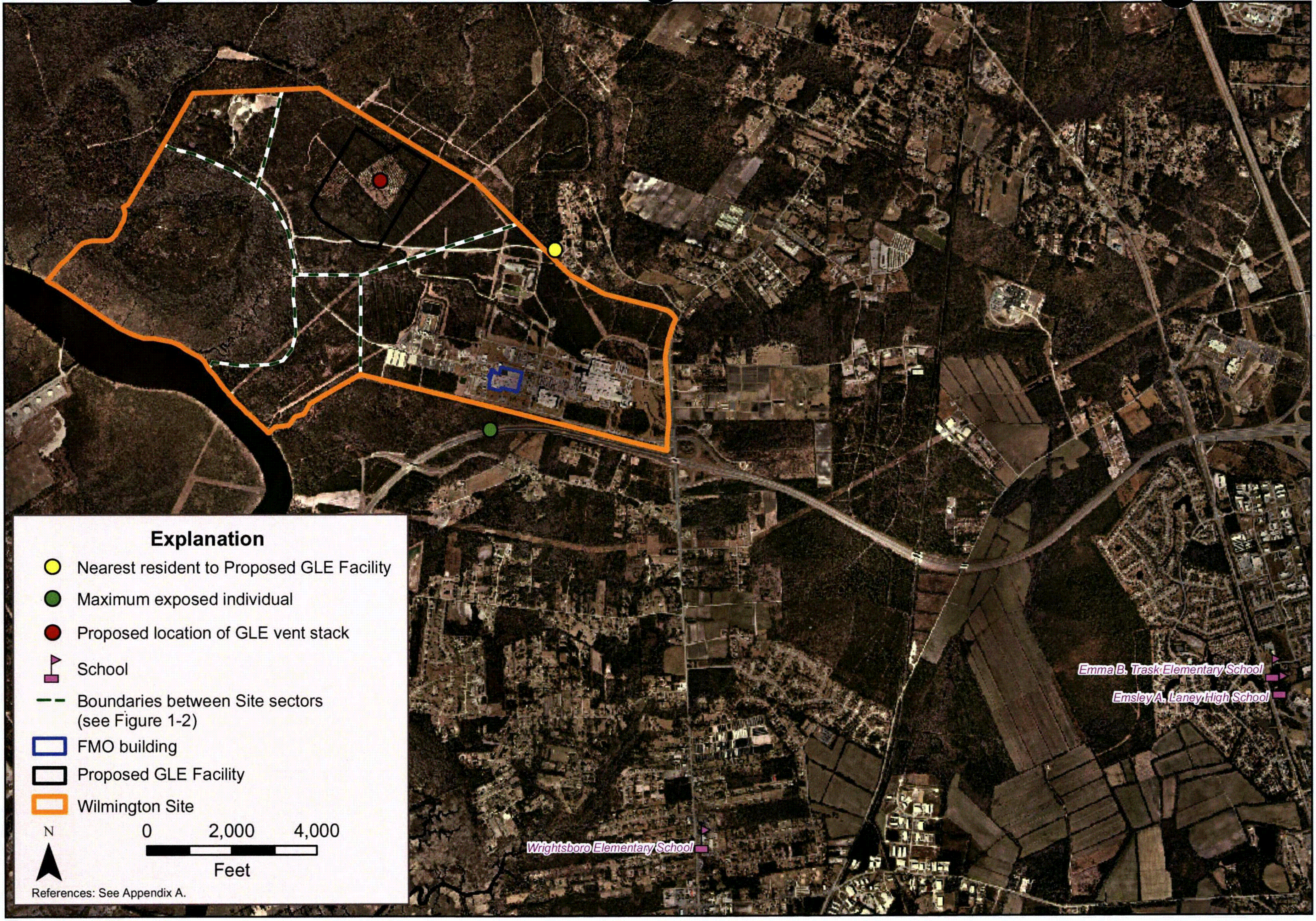

Figure 4.12-2. Wilmington Site layout – radiological points of interest and potential receptors.

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4.13 Waste Management Impacts

The existing Wilmington Site facilities generate wastewaters and solid wastes. The quantities and management of these wastes are described in **Section 3.12** of this Report (*Waste Management*). This section describes the potential impacts projected to result from the management of wastes generated by the No Action Alternative (**Section 4.13.1**) and the Proposed Action (**Section 4.13.2**). Waste minimization plans for the Proposed Action are discussed in **Section 4.13.3**. A description of the projected cumulative waste management impacts assuming implementation of the Proposed Action is presented in **Section 4.13.4**. The controls planned for the Proposed Action to mitigate waste management impacts are discussed in **Section 4.13.5**.

4.13.1 No Action Alternative

Under the No Action Alternative, waste generation sources associated with uranium-enrichment operations would not be added to the Wilmington Site. Consequently, no new gaseous, liquid, or solid waste streams would be added to the wastes already generated and managed at the existing Wilmington Site facilities. Therefore, the waste management impacts resulting from the No Action Alternative would be SMALL.

4.13.2 Proposed Action

Under the Proposed Action, the Proposed GLE Facility would generate additional wastewaters and solid wastes requiring management at the Wilmington Site, as well as some requiring off-site management. The sources and quantities of these wastes would vary over the life of the project. Waste minimization and pollution-prevention practices would be implemented to reduce the quantities of waste generated by the Proposed Action that require on-site management and, ultimately, final disposal. Gaseous wastes from the Proposed Action are addressed as air emissions in **Section 4.6**, *Air Quality Impacts*.

4.13.2.1 Site Preparation and Construction Impacts

Construction of the Proposed GLE Facility would generate solid waste materials that would need to be collected and transported off-site for recycling or disposal. It is expected that predominately refuse and construction debris typical of industrial construction projects would be generated during the construction phase. No radioactive wastes would be generated during the initial 3-year construction phase. The types of waste anticipated to be generated 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 construction, may be required to be managed as hazardous waste. The specific compositions and quantities for these construction waste types will depend on the final Facility design.

The general construction contractor selected for the Proposed GLE Facility project would have responsibility for the day-to-day supervision of on-site waste collection and storage and for arranging for removal of these wastes from the GLE Facility site. Good work practices for Facility site waste management would be used to collect and sort the wastes for recycling or disposal (e.g., using designated roll-off containers and collection areas for different types of wastes). Hazardous waste generated throughout the construction phase would be temporarily stored on-site and then shipped to an off-site facility appropriate for handling the waste composition, in accordance with established recycling and hazardous waste management programs. Therefore, the waste management impacts resulting from construction of the Proposed GLE Facility would be SMALL.

4.13.2.2 Operation Impacts

Operation of the Proposed GLE Facility would generate wastewaters and solid wastes. Wastewaters would be collected and treated on-site before being discharged to receiving waters. Solid wastes generated by Proposed GLE Facility operations would be collected for on-site incineration or for shipment to an off-site facility appropriate for treatment or disposal of the waste type.

4.13.2.2.1 Wastewaters

The sources and estimated quantities of wastewaters that would be generated by the Proposed GLE Facility operations are summarized in **Table 4.13-1**. A summary of the treatment and discharge practices planned to be used for the management of these wastewaters is presented in **Table 4.13-2**. Based on wastewater quantities and management practices presented in these tables and described in **Sections 4.13.2.2.1.1 through 4.13.2.2.1.4**, the wastewaters management impacts resulting from operation of the Proposed GLE Facility would be SMALL.

4.13.2.2.1.1 Liquid Radwaste Management

Uranium-enrichment operations inside the main GLE operations building would generate process wastewater streams from the collective drain water resulting from decontamination, cleaning, and laboratory activities conducted inside the main GLE operations building (see **Table 4-13.1**). The liquid radwastes generated in the main GLE operations building would be collected in a closed-drain system that discharges to an accumulator tank. Total average daily liquid radwaste volume to the accumulator tank from Proposed GLE Facility operations would be approximately 5,000 gpd (18,927 lpd) (see **Table 4-13.1**). The uranium concentration of the liquid radwastes in the accumulator tank would be measured on a regular basis before being routed to the GLE liquid effluent treatment system. The measurement results would be used to assess the treatment sequence required to remove uranium from the wastewaters to acceptable levels that would allow discharge of the treated effluent to the existing Wilmington Site final process lagoon facility.

The first step in the liquid effluent treatment system planned for the Proposed GLE Facility would be to add a caustic solution to the wastewater in the accumulator tank. The addition of this caustic would increase the pH of the solution, resulting in the precipitation of uranium and other metal cations from the solution. Two phases then would exist in the accumulator tank: an upper solution layer containing fluoride, and a lower slurry layer containing uranium and other metals precipitated out of the solution.

