# GLE Environmental Report

# Section 3.7 – Noise

# Revision 0

# December 2008

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# 3.7 Noise

## 3.7.1 Baseline Sound Conditions

### 3.7.1.1 Site Acoustical Observations

The Wilmington Site has a variety of surrounding land uses, which are described in **Section 3.1**, *Land Use*. The most sensitive acoustically is the residential community to the northeast of the existing Site (Wooden Shoe residential subdivision) and directly east of the Proposed GLE Facility. Other land uses adjacent to the Site include a hunting/recreational area to the north, the Northeast Cape Fear River to the southwest, I-140 to the south, and NC 133 (Castle Hayne Road) to the east. There are also residences south of I-140.

The Wilmington Site has a number of existing industrial facilities and open-space areas located in the Eastern Site Sector. Much of the remaining undeveloped land on the Site is wooded, with various access roads provided to navigate through these areas. From an acoustical perspective, these medium-density wooded areas are likely to provide a modest, although useful, increase in attenuation for Facility sound propagating to the perimeter of the property.

The topography of the Wilmington Site is generally flat, with little to no change in elevation in the upland area that would affect the propagation of sound across the property. The only significant elevated topographical feature in the vicinity of the Site is the raised elevation of I-140 south of the Site. This elevated highway provides a natural barrier to sounds from the current Wilmington Site operations that could otherwise propagate to the residences to the south.

### 3.7.1.2 Site Sound-Survey Monitor Locations

The baseline sound survey conducted in 2007 incorporated several environmental sound monitors at four positions around the Wilmington Site (**Figure 3.7-1**) to characterize the existing acoustical conditions. The sound-level monitoring sought to accomplish several objectives to document the existing sound levels. First, sound-level monitoring was conducted to measure the sound levels of the existing Wilmington Site operations at the property line adjacent to the nearest residential neighbors to the north. Sound levels measured from this monitor can be compared to permissible sound levels established by community sound-level ordinances or guidelines applicable to the Proposed GLE Facility. To accomplish this goal, a position on the Site property near the Wooden Shoe subdivision streets Dekker Road and Berg Lane (Sound Monitor Position A in **Figure 3.7-1**) was chosen as the closest position for assessing the existing community sound level resulting from the existing Wilmington Site operations. This location was used to measure the community sound levels because other residential neighbors are located significantly farther from the Proposed GLE Facility and are shielded by the topography of the elevated I-140 roadway south of the Site. These two conditions will significantly reduce the community sound-level exposure from sound generated by the Proposed GLE Facility.

Second, sound-level monitoring was conducted to document the existing sound levels at the location of the Proposed GLE Facility (Sound Monitor Position B in **Figure 3.7-1**). To this end, a monitor was placed in the middle of the GLE Study Area, which currently contains a tree farm. The sound levels measured by this monitor do not reflect the community sound levels because this location is well within the property boundaries of the Wilmington Site.

Third, a monitor was used to measure sound levels of the existing operations, close to the existing industrial facilities, to characterize the sound from existing operations (Sound Monitor Position C in **Figure 3.7-1**). Sound levels from this monitor location can be compared with the property line sound levels to determine whether there is any correlation between sound levels measured in the vicinity of the current Wilmington Site facilities and those measured at the property line. The sound levels measured at

this location do not relate to any of the ordinance or community sound levels, but they do provide an understanding of the sound levels generated by the existing Wilmington Site operations that may propagate to the community.

Fourth, a monitor was used to document the existing traffic sound levels on the Wilmington Site along the roadway nearest to the residential neighbors (Sound Monitor Position D in **Figure 3.7-1**). The sound levels measured with this monitor do not reflect the community sound levels because Position D is located well within the Site boundaries.