The uranium-containing slurry from the bottom of the accumulator tank would be pumped to a centrifuge. The solids collected from the centrifuge would be oven-dried, sampled, and packaged for disposal off-site as a solid LLRW, as discussed in **Section 4.13.2.2.2.5**. The treated solution from the centrifuge would be sampled to evaluate the residual uranium concentration. If the solution requires further treatment to remove uranium, the solution would be pumped to a pipe reactor, where a chemical metal scavenger would be injected. The concentration of metal scavenger in the radwaste liquid would be adjusted as necessary to further precipitate the uranium and other metal cations from the solution and to facilitate coagulation of remaining suspended solids in the solution. The resulting slurry would be then pumped to a bank of bag filters. The wet solids would be collected inside the filter bags. The solids would be dried, sampled, and packaged for disposal off-site as a LLRW. The filtered solution would be pumped to a holding tank, where it would be sampled to evaluate if the uranium concentration is below the acceptable level for discharge from the liquid effluent treatment system. If the uranium concentration is unacceptable, the solution would be pumped back to the accumulator tank for re-processing through the liquid effluent treatment system.

The fluoride-containing solution from the upper portion of the accumulator tank would be pumped to a fluoride treatment unit. Fluoride treatment would consist of precipitating the fluoride by salt addition, followed by either a filtration or evaporation step to separate the precipitate from the treated solution. The solid fluoride waste would be dried and sampled to measure any residual uranium concentration. Based on the results of the uranium concentration analysis, a determination of the waste type would be made (e.g., LLRW or nonhazardous waste). The dried waste would then be packaged and shipped off-site to a licensed treatment or disposal facility, as appropriate for the waste type.

The treated wastewaters from the GLE liquid effluent treatment system would be discharged to the existing Wilmington Site process wastewater aeration basin and final process lagoon facility. This facility currently receives Wilmington Site process wastewater, including the treated effluent from the FMO facility liquid effluent treatment system. The treated effluent from the final process lagoon facility is discharged via NPDES-permitted Outfall 001 to the Wilmington Site effluent channel where it mixes with stormwater, discharging groundwater and treated sanitary wastewater effluent (see **Section 4.13.2.2.1.3**). The effluent channel flows to Unnamed Tributary #1 to Northeast Cape Fear River. Impacts to the receiving surface waters into which the treated effluent from the final process wastewater treated lagoons would be discharged are discussed in **Section 4.4.2.3.1.2**, *Operation (Impacts to Surface Water Quality [Receiving Waters])*. The cumulative impacts of combining the process wastewater stream from the Proposed GLE Facility with the process wastewater stream from the existing and other planned Wilmington Site facilities are discussed in **Section 4.13.4.1**.

4.13.2.2.1.2 Cooling Tower Blowdown Management

The cooling tower for the Proposed GLE Facility would be a closed-loop system that does not contact any uranium materials or uranium-contaminated wastewater streams. To maintain the integrity and maximize the service life of the cooling tower components, the concentrations of minerals and other impurities in water circulating in the cooling-loop system must remain within specific water quality limits. To maintain the amount of dissolved solids and other impurities in the circulating water at acceptable levels, the SOP for cooling towers is to regularly remove a portion of the circulating water from the cooling tower loop and discharge the water to the process waste treatment facility (adding fresh water to the cooling tower loop to make up for the corresponding water loss). The water removed from the cooling tower loop is referred to as "blowdown." The blowdown from the cooling tower design that would be used for the Proposed GLE Facility operations is not expected to contain any uranium contamination since the cooling tower would operate as an independent, closed-loop system. Consequently, the Proposed GLE Facility cooling tower blowdown would be pumped directly to the existing Wilmington Site final process lagoon facility. Cooling tower blowdown from Proposed GLE Facility operations would add approximately 30,000 gpd (113,562 lpd) to the final process lagoons (see **Table 4-13.1**).

4.13.2.2.1.3 Sanitary Wastewater Management

Operation of the Proposed GLE Facility is estimated to generate approximately 10,500 gpd (39,747 lpd) of sanitary wastewater (see **Table 4-13.1**). The sanitary wastes would be collected in a sewer system connected to the existing Wilmington Site sanitary wastewater treatment facility. This facility uses an activated sludge aeration process (see **Section 3.12.2.2** of this Report, *Sanitary Wastewater*). The treated effluent from the sanitary wastewater treatment facility can be discharged via NPDES-permitted Outfall 002 to the Wilmington Site effluent channel, where it mixes with stormwater, discharging groundwater and treated process wastewater effluent (see **Section 4.13.2.2.1.1**). The effluent channel flows to Unnamed Tributary #1 to Northeast Cape Fear River. Sanitary wastewater treatment facility upgrades became operational in April 2008 and, along with securing a re-use permit from NCDENR, these upgrades enabled the industrial re-use of treated sanitary wastewater effluent as make-up water in Wilmington Site cooling towers. This effluent re-use process resulted in a switch away from the discharge of treated sanitary wastewater effluent to the effluent channel. The NPDES discharge permit remains valid should discharges of treated sanitary wastewater become necessary in the future.

The impacts to the receiving surface waters into which the treated sanitary wastewater effluent would be discharged are discussed in **Section 4.4.2.3.1.2**, *Operation (Impacts to Surface Water Quality [Receiving Waters])*. The cumulative impacts of adding the sanitary waste stream that would be generated by the Proposed GLE Facility with the other sanitary waste streams generated at the Wilmington Site and treating the combined waste stream in the Wilmington Site sanitary wastewater treatment facility are discussed in **Section 4.13.4.1**.

4.13.2.2.1.4 Stormwater Management

Stormwater runoff from outdoor impervious surfaces other than the UF_6 storage pads within the Proposed GLE Facility would be collected in drainage conduits and channels that flow into a stormwater wet detention basin used only for runoff from the Proposed GLE Facility. The GLE stormwater wet detention basin would serve to regulate stormwater quality and quantity, as required by the NPDES stormwater permit, before discharging to receiving waters. Impacts to the receiving surface waters into which stormwater from the wet detention basin would be discharged are discussed in **Section 4.4.2.3.1.2**, *Operation (Impacts to Surface Water Quality [Receiving Waters])*.

Stormwater runoff collected from the UF_6 storage pads (see **Section 4.13.2.2.2.5**) would be first routed to a holding pond. This holding pond would be monitored, and the data would be evaluated by GLE personnel to ensure that no unanticipated radiological discharge occurs to the stormwater wet detention basin. Should unanticipated radioactivity be 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. Surveys then would be conducted on the contained solids to identify contaminated portions to be disposed as LLRW. Given these BMPs and that the holding pond would be designed with concrete and/or synthetic liners so as not to leak, no more than trace levels of radiological contamination would be anticipated to be released from the UF_6 storage pads area stormwater holding pond.

4.13.2.2.2 Solid Wastes

Operation of the Proposed GLE Facility would generate refuse and other nonhazardous solid waste, wastes designated as RCRA hazardous wastes, and LLRW. In addition, depleted uranium would be produced by the uranium-enrichment process. No high-level radioactive wastes or mixed wastes would be generated by the Proposed GLE Facility operations. The types, sources, and estimated quantities of solid wastes that would be generated by the Facility operations are summarized in **Table 4.13-3**. A summary of the storage, treatment, and disposal practices planned to be used for the management of these wastes is presented in **Table 4.13-4**. Based on the solid waste quantities and management practices presented in these tables and described in **Sections 4.13.2.2.2.1 through 4.13.2.2.2.6**, the solid waste management impacts resulting from operation of the Proposed GLE Facility would be SMALL.

4.13.2.2.2.1 Municipal Solid Waste Management

The Proposed GLE Facility operations would generate an estimated 380 tons/year of MSW (345 mt/year]). This waste would be collected and placed in roll-off type containers. A commercial refuse collection service would regularly pickup the filled containers and transport the waste approximately 4.5 miles (7.3 km) to the New Hanover County municipal landfill (a RCRA-permitted Subtitle D landfill) for disposal. The cumulative impacts of adding the MSW that would be generated by the Proposed GLE Facility with the other MSW generated at the Wilmington Site and disposing of the combined waste stream off-site are discussed in **Section 4.13.4.2**.

4.13.2.2.2.2 Other Nonhazardous Solid Waste Management

An estimated 107 ton/year (97 mt/year) of nonhazardous solid wastes would be generated as a result of equipment maintenance for the Proposed GLE Facility operations. Examples of these wastes are spent coolant and used filter media. These wastes would be collected and temporarily stored in containers appropriate for the waste type. Depending on the composition of the nonhazardous waste, these materials would be either shipped directly to the Heritage Environmental Services facility in Indianapolis, IN, for treatment and burial, or routed through Heritage Environmental Services to other GLE-approved facilities for reuse, reclamation, or treatment. The cumulative impacts of combining the nonhazardous waste that would be generated by the Proposed GLE Facility with the other nonhazardous waste generated at the Wilmington Site and shipping the combined waste stream off-site for treatment and disposal are discussed in **Section 4.13.4.2**.

4.13.2.2.2.3 RCRA Hazardous Waste Management

The Proposed GLE Facility is projected to generate approximately 12 ton/year (11 mt/year) of RCRA hazardous waste. This waste would be collected, packaged in DOT-approved shipping containers and then temporarily stored on-site for shipment with RCRA hazardous waste generated by the existing Wilmington Site facilities. At least once every 90 calendar days, the containers would be shipped to the RCRA-permitted Subtitle C treatment, storage, and disposal facility (TSDF) operated by Heritage Environmental Services in Indianapolis, IN. The cumulative impacts of combining the RCRA hazardous waste that would be generated by the Proposed GLE Facility with the other RCRA hazardous waste generated at the Wilmington Site, and shipping the combined waste stream off-site for treatment and disposal, are discussed in **Section 4.13.4.2**.

4.13.2.2.2.4 Low-Level Radioactive Wastes Management

The sources and estimated quantities of LLRW that would be generated by Proposed GLE Facility operations are summarized in **Table 4.13-3**. Combustible and non-combustible, uranium-contaminated LLRW generated by the Proposed GLE Facility operations would be collected in containers appropriate for the waste form and shipped by truck to the Energy*Solutions* disposal facility in Clive, UT. The Proposed GLE Facility is projected to generate a total of approximately 344 tons/year (312 mt/year) of LLRW. The packaging and transportation of the LLRW from the Proposed GLE Facility to the Energy*Solutions* disposal facility is discussed in **Section 4.2.3**, *Radioactive Material Transportation Impacts*.

4.13.2.2.2.5 On-site Depleted UF_6 Management

Depleted UF_6 (referred to here as "UF_6 tails" or "DUF_6") from the Proposed GLE Facility operations would be temporarily stored at the Proposed GLE Facility in 48Y or 48G cylinders until such time as the material can be shipped off-site to other facilities for further processing and ultimate disposal, as discussed in **Section 4.13.2.2.2.6**. There would be no on-site processing or disposal of the UF_6 tails at the Wilmington Site.

Temporary on-site storage of the UF_6 tails cylinders at the Proposed GLE Facility would be on an outdoor storage pad. The planned storage pad is designed to provide storage capacity for approximately 9,000 48-inch diameter cylinders, which is equivalent to the quantity of UF_6 tails expected to be generated from 10 years at full production of Proposed GLE Facility operation. Approximately 60 acres (24 ha) to the west of the Proposed GLE Facility (within the GLE Study Area) are available for facility expansion and could accommodate additional UF_6 tails cylinder storage pad capacity. However, it is anticipated that at least one of the off-site UF_6 tails disposition options discussed in **Section 4.13.2.2.2.6** will be available to GLE. Therefore, shipment of UF_6 tails cylinders from the Proposed GLE Facility likely would begin before the number of UF_6 tails cylinders generated by the Facility operations and requiring on-site storage reaches the 9,000-cylinder storage pad capacity limit. GLE does not expect the on-site UF_6 tails cylinder storage pad to reach its NRC-licensed capacity limit. If this were to occur, then GLE would fully evaluate available options at that time, including possible expansion of the UF_6 tails on-site storage capacity beyond 9,000 cylinders. If necessary, GLE would apply to the NRC for any required license amendment and perform the appropriate safety and environmental analyses at that time.

The UF_6 tails cylinder storage pad design layout for the Proposed GLE Facility would use double stacking of the 48-inch diameter cylinders and allow for moving of the cylinders with gantry cranes, as discussed below. The storage pad would be constructed of concrete and would occupy approximately 45,000 ft^2 (4,180 m^2) of outdoor area within the Proposed GLE Facility. To provide stormwater drainage, the pad would be sloped at the edges. The terrain surrounding the storage pad would be graded to provide collection and drainage of stormwater to a holding pond. Runoff collected in this holding pond would be monitored and released to the Proposed GLE Facility's stormwater wet detention basin only when the measured uranium concentration is determined to be within acceptable limits. Action levels will be established so that any upset conditions are detected early and corrected in order to prevent an inadvertent release to the environment in potential exceedance of regulatory limits.

The entire perimeter of the storage pad would be fenced for security purposes and to protect worker radiological health and safety. A single entry gate to the pad would provide worker access, which would be restricted to only authorized personnel with a need to work in the storage pad area. Concrete saddles would be used to stack and store the cylinders above the storage pad surface. A diesel-powered, self-propelled gantry crane would be used to transfer the UF_6 tails cylinders between the main GLE operations building dock area and the storage pad. At the UF_6 tails pad, the crane would then move each cylinder to the appropriate storage location and place the cylinder on its pad cradle.

The UF_6 tails storage pad would include design elements and safety procedures that would be used for cylinder-handling activities to avoid and minimize the potential for adverse health and safety impacts. Workers would be trained in safe cylinder handling and cylinder maintenance procedures. The design criteria and work practices are discussed further in **Section 5.13** of this Report (*Waste Management [Mitigation Measures]*). Each UF_6 tails cylinder would initially be inspected prior to placing a filled cylinder on the storage pad and, thereafter, periodically inspected for damage or surface coating defects. The inspection criteria are also discussed further in **Section 5.13**.

The principal potential impacts would be the radiological exposure resulting from the radioactive material temporarily stored in up to 9,000 UF_6 tails cylinders under normal conditions and the potential release of UF_6 from UF_6 tails cylinders due to an abnormal event or accident (i.e., operational, external, or natural phenomena hazard events). As discussed in the draft Radiological Safety Analysis Summary Report *UF_6 Cylinder Handling and Storage*, internal and external radiation exposures during UF_6 cylinder handling and storage would be maintained within regulatory compliance limits through the use of design and engineering features, radiological surveys, Radiation Work Permits (RWPs), administrative procedures and controls, and PPE. The *ISA Summary for the Proposed GLE Facility* (GLE, 2009) includes the analysis of a release from UF_6 tails cylinders in the on-site storage pad area due to an abnormal event or accident. Based on these analyses, the impacts from on-site UF_6 tails cylinders storage during normal conditions would be SMALL and, in the event of an accident, the impacts would be SMALL to MODERATE, depending on the type and magnitude of the incident.

4.13.2.2.2.6 Off-site Depleted UF_6 Management

The current options for off-site disposition of the depleted uranium tails, which include DOE conversion and/or commercial conversion of the depleted uranium tails into an uranium oxide in the form of triuranium octaoxide (U_3O_8) for disposal in a licensed disposal facility, are discussed in the following sections.

Transfer of UF_6 Tails to DOE for Off-Site Conversion into Depleted Uranium Oxide Pursuant to Section 3113 of the United States Enrichment Corporation (USEC) Privatization Act. Section 3113 of the USEC Privatization Act, 42 U.S.C. 2297h-11 (2006), directs the DOE, upon request and subject to reimbursement of its costs, to "accept for disposal" depleted uranium generated by NRC-licensed uranium enrichment facilities, such as the UF_6 tails that would be generated by the Proposed GLE Facility. Section 311 of Public Law 108-447 amended Section 3113 of the USEC Privatization Act in 2004 by adding a new paragraph (4) to subsection (a). The new paragraph provides that, if a licensee requests the DOE to accept for disposal depleted uranium pursuant to Section 3113(a), then the DOE "shall be required to take title to and possession of such depleted uranium at an existing DOE DUF_6 storage facility." The Commission has ruled that depleted uranium is considered a form of LLRW (in the Matter of Louisiana Energy Services, L.P. [LES] National Enrichment Facility [NEF], Docket No. 70-3103-ML, Commission Memorandum and Order, CLI-05-20, 62 NRC 523 [Oct. 19, 2005]). The Commission also has concluded that "disposal of [UF_6 tails] by DOE represents a 'plausible strategy' under the USEC Privatization Act" (42 USC §2297h).

As part of the DOE's plans to comply with this legislative directive, the agency has contracted with Uranium Disposition Services, LLC (UDS), to construct depleted-uranium conversion facilities at two existing DOE facility sites in the United States (UDS, 2008). One facility is located at the DOE site in Paducah, KY, and is designed to have an annual UF_6 tails processing capacity of approximately 19,840 tons/year (18,000 mt/year). The second facility is located at the DOE site in Portsmouth, OH, and is designed to have an annual UF_6 tails processing capacity of approximately 14,880 tons/year (13,500 mt/year). Physical construction of these facilities has been completed. Currently, plant equipment testing and plant operator training are being conducted in preparation for start-up of the conversion operations at the facilities.

Environmental Impacts of Off-site Conversion of Depleted Uranium by DOE at the Paducah and Portsmouth Depleted-Uranium Conversion Facilities. One off-site disposition option for the UF_6 tails generated by the Proposed GLE facility is to ship the UF_6 tails cylinders to either of the DOE's depleted-uranium conversion facilities (i.e., the Paducah or Portsmouth facility). The packaging and transportation of the UF_6 tails from the Proposed GLE Facility to these DOE depleted-uranium conversion facilities are discussed in **Section 4.2.3**, *Radioactive Material Transportation Impacts*. Once delivered to these facilities, the UF_6 tails would be converted into uranium oxide. Aqueous HF also is a product of the conversion process. The HF has commercial value and would be sold for use, and the uranium oxide product would be reused to the extent possible or packaged for disposal at an appropriate LLRW disposal facility. The DOE has analyzed the environmental impacts of the construction, operation, and decontamination and decommissioning of the Paducah and Portsmouth depleted-uranium conversion facilities (U.S. DOE, 2004a, 2004b). The DOE considered the impacts resulting from the disposal of HF (as calcium fluoride [CaF_2] after neutralization) and depleted uranium oxide in the event that these materials cannot be sold and/or reused, and determined that the impacts would be SMALL (U.S. DOE, 2004a, 2004b).