Based on these four objectives, the following specific sound monitor locations were identified to be important for the survey:

- **Position A.** Sound monitor located to the east of the Proposed GLE Facility, along the northeastern edge of the Site property line in the Eastern Site Sector. The closest residential neighbors to the Proposed GLE Facility site are located on Dekker Road and Berg Lane, which are situated across an access road to a hunting facility that is further north of the property (see photograph in **Figure 3.7-2** of the monitor in this location).
- **Position B.** Located in the North-Central Site Sector near the Proposed GLE Facility and the center of the GLE Study Area, which is currently the site of a tree farm (see photograph in **Figure 3.7-3** of the monitor in this location).
- **Position C.** Located to the southeast of the Proposed GLE Facility in a clearing to the north of the existing Wilmington Site facility in the Eastern Site Sector (see photograph in **Figure 3.7-4** of the monitor in this location).
- **Position D.** Located along the existing northern entrance roadway on the Wilmington Site in the Eastern Site Sector (see photograph in **Figure 3.7-5** of the monitor in this location).

#### 3.7.1.3 Environmental Sound-Monitor Setup and Calibration

At each position, an environmental sound monitor was set up to measure the sound levels continuously at 5-minute intervals from Tuesday afternoon, October 30, 2007, to Thursday morning, November 1, 2007. From these sound-level data, the energy equivalent sound levels ($L_{EQ}$) and the day-night average sound levels ($L_{DN}$) of the existing ambient sound were calculated; these metrics are commonly used to compare measured sound levels to applicable community sound criteria (see **Section 3.7.2**). The monitors measured the overall sound levels through an A-weighted filter and recorded the numerical data. The A-weighted filter correlates with the response of human hearing to different sound levels (see **Appendix L**, *Sound in Lay Terms*, for a description of these metrics).

Two environmental sound-monitor models were used for this project. At Positions A, B, and D, Rion NL-31 sound-level meters recorded the overall A-weighted sound levels in a numerical format. At Position C, a Rion NL-32 sound-level meter recorded the sound levels in a numerical format and also recorded the actual sounds of the events that exceeded 60 the A-weighted decibel sound level (dBA). All of the monitors used a Rion UC-53A microphone and a Rion NH-21 preamplifier. The clocks of each meter were synchronized so that the sound-level data from each period could be compared between the monitor locations. The sound-level meters were field-calibrated with a handheld Norsonic 1251 calibrator. These calibrations confirmed that each meter was measuring the same sound level relative to the calibration tone of 114.0 dBA at 1,000 Hz. The meters were placed in weatherproof cases, with the microphone placed onto a tripod. The microphone height was approximately 5 ft (1.5 m) off of the ground. A windscreen was placed over the microphone to minimize the influence of wind noise in the measurements.

### 3.7.1.4 Site Sound-survey Short-term Measurements

In addition to the sound levels obtained from the continuous environmental sound monitors, short-term (5-minute) measurements were also gathered using a handheld sound-level meter at each of the four sound-monitor positions. The data collected from this meter included octave-band sound-pressure levels, which include frequencies from 31.5 Hz to 8,000 Hz, and overall A-weighted sound levels. These octave-band spectra show what frequency sounds were heard at the monitors during these measurements. This information can be used to ascertain the frequency characteristics of the measured sound, which, in turn, may assist with understanding how particular sounds, such as insects chirping, relate to the other sounds being measured. The octave-band sound levels are also useful for possible comparison to community sound criteria.

### 3.7.1.5 Weather Conditions during Site Sound Survey

The summary of the weather data collected by NOAA at Wilmington International Airport for each day of the Wilmington Site sound survey are provided in **Appendix M**, *Summary of Weather Data Collected for the Site Sound Survey* (NOAA, 2007). In general, the weather during the three days was clear to partly cloudy, with average temperatures between 55° and 70°F (12.8 ° and 21.1 ° C), highs of about 85°F (29.4 ° C) during the day and lows of about 55°F (12.8 ° C) at night, no precipitation, light winds (average 6 to 9 miles [9 to 14 km] per hour) to the northeast, and 65% to 75% humidity (NOAA, 2007).