Cumulative Impacts of Conversion by the DOE on the Environment and DOE Depleted-Uranium Conversion Facility Operations. At full production capacity, the Proposed GLE Facility would generate approximately 12,401 tons (11,250 mt) of UF_6 tails per year. This annual UF_6 tails generation rate is equivalent to approximately one-third of the current combined annual UF_6 tails processing capacity of the two DOE depleted-uranium conversion facilities. Depleted UF_6 from the Proposed GLE Facility would not be the only source of UF_6 tails processed at the DOE depleted-uranium conversion facilities. The DOE has an existing inventory of approximately 771,600 tons (700,000 mt) of UF_6 tails in storage at its facilities that were produced by past DOE enrichment operations (UDS, 2008). In addition, it is possible that UF_6 tails from other NRC-licensed commercial enrichment facilities, such as LES's NEF and USEC's American Centrifuge Plant (ACP), could be transferred to DOE pursuant to Section 3113 of the

USEC Privatization Act. This would add to the inventory of material needing conversion at the Piketon and/or Paducah depleted-uranium conversion facilities.

The DOE has recognized that the depleted-uranium conversion facilities to be operated at Piketon and Paducah may need to operate longer than initially planned to process waste transferred to the DOE from proposed commercial enrichment facilities. In fact, in the DOE's Final Environmental Impact Statements (FEISs) for these facilities, the DOE stated that "...it is reasonable to assume that the depleted-uranium conversion facilities could be operated longer than specified in the current plans in order to convert this material" (U.S. DOE, 2004a, 2004b). Consequently, the DOE site-specific FEISs include evaluations of the environmental impacts associated with expanding depleted-uranium conversion facility operations at each site, either by process improvements or by extending operations beyond 25 years and 18 years, respectively, "in order to provide future planning flexibility" (U.S. DOE, 2004a, 2004b). Notably, in March 2008, when the DOE provided GLE with a cost estimate for providing UF_6 tails conversion services, it stated that it "will extend the operating period at the Portsmouth and Paducah plants to process DOE backlog and additional UF_6 tails accepted material" (U.S. DOE, 2008). The DOE estimated that "the plants will operate for ~43 years starting in 2009 with the existing and additional DUF_6 treated concurrently," with decontamination and decommissioning occurring in 2052.

The DOE determined that the estimated annual impacts during operations are within applicable guidelines and regulations, with collective and cumulative impacts being quite low, and that "[t]his would also be expected during extended operations" (U.S. DOE, 2004a, 2004b). The DOE indicated that with routine facility and equipment maintenance and periodic replacements or upgrades, the Paducah and Portsmouth depleted-uranium conversion facilities could be operated safely beyond the initially planned time periods of 18 and 25 years, respectively, to process UF_6 tails from commercial enrichment facilities. The DOE concluded that the estimated impacts that would occur from prior depleted-uranium conversion facility operations would remain the same when processing UF_6 tails from a commercial enrichment facility, and that the overall cumulative impacts from the operation of the depleted-uranium conversion facility would increase proportionately with the increased life of the facility (U.S. DOE, 2004a, 2004b).

The NRC analyzed the radiological impacts from the processing of UF_6 tails received from two previously licensed commercial uranium-enrichment facilities (specifically, the proposed NEF in Lea County, NM, and the ACP in Piketon, OH), in addition to the DOE's existing UF_6 tails inventory at the DOE Paducah and Portsmouth depleted-uranium conversion facilities (NRC, 2005, 2006). In addition, the NRC considered the impacts of NEF- and ACP-generated UF_6 tails on the DOE depleted-uranium conversion facility operations, taking into account the relative amount of additional material as compared to the DOE's existing depleted UF_6 inventory. With respect to the NEF, the analysis was for a uranium-enrichment facility generating and shipping 8,600 tons (7,800 mt) of UF_6 tails per year to the DOE's depleted-uranium conversion facilities (NRC, 2005). The NRC concluded that the additional radiological impacts of converting the depleted UF_6 from the NEF at the DOE depleted-uranium conversion facilities would be SMALL (NRC, 2005).

In the ACP FEIS, the NRC similarly concluded that the added inventory of depleted UF_6 coming from the proposed ACP should not change the nature or magnitude of the impacts from the DOE depleted-uranium conversion facility operations, though it would extend those impacts for additional years. The NRC considered the overall impacts to the DOE depleted-uranium conversion facility operations to be MODERATE, given that the maximum amount 628,420 tons (571,000 mt) of UF_6 tails generated by the proposed ACP, which is to be located in Piketon, OH, would require the DOE to significantly extend the life of the Portsmouth depleted-uranium conversion facility, or to construct a second depleted-uranium conversion facility at that site (NRC, 2006). The projected maximum amount of UF_6 generated by the Proposed GLE Facility over a 40-year operating period is 496,031 tons (450,000 mt; this assumes a 6 million SWU plant averaging 4.95% enrichment). Based on the NRC's prior analyses (NRC, 2005, 2006), the additional impacts for converting additional quantities of UF_6 tails similar to those expected to be generated by the Proposed GLE Facility at the DOE's Paducah and Portsmouth depleted-uranium conversion facilities would be SMALL. With respect to throughput, the overall impacts to the DOE depleted-uranium conversion facility operations are similar to those for the ACP, which the NRC concluded to be MODERATE.

Transfer of UF_6 Tails to a Commercial Depleted-Uranium Conversion Facility for Off-site Conversion into Depleted Uranium Oxide. Although the NRC Commissioners (Commission) have deemed transfer of UF_6 tails to the DOE to be a plausible disposition strategy, and several potential enrichers (including GLE) have obtained cost estimates for UF_6 tails disposition services from the DOE, it is conceivable that NRC-licensed commercial enrichers also could pursue an alternative UF_6 tails disposition path. Specifically, an alternative to shipping the UF_6 tails generated by the Proposed GLE Facility to the DOE Paducah or Portsmouth depleted uranium-conversion facilities is to ship the UF_6 tails to a commercial depleted uranium-conversion facility, should one or more commercial conversion facilities become available. In the NEF licensing proceeding, the Atomic Safety and Licensing Board found the potential construction and operation of a depleted-uranium conversion facility in the United States, sufficient to satisfy the licensee's projected timing and throughput requirements, to be a plausible strategy for conversion of UF_6 tails (in the Matter of Louisiana Energy Services, L.P. National Enrichment Facility, Docket No. 70-3103-ML, Atomic Safety and Licensing Board, Third Partial Initial Decision [Safety-Related Contentions], LBP-06-15, 63 NRC 591 [May 31, 2006]).

International Isotopes, Inc., for example, has announced plans to construct a new depleted-uranium conversion facility that would process UF_6 tails received from U.S. uranium-enrichment facilities for a fee (International Isotopes, 2008). The facility is being designed to use technology similar to the DOE depleted-uranium conversion facilities, with initial capacity to process approximately 7,700 tons (7,000 mt) of UF_6 tails per year. The impacts of conversion of UF_6 tails generated by the Proposed GLE Facility at this commercial facility are expected to be similar to the impacts determined for the DOE Paducah or Portsmouth depleted uranium-conversion facilities because all of these facilities will convert UF_6 tails to uranium oxide and a salable fluorine byproduct.

The NRC's impact analysis for the proposed NEF (NRC, 2005) included the option of shipping UF_6 tails cylinders to a commercial depleted uranium-conversion facility (i.e., privately owned and operated) located at Metropolis, IL, which is relatively near Paducah, KY. The NRC determined that the construction of a private depleted-uranium conversion facility near Metropolis would have similar environmental impacts as construction of an equivalent facility anywhere in the United States. The NRC also concluded that the radiological impacts of conversion at a private facility and the DOE depleted-uranium conversion facilities would be similar because it is assumed that the facility design of a private depleted-uranium conversion facility would be similar to the DOE depleted-uranium conversion facilities. The analysis concluded that the impacts for converting the UF_6 tails generated by the proposed NEF at commercial depleted-uranium conversion facilities also would be SMALL.

During the environmental review process for obtaining an NRC license, International Isotopes, Inc., or any other entity seeking a license to operate a private depleted-uranium conversion facility, will need to provide adequate information for the NRC to make a similar determination regarding the impacts to the environment resulting from construction and operation of a depleted-uranium conversion facility. Therefore, while additional, site-specific environmental analysis would be required for the construction and operation of any future private depleted-uranium conversion facility to which GLE might send UF_6 tails, the impacts for converting the UF_6 tails generated by the Proposed GLE facility at commercial depleted-uranium conversion facilities are expected to be SMALL based on reasonably available information.

Environmental Impacts of Off-site Disposal of UF_6 Tails in a Licensed Disposal Facility. Regardless of which depleted uranium-conversion facility receives the Proposed GLE Facility UF_6 tails, LLRW generated from the conversion of the UF_6 tails into uranium oxide would be transported to a licensed commercial LLWR disposal facility for final disposal. As discussed in the FEISs for the proposed NEF and ACP, the NRC has reviewed the Waste Acceptance Criteria for the Energy*Solutions* (formerly Envirocare) disposal facility in Clive, UT, and confirmed that these criteria permit the disposal of depleted uranium oxide forms in Class A disposal cells with no volume restrictions (NRC, 2005, 2006). The NRC contacted the Division of Radiological Control of the State of Utah to discuss the Energy*Solutions* facility Waste Acceptance Criteria and performance assessment, and reviewed relevant provisions of the disposal license. The NRC also reviewed the licensing basis for the Energy*Solutions* license issued by the State of Utah, including an underlying technical report (Baird et al., 1990) that supports the State's conclusion that disposal of large quantities of depleted uranium will not exceed the relevant regulatory performance requirements, thereby ensuring that any potential dose to members of the public from disposal of depleted uranium in the oxide form at the Energy*Solutions* facility would be small. The NRC Staff agreed with the State of Utah's analysis of the unique characteristics of the site (e.g., low precipitation, high evapotranspiration rates, high salinity of soil and groundwater) and relevant intruder scenarios. The NRC thus concluded that the potential impact from disposal of the oxide form of depleted uranium at the Energy*Solutions* facility is SMALL (NRC, 2005, 2006).

The DOE also has evaluated the feasibility and environmental impacts of near-surface disposal of depleted uranium oxide and reached conclusions consistent with those of the NRC (U.S. DOE, 1999, 2004a, 2004b, 2007). The DOE analyzed the human health impacts from long-term disposal of uranium oxide in their Programmatic Environmental Impact Statement (PEIS) on the disposal of depleted uranium (U.S. DOE, 1999). The results of the DOE's disposal assessment are presented in Appendix I of the PEIS. The PEIS included a generic assessment of disposal of depleted uranium oxide (in the form of U_3O_8 or uranium dioxide [UO_2]), in either ungrouted or grouted form, in a generic wet or dry environment. The DOE's analysis determined that the long-term disposal of depleted uranium in the oxide form at a "generic dry location" is feasible. In particular, the DOE determined that, for shallow earthen structures in a dry setting, the chemical stability of the oxide form, combined with the low infiltration rate of water into the material and greater depth to groundwater, results in essentially no radiological impacts to groundwater or human health.

In March 2007, the DOE issued a Draft Supplement Analysis (SA) to evaluate whether it needed to supplement the two site-specific EISs, or to prepare any new EISs, for the depleted-uranium conversion facilities at Paducah, KY, and Portsmouth, OH, in order to decide where it will dispose of the depleted uranium oxide product from those facilities (U.S. DOE, 2007). Based on the analysis presented in this Draft SA, DOE concluded that existing NEPA documentation identifies reasonable disposal alternatives (i.e., Nevada Test Site and Energy*Solutions* facility). With respect to the Energy*Solutions* facility, the DOE determined that the impacts from construction and operation of the depleted-uranium conversion facilities would be low because 1) Energy*Solutions* has confirmed its ability to accept the annual amount of depleted uranium oxide that will be produced by the two DOE depleted-uranium conversion facilities for the next 25 years; 2) the DOE's proposed waste load would be a small part of the Energy*Solutions* facility's throughput; and 3) analyses performed by the Utah Division of Radiation Control and the NRC indicate that the Energy*Solutions* facility would operate well within its established standards. Accordingly, the DOE concluded that additional NEPA coverage of on-site handling and disposal impacts is not needed to support a DOE decision concerning disposal at the Energy*Solutions* facility (U.S. DOE, 2007).

With respect to the Nevada Test Site, the DOE's Draft SA analysis concludes that site-specific NEPA coverage at the Nevada Test Site is adequate for disposal of up to 2.1 million ft^3 (60,000 m^3) of unused depleted uranium oxide conversion product, and the Nevada Test Site disposal capacity (i.e., 130 million ft^3 [3.7 million m^3]) is more than sufficient to accommodate the output from the conversion of DOE's entire existing UF_6 tails inventory, emptied cylinders, and the small amount of CaF_2 produced during normal conversion operations, such that preparation of a supplemental EIS is not needed to support a decision for disposal at the Nevada Test Site. The DOE concluded that additional site-specific NEPA analyses would be necessary to support any future DOE decision to dispose of additional depleted uranium oxide conversion product volumes beyond the 2.1 million ft^3 (60,000 m^3) previously analyzed. The DOE stated that disposal of the total volume of depleted uranium oxide conversion product to be generated by the UF_6 tails conversion project will be addressed as part of the upcoming review and evaluation of the Nevada Test Site site-wide EIS. Further analyses and documentation will be prepared, as necessary, based on the results of that review. Depleted uranium oxide conversion product not acceptable for disposal at Nevada Test Site, if any, would be disposed of at the Energy*Solutions* facility, or another disposal facility determined to be acceptable at that time, following appropriate NEPA review (U.S. DOE, 2007).

In summary, based on the foregoing information, including the referenced NRC and DOE NEPA analyses, it is expected that the environmental impacts of disposal of UF_6 tails (after conversion to depleted U_3O_8) at an appropriately licensed LLWR disposal facility would be SMALL.

Impacts of Disposal of UF_6 Tails from the Proposed GLE Facility on LLWR Disposal Capacity. The quantity of depleted uranium generated as a result of the Proposed GLE Facility operations would also affect the available disposal capacity for such material. Since the depleted uranium oxide to be generated by the conversion of the Proposed GLE Facility UF_6 tails would be a Class A low-level waste (LLW), it would need to be disposed of in a facility licensed to accept Class A waste. The NRC has evaluated the potential impact of disposing of UF_6 tails (as depleted U_3O_8) from a single proposed commercial uranium-enrichment facility (i.e., USEC's ACP) on available Class A waste disposal capacity. In view of certain legal and regulatory constraints, the NRC found that, at present, viable existing disposal options for such a facility include the Energy*Solutions* facility in Clive, UT, and the DOE's Nevada Test Site (NRC, 2006). Since the Nevada Test Site is a DOE disposal facility, it could receive LLWR generated by NRC-licensed enrichment facilities if ownership of the waste is first transferred to the DOE, as contemplated by Section 3113(a)(4) of the USEC Privatization Act.

The NRC determined that the total amount of UF_6 tails estimated to be generated by the proposed ACP (which, as noted above, is similar to the total amount of UF_6 tails projected for the Proposed GLE Facility) would take up approximately 11% of the remaining Energy*Solutions* facility capacity. Given this small fraction and the fact that some of the proposed ACP's converted depleted uranium could be disposed at NTS, if necessary, NRC stated that the impacts on available disposal capacity are expected to be SMALL (NRC, 2006).

In view of the potential for construction and operation of multiple new commercial enrichment facilities in the United States, the NRC also has evaluated the potential cumulative impacts of disposing of UF_6 tails from multiple sources or facilities on national waste disposal capacity (NRC, 2006). The NRC considered the DOE's existing inventories of UF_6 tails (as described in DOE's 2004 site-specific Paducah and Portsmouth EISs) and the estimated total amounts of UF_6 tails to be generated by the proposed NEF and ACP facilities during their operating lives. The specific quantitative assumptions are set forth in the ACP FEIS. The NRC determined that the aggregate amount of depleted U_3O_8 that would be generated from converting the UF_6 tails produced by the proposed ACP, the UF_6 tails produced by the NEF, and the depleted UF_6 stored at the Portsmouth and Paducah sites would represent only approximately 20% of the available disposal capacity of the Energy*Solutions* facility (NRC, 2006). More recent information contained in the DOE's March 2007 Draft SA indicates that the impact on Energy*Solutions* facility's overall disposal capacity would be even smaller due to a significant recent expansion of Energy*Solutions*' licensed Class A disposal capacity (now estimated by the DOE to be 190.6 million ft^3 [5.4 million m^3]) (U.S. DOE, 2007).

The DOE also could dispose of converted depleted uranium from commercial uranium enrichment facilities at the Nevada Test Site rather than at the Energy*Solutions* facility (NRC, 2006). In its March 2007 SA, the DOE stated that depleted uranium oxide conversion product not acceptable for disposal at the Nevada Test Site, if any, would be disposed at the Energy*Solutions* facility or another disposal facility determined to be acceptable at that time following appropriate NEPA review. Significantly, the DOE indicated that the depleted uranium oxide conversion product resulting from the processing of the DOE's existing UF_6 tails inventory would occupy about 6% of the total Nevada Test Site available volume, or about 9% of the reserve capacity, suggesting sufficient capacity for the disposal of additional large volumes of depleted uranium oxide conversion product that might result from DOE processing of UF_6 tails from commercial enrichment facilities such as the Proposed GLE Facility.