### 3.7.1.6 Existing Sound Sources Observed

There are a number of natural and human-generated noise sources that were observed during the Wilmington Site sound survey. The natural sounds included birds singing/calling, wind rustling the fall leaves, and insects chirping/peeping; these insect noises are evident in the octave-band data as increased levels at 4,000 Hz during the nighttime measurements. The human activity in the area surrounding the Site generated sounds that were observed and measured at each of these monitor locations. These sounds included local vehicular traffic on NC 133 (Castle Hayne Road), distant vehicular traffic on I-140 and I-40, aircraft overflights, a leaf blower used at a residence, and gun shots from the hunting/recreation area. Sounds generated from the existing Wilmington Site facilities included vehicular traffic on the Site roadways, various mechanical systems operating at the plant (heard primarily at Position C), pump noise from air quality monitoring stations (also heard at Position C), back-up beepers from facility/construction vehicles, human activity outside of the Wilmington Site facilities, an announcement from a public address system at the Site, and the hum of sodium lights.

### 3.7.1.7 Site Sound-Survey Monitor Results

The sound-level data obtained by the four environmental sound monitor positions over the survey period are plotted in **Figures 3.7-6 through 3.7-9**. On these graphs, the red lines ($L_{EQ}$) indicate the energy-equivalent sound levels for each 5-minute period; this is a common sound-level metric that is used for comparison to community sound-level ordinances and is typically considered an "average" sound level. The blue line ($L_1$) represents the sound level that was exceeded 1% of the time in each 5-minute period; this sound level represents very short duration impulsive sounds that can be easily heard amongst the quieter and steadier background sound levels. The black line ($L_{90}$) represents the sound level that was exceeded 90% of the time in each 5-minute period; this sound level represents the steady-state sound level that is often considered the "ambient" sound level, which is controlled by mechanical equipment or distant human activity.

Graphs of the octave-band spectra data are shown in **Figures 3.7-10 through 3.7-13**. The graphs present the $L_{EQ}$ octave-band sound-level data from the 5-minute intervals obtained during the four measurement periods, when each of the monitor positions was visited. The sound-level data were measured at each of the octave-band frequencies indicated on the graphs. Additionally, the symbols on the right axis of each

graph depict the overall dBA that is representative of the measurements made across the octave band at the times indicated by the legend.

A summary of the results from the continuous sound-level monitoring is shown in **Table 3.7-1**. In this table, the "day" time period is between 7:00 a.m. and 10:00 p.m., whereas the "night" time period is between 10:00 p.m. and 7:00 a.m.

For the most part, these sound levels represent a "typical" operating condition at the existing Wilmington Site facilities. These sound levels also include one unusual activity, which is the noise of truck traffic associated with construction activities at the eastern end of the Wilmington Site related to the construction of the GEH Headquarters Business Center. This construction traffic, which is interim in nature, was routed primarily along the interior roadways at the existing Wilmington Site facilities and occurred only during daylight hours.

A graph comparing the sound levels at Positions A and C is shown in **Figure 3.7-14**. In this comparison, the northern property line sound levels (Position A) would demonstrate a variation similar to variation of the sound levels at the existing Wilmington Site facilities (Position C), if the sounds at the northern property line were controlled by the existing facilities on the Wilmington Site. The sound-level data in this graph indicate that the variations in sound levels from the existing Wilmington Site facilities have little correlation to the sound levels to the adjacent community north of the Site. This conclusion is clear from the daytime/nighttime variations, which are significantly different, meaning that the sound levels in the residential areas are controlled more by the sounds from community activities and events, rather than the more consistent sound levels of the existing Wilmington Site facilities, which were measured at Position C. There is also no apparent correlation with sound levels of the vehicular activities near the existing Wilmington Site facilities, which do not produce a measurable increase in the sound levels at the northern property line. There are some direct correlations between sounds