As the NRC further noted, it is possible that, decades from now, the entire disposal capacity of the Energy*Solutions* facility ultimately could be utilized, given that Energy*Solutions* accepts other forms of Class A waste for disposal. It is also possible that, in response to such a circumstance, private entities will develop additional LLWR disposal capacity during that timeframe. For example, the August 2008 draft license for Waste Control Specialists, LLC, (WCS's) proposed LLRW disposal facility in Andrews County, TX, issued on August 12, 2008, provides that WCS may seek Texas Commission on Environmental Quality authorization to dispose of large depleted uranium waste streams by submitting a license application amendment that includes "information on complete waste profiles, radionuclide information, total radioactivity, radionuclide concentrations, chemical constituents, and analysis of any impacts to members of the public and the environment" (TCEQ, 2008).

Accordingly, based on the above information, it is anticipated that the cumulative effect of the generation and disposal of depleted uranium on national LLW disposal capacity would be SMALL.

Potential NRC Rulemaking Activities Regarding Disposal of Large Quantities of Depleted Uranium. In CLI-05-20, the NRC explained that 10 CFR 61.55(a)(6), *Waste classification*, specifies that if radioactive waste does not contain any of the radionuclides listed in either of two listed waste classification tables, it is Class A waste. The NRC concluded that, because depleted uranium does not contain the radionuclides listed in the specified tables, "under a plain reading of the regulation, depleted uranium is a Class A waste." The NRC nonetheless directed NRC Staff, "outside of the LES adjudication, to consider whether the quantities of depleted uranium at issue in the waste stream from uranium enrichment facilities warrant amending section 61.55(a)(6) or the section 61.55(a) waste classification tables" (NRC, 2008).

NRC Staff responded to the NRC's directive in SECY-08-0147, *Response to Commission Order CLI-05-20 Regarding Depleted Uranium* (October 7, 2008). SECY-08-0147 presents four possible regulatory approaches and includes a technical analysis of the impacts of near-surface disposal of large quantities of depleted uranium, such as those expected to be generated at uranium-enrichment facilities. The technical analysis addressed whether amendments to 10 CFR 61.55(a) are necessary to assure that large quantities of depleted uranium are disposed of in a manner that meets the performance objectives in Subpart C of 10 CFR 61, *Licensing Requirements for Land Disposal of Radioactive Waste*. The analysis concluded that near-surface disposal of large quantities of depleted uranium may be appropriate, but not under all site conditions. NRC Staff therefore recommended conducting a limited rulemaking to revise 10 CFR 61 to specify the need for a disposal facility licensee or applicant to conduct a site-specific analysis that addresses the unique characteristics of the waste and the additional considerations required for its disposal prior to disposal of large quantities of depleted uranium and other unique waste streams. The technical requirements associated with disposal of large quantities of depleted uranium would be developed through the rulemaking process and further addressed in a new guidance document.

The NRC Staff's technical analysis and rulemaking recommendation do not affect the conclusions stated above regarding the environmental impacts of depleted uranium disposal in a near-surface LLWR facility, as analyzed under NEPA. The prior NRC NEPA analyses of depleted uranium disposal impacts discussed above in connection with the NEF and ACP facilities used the Energy*Solutions* facility as a "reference" site. In SECY-08-0147, the NRC Staff specifically notes that the Utah Division of Radiation Control has indicated that Energy*Solutions* completed site-specific performance modeling for disposal of natural uranium at its Clive, UT, site, and that Energy*Solutions* determined that even when the disposal cells were assumed to contain 100% natural uranium, risks were found to be within applicable Agreement State regulatory limits, which are comparable to those in 10 CFR 61. Energy*Solutions* compared the risk from natural uranium to the risk associated with depleted uranium and found that depleted uranium can be safely placed in their facility. This conclusion is based on numerous assumptions that can be found in Energy*Solutions*' performance assessment. In addition, NRC Staff noted that its recommended rulemaking approach (Option 2 of SECY-08-0147) is consistent with the NRC's expectation (as set forth in CLI-06-15) that the appropriate regulatory authority would conduct any site-specific evaluations necessary to confirm that radiological dose limits and standards can be met at the disposal facility, taking into account the quantities of depleted uranium expected for disposal.

4.13.2.3 Decommissioning Impacts

The plans for Proposed GLE Facility decommissioning are described in **Section 2.1.2.1.3** of this Report (*Decontamination and Decommissioning [Proposed Action]*) With the permanent cessation of enriched uranium production and a reduction in the number of on-site workers, sanitary and process wastewater quantities generated by the Proposed GLE Facility would decrease from the levels generated during operations to eventually zero by the end of the decommissioning phase. During the decommissioning phase, radioactive-contaminated solutions generated from Proposed GLE Facility decontamination activities would be treated in the GLE liquid effluent treatment system and managed as described in **Section 4.13.2.2.1.1**. Stormwater would continue to be routed from the Proposed GLE Facility's stormwater drainage system to the on-site GLE stormwater wet detention basin during the decommissioning phase and after closure. Therefore, the wastewater management impacts resulting from decommissioning of the Proposed GLE Facility would be SMALL

Decommissioning activities would include the cleaning and removal of radioactive and hazardous waste contamination that may be present on materials, equipment, and structures. Solid wastes would be generated by these activities required for the decontamination, as well as by the removal of used process equipment from inside the buildings. Decontaminated used equipment would be shipped off-site to salvage or disposal facilities, as appropriate to the equipment type. In the event that structures needed to be demolished as part of the decommissioning activities, the demolition material would be shipped off-site. Radioactive-contaminated equipment and materials removed during decommissioning would be shipped to a licensed treatment or disposal facility (as appropriate for the material type) or disposed of in a manner authorized by the NRC. Similarly, hazardous waste materials removed during decommissioning would be shipped to a RCRA-permitted Subtitle C TSDF or an appropriate licensed recovery facility. Therefore, the solid waste management impacts resulting from decommissioning of the Proposed GLE Facility would be SMALL.

4.13.3 Waste Minimization Plan

Waste minimization involves the implementation of practices that either reduce the quantity of waste generated by a source; recycle or reprocess the material so that it can be reused, thereby avoiding the need to dispose the material as a waste; or treat the waste to remove hazardous constituents or reduce the waste volume. Waste minimization planning for the Proposed GLE Facility began with the selection of the laser uranium-enrichment technology. The selected technology is expected to generate less radioactive wastes than the alternatives (gas centrifuge or gaseous-diffusion technologies) when operating at comparable production levels.

Prior to finalization of the Proposed GLE Facility design, GLE will review the planned Proposed GLE Facility operations and associated waste streams to evaluate if the design supports best practices for waste minimization. The design will be adjusted to accommodate recommendations from this initial waste stream assessment. As part of the preparations for start-up of Proposed GLE Facility operations, GLE would develop and implement a written waste minimization plan for the Facility operations. The goal of this waste minimization plan would be to reduce targeted waste activities to the technically feasible and economically practicable minimum by the implementation of projects and work practices for the Facility operations identified in the plan. GLE would work towards achieving these waste reductions by a combination of waste reduction assessments, procedural improvements, equipment and manufacturing process improvements, material substitution, employee training, and other reduction methods, as applicable and appropriate to the uranium-enrichment technology used at the Proposed GLE Facility.

The waste minimization plan for the Proposed GLE Facility would be prepared in accordance with GLE corporate pollution-prevention policies and comply with applicable regulatory agency requirements for waste minimization plans, including those specified in 10 CFR 20.1406, *Minimization of contamination*. The waste minimization plan would include the following elements:

- **Policy Statement with Top Management Commitment.** A statement of GLE's corporate pollution prevention policy would introduce the plan and establish the fundamental principles upon which the waste minimization program for the Proposed GLE Facility would be based. This statement would be signed by senior GLE management responsible for the Facility operations to demonstrate top management commitment and support to implementing the projects identified in the waste minimization plan for reducing waste from the Proposed GLE Facility.
- **Plan Scope and Objectives.** The plan scope would describe the waste streams, processes, and activities at the Proposed GLE Facility that are addressed by the plan. Objectives would be presented in the plan that relate GLE's corporate pollution prevention policy specifically to the Facility operations involving the identified waste streams, processes, and activities.
- **Waste Minimization Committee.** A GLE Waste Minimization Committee would be established for the Proposed GLE Facility to develop, administer, and implement the Facility's waste minimization plan. This committee would identify waste streams, review the effectiveness of waste minimization activities, implement new waste minimization projects, and assist with personnel training and community outreach. An on-site Pollution Prevention Coordinator would be assigned to lead the GLE Waste Minimization Committee. The Pollution Prevention Coordinator would supervise the administration of the waste minimization plan, compile progress reports for senior GLE management review, and lead the preparation of waste minimization assessments and subsequent plan updates, as appropriate, for any identified new waste minimization projects. Other members of the GLE Waste Minimization Committee would be selected from Facility operations line supervisors; GLE and GNF-A Environment, Health, and Safety (EHS) Functions' staff; and other appropriate GLE employees.
- **Waste Stream Assessments.** The plan would describe a methodology for conducting waste stream assessments to identify the sources and quantities of waste streams generated by the Proposed GLE Facility operations. This would include descriptions of the methods to be used to characterize the types and amounts of wastes generated at the Facility and to determine the costs for management of these wastes (e.g., costs of regulatory compliance, transportation, treatment, storage, and disposal). Using this methodology, an inventory of the waste streams from the

Proposed GLE Facility operations would be prepared for presentation in the plan, with an assessment of each waste stream's potential for further waste minimization.

- **Waste Minimization Project Identification and Selection.** Based on the results of the waste stream assessment, the GLE Waste Minimization Committee would identify waste minimization options for reducing or eliminating the wastes from those waste streams with the potential for further waste minimization. This would include developing cost estimates for capital investment and implementation of the options. The GLE Waste Minimization Committee then would evaluate and select specific waste minimization projects for implementation based on corporate criteria that includes technical feasibility and economical practicality of applying the option to the Proposed GLE Facility operations.
- **Selected Waste Minimization Projects Implementation.** For each waste minimization project selected for implementation, the plan would include a project description, project schedule, and waste minimization targets or other appropriate parameters for measuring project progress and performance.
- **Results Measurement and Progress Evaluation.** After a waste minimization project has been implemented for a period of time, it is important to evaluate the actual level of waste reduction achieved. To evaluate performance, the plan would include procedures for measuring the results and evaluating the progress of each implemented waste minimization project towards waste reduction and economic targets. Using the measurement and evaluation results, periodic progress reports would be prepared to inform GLE senior management about the status and performance of the waste implementation program implemented for the Facility operations. Knowledge gained from the results measurements and evaluation would be used to modify or fine-tune specific waste minimization projects, as needed.
- **Periodic Plan Review Procedures.** To ensure continuous improvement, a procedure for periodic review of the entire waste minimization plan would be specified in the plan. This procedure would include holding meetings and using other information exchange formats between Proposed GLE Facility staff to identify new waste minimization opportunities. Based on the reviews, the plan would be updated as needed to include revisions to on-going projects and addition of new projects for reducing waste from the Facility operations.

4.13.4 Cumulative Impacts

The Proposed GLE Facility would add to the total quantities of wastewaters and solid wastes generated at the Wilmington Site and requiring subsequent management. The impacts from the management of these wastes would not be cumulative over the construction, operation, and decommissioning phases of the Proposed Action, with one exception: solid wastes sent off-site to a Facility for landfill disposal would cumulatively consume a portion of the permitted landfill capacity limit, which is discussed in **Section 4.13.4.2**. The other cumulative impacts resulting from the Proposed Action are addressed separately for wastewaters in **Section 4.13.4.1** and for solid wastes in **Section 4.13.4.2**. Cumulative impacts associated with the disposition of UF_6 tails generated by the Proposed GLE Facility are addressed in **Section 4.13.2.2.2.6**.

4.13.4.1 Wastewaters Cumulative Impacts

Two other projects besides the Proposed GLE Facility currently planned for the Wilmington Site are the addition of the ATC II complex and the Tooling Development Center, as described in **Section 2.3** of this Report (*Cumulative Effects*). The combined process wastewater flow from existing Wilmington Site operations with the Proposed GLE Facility and other new projects is projected to be in the range of 516,200 gpd (1,954,000 lpd; see **Table 4.13-5**). The existing Wilmington Site process wastewater aeration basin and final process lagoons have the capacity to handle this combined wastewater flow rate.

The current NPDES permit discharge limit (Permit No. NC0001228, Outfall 001) for process wastewaters from the Wilmington Site is 1.8 million gpd (6.8 million lpd) of treated process wastewater. The projected total cumulative flow rate is within the maximum allowable discharge limit specified by the current NPDES permit for the Wilmington Site.

Based on the projected sanitary wastewater flows presented in **Table 4.13-5**, the combined sanitary wastewater flow from operations at the Wilmington Site with the Proposed GLE Facility is projected to be in the range of 62,300 gpd (236,000 lpd). The existing Wilmington Site sanitary wastewater treatment facility has the capacity to handle this wastewater flow rate. The maximum allowable discharge limit of 75,000 gpd (283,905 lpd) for treated sanitary wastewater is specified in the Wilmington Site's current NPDES (Permit No. NC0001228, Outfall 002). The projected total cumulative flow rate is within the maximum allowable discharge limit specified by the current NPDES permit for the Wilmington Site. However, as discussed in Section **4.13.2.2.1.3**, beginning in April 2008, the industrial re-use of treated sanitary wastewater effluent as make-up water in Wilmington Site cooling towers resulted in a switch away from the discharge of treated sanitary wastewater effluent to the effluent channel. The NPDES discharge permit remains valid should discharges of treated sanitary wastewater become necessary in the future. Although this effluent re-use process commenced in April 2008, the effects of this process are considered in the cumulative impacts assessments because it postdates the 2006 baseline set of conditions presented in **Chapter 3** of this Report (*Description of the Affected Environment*).

Stormwater runoff from the Proposed GLE Facility would not be combined with or interfere with the management of stormwater runoff from other developed locations on or in the vicinity of the Wilmington Site. Construction, operation, and decommissioning of the Proposed GLE Facility would not require any connections to the local municipal sewer systems. Thus, the Proposed GLE Facility would not affect the wastewater management systems required for the new residential and other projects discussed in **Section 4.1.3**, *Cumulative Impacts (Land Use Impacts)*, that are planned for development in the vicinity of the Wilmington Site. Therefore, the cumulative wastewater and stormwater management impacts of the Proposed GLE Facility with the other planned on-site projects and expected off-site projects in the vicinity of the Wilmington Site would be SMALL.

4.13.4.2 Solid Wastes Cumulative Impacts

The solid wastes generated by the Proposed GLE Facility operations and shipped off-site (with the exception of UF_6 tails, which is a waste stream unique to the Proposed GLE Facility) would be shipped to the same waste management facilities already used for the other solid wastes generated by the existing Wilmington Site facilities, as appropriate to the waste type (see **Table 4.13-4**). These facilities have adequate capacity to continue accepting solid waste materials generated at the Wilmington Site for the foreseeable future. GLE is not aware of any closure or other plans that would impede the future acceptance of the appropriate waste materials generated by the operations at the Wilmington Site. The pending closure of the Barnwell, SC, LLRW facility is not anticipated to impede the disposal of GLE LLRW, as there are other facilities available to accept the type of LLRW that GLE will generate (e.g., Energy *Solutions* in Clive, UT). The operation of the Proposed GLE Facility with the existing GNF-A operations would increase the amount of LLRW shipped from the Wilmington Site to the Energy*Solutions* disposal facility in Clive, UT, by approximately 345 tons/year (313 mt/year). Operation of the Proposed GLE Facility is projected to increase the quantity of nonhazardous industrial waste shipped from the Wilmington Site by approximately 5% and the quantity of RCRA hazardous waste shipped from the Wilmington Site by less than 1%.

The solid wastes generated by the ATC II complex and the Tooling Development Center projects are expected to be predominately MSW that would be disposed at the local New Hanover County landfill. The activities in the Tooling Development Center could generate small quantities of some hazardous wastes. These wastes would be added to and managed with the hazardous wastes generated by the existing Wilmington Site facilities. Neither of these other new projects would generate industrial or radioactive waste.

The MSW generated by the Proposed GLE Facility and the other new on-site projects discussed above would add to the total MSW quantity collected throughout New Hanover County and disposed in the New Hanover County municipal landfill. Based on the landfill's current permitted capacity and planned capacity expansion to meet the projected MSW disposal needs for the county (see **Section 3.12.3.1** of this Report, *Municipal Solid Wastes*), it is expected that the landfill will have the capacity to accept the MSW generated within New Hanover County, including that from the Proposed GLE Facility, for the foreseeable future. The proposed new Carolinas Cement Company, LLC, manufacturing plant would not generate radioactive wastes. Regarding nonhazardous industrial wastes and hazardous wastes, those generated by the cement manufacturing plant requiring off-site treatment or disposal would not be shipped to the same facilities as those receiving these types of wastes generated at the Proposed GLE Facility. Therefore, the cumulative solid waste management impacts of the Proposed GLE Facility, the other planned on-site projects, and the expected off-site projects in the vicinity of the Wilmington Site would be SMALL.

4.13.5 Control of Impacts

Waste management impacts resulting from the Proposed GLE Facility would be controlled by implementing a comprehensive program that incorporates the following waste management impact mitigation components:

- Minimizing the quantities of waste generated by the Proposed GLE Facility by implementing the waste minimization plan discussed in **Section 4.13.3**
- Performing an ISA for each on-site waste storage area to identify and prevent potential accidental releases to the environment
- Monitoring and inspecting on-site waste storage facilities on a periodic schedule to detect any leaks or releases to the environment due to equipment malfunctions so that corrective action can be taken promptly
- Maximizing use of the existing Wilmington Site waste treatment and disposal facilities within the facilities' current regulatory permit limits to avoid the need to add new on-site waste treatment and disposal facilities for the Proposed GLE Facility operations
- Shipping each waste generated by the Proposed GLE Facility that would require off-site storage, treatment, or disposal to a licensed facility (as appropriate for the waste type) in compliance with EPA and NRC requirements.

The waste management impact mitigation measures that would be applied to the Proposed Action are further discussed in **Section 5.13** of this Report, *Waste Management (Mitigation Measures).*

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Tables

Table 4.13-1. Types, Sources, and Quantities of Wastewaters Generated by Proposed GLE Facility Operations

Wastewater Type	Wastewater Source	Estimated Average Daily Quantity Generated
Process liquid radwaste	Wastewaters from main GLE operation 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	5,000 gpd (18,927 lpd)
Cooling tower blowdown	Main GLE operation building HVAC cooling tower	30,000 gpd (113,562 lpd)
Sanitary waste	Sanitary waste from building areas used by Proposed GLE Facility workers (e.g., restrooms, break rooms)	10,500 gpd (39,746 lpd)
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

Table 4.13-2. Management of Wastewaters Generated by Proposed GLE Facility Operations

Wastewater Type	On-site Waste Management	Offsite Waste Treatment/Disposal
Process liquid radwaste	Wastewaters collected in closed drain system connected to Proposed GLE Facility liquid effluent treatment system (see text description in **Section 4.13.2.2.1.1**). Treated radwaste effluent discharged to existing Wilmington Site process wastewater aeration basin and final process lagoon facility.	Treated effluent from the Wilmington Site final process lagoon facility is discharged at NPDES-permitted Outfall 001 to the on-site effluent channel.[a]
Cooling tower blowdown	Blowdown pumped from cooling tower to existing Wilmington Site final wastewater process lagoon facility.	Treated effluent from the Wilmington Site final process lagoon facility is discharged at NPDES-permitted Outfall 001 to the on-site effluent channel.[a]
Sanitary waste	Sanitary waste collected in sewer system connected to existing Wilmington Site sanitary wastewater treatment plant. Waste stream treated by single-train, extended aeration activated sludge wastewater treatment facility with membrane ultrafiltration and ultraviolet filtration (operational March 2008).	Treated effluent from the Wilmington Site sanitary wastewater treatment plant is discharged at NPDES-permitted Outfall 002 to the on-site effluent channel.[a]
Stormwater runoff	Runoff routed to stormwater detention ponds before discharging to receiving waters, which would serve to regulate stormwater quality and quantity as required by the NPDES stormwater permit. Runoff collected from the UF_6 cylinders storage pad first routed to a holding basin, where it would be monitored and released to a GLE stormwater detention pond only if the uranium concentration is below the acceptable level.	Stormwater from on-site GLE detention ponds is discharged per requirements of NPDES stormwater permit NCS000022, as modified.

[a] Effluent discharges within NPDES wastewater permit NC0001228 limitations. The on-site effluent channel flows to Unnamed Tributary #1 to Northeast Cape Fear River.

Table 4.13-3. Types, Sources, and Quantities of Solid Wastes[a] Generated by Proposed GLE Facility Operations

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	380 ton/yr (345 mt/yr)
Nonhazardous industrial wastes	Nonhazardous wastes from GLE facility equipment cleaning and maintenance activities (e.g., used coolant, non-hazardous caustic, and filter media) that are recyclable or not accepted by MSW landfill	107 ton/yr (97 mt/yr)
RCRA hazardous waste	Wastes designated as RCRA hazardous wastes from GLE facility equipment and maintenance activities (e.g., used cleaning solvents, used solvent-contaminated rags)	12 ton/yr (11 mt/yr)
Low–level radioactive Waste (LLRW)	Laboratory waste from UF_6 feed cylinder sampling and analysis	97 lb/yr (44 kg/yr)
	Combustible, uranium-contaminated used items (e.g., worker personal protection equipment, swipes, step off pads)	103 ton/yr (93 mt/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, values, other safety equipment that need replacement)	241 ton/yr (219 mt/yr)
	Liquid effluent treatment system filtrate/sludge	2,100 lb/yr (953 kg/yr)
	Depleted UF_6 (UF_6 tails)	12,400 ton/yr (11,250 mt/yr)

[a] Includes liquid and semi-solid wastes that are stored and managed in tanks or containers.

Table 4.13-4. Management of Solid Wastes[a] Generated by Proposed GLE Facility Operations

Solid Waste Source	On-site Waste Management	Offsite Waste Treatment/Disposal
Municipal solid waste (MSW)	Collected and temporarily stored in roll-off containers	Filled roll-off containers transported by commercial refuse collection service to New Hanover County Landfill[b] in Wilmington, NC.
Nonhazardous wastes from GLE operations equipment cleaning and maintenance activities that are recyclable or not accepted by MSW landfill	Collected and temporarily stored in containers	Filled containers transported by truck to Heritage Environmental Services TSDF[c] in Indianapolis, IN for treatment and burial, or routed through Heritage Environmental Services to other GEH-approved facilities for reuse, reclamation, or treatment.
Wastes designated as RCRA hazardous wastes	Collected and temporarily stored in containers	Filled containers transported by truck to Heritage Environmental Services TSDF[c] in Indianapolis, IN.
Laboratory waste from UF_6 feed cylinder sampling and analysis	Collected and transferred to FMO for processing to deconvert to U_3O_8	Not applicable
Combustible and noncombustible used or spent uranium-contaminated materials	Collected and temporarily stored in boxes	Filled boxes transported by truck to Energy*Solutions* disposal facility[d] in Clive, UT.
GLE liquid effluent treatment system filtrate/sludge	Collected and temporarily stored in metal cans	Filled cans transported by truck to Energy*Solutions* disposal facility[d] in Clive, UT.
UF_6 tails	Filled 48Y cylinders moved to on-site, outdoor, concrete, UF_6 storage pad for interim storage until off-site shipment.	Filled 48Y or 48G cylinders transported by truck to depleted uranium-conversion facilities[e] at DOE sites in Portsmouth, OH, and Paducah, KY, or to a commercial depleted uranium-conversion facility, should one become available

[a] Includes liquid and semi-solid wastes that are stored and managed in tanks or containers.

[b] Licensed Resource Conservation and Recovery Act (RCRA) subpart D landfill.

[c] Licensed RCRA subpart C treatment, storage, and disposal facility (TSDF).

[d] Licensed low level radioactive waste (LLRW) disposal facility.

[e] Licensed depleted uranium-conversion facilities being developed by Uranium Disposition Services under contract to the U.S. Department of Energy at existing DOE facility sites in Portsmouth, OH, and Paducah, KY..

Table 4.13-5. Cumulative Wastewater Quantities Generated at the Wilmington Site with Proposed GLE Facility Operations

Wilmington Site Wastewater Source	Total Average Daily Wastewater Flow Rate		
	Process Wastewater	Sanitary Wastewater	Combined Wastewater Flow Rate
Existing Wilmington Site facilities [a]	476,200 gpd	33,300 gpd	509,500 gpd
Proposed GLE Facility [b]	35,000 gpd	10,500 gpd	45,500 gpd
Other planned on-site projects [c]	5,000 gpd	18,500 gpd	23,500 gpd
Total projected treated wastewater effluent (not including industrial re-use of treated sanitary wastewater effluent)	**516,200 gpd**	**62,300 gpd**	**578,500 gpd**
Effects of industrial re-use of treated effluent from the Wilmington Site sanitary wastewater treatment facility [d]	-62,300 gpd [e]	-62,300 gpd [f]	-124,600 gpd
Projected NPDES-permitted discharges of wastewaters to the on-site effluent channel	**453,900 gpd** [e]	**0 gpd** [f]	**453,900 gpd**

[a] Total averaged daily volumes based on measured flow for 2006 (see **Table 3.12-1**).

[b] Total averaged daily volumes based on estimated flow rates for GLE operations (see **Table 4.13.1**).

[c] Total averaged daily volumes based on estimated flow rates for ATC II complex and Tooling Development Center.

[d] Although the re-use 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 presented in **Chapter 3** of this Report, *Description of the Affected Environment.*

[e] Because the treated sanitary wastewater effluent has such low hardness, its addition to the Wilmington Site cooling towers increases efficiencies. Each gallon of re-use water introduced into a cooling tower offsets 2 gallons of process make-up 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 re-use 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 re-use process also reduces the requirement to withdraw groundwater to meet the Wilmington Site process-water requirement (see **Section 4.4.5**, *Water Use Impacts*).

Note: Total wastewater quantities presented in this table are less than the process-water and potable-water demands presented in **Table 4.4-2** due to consumptive losses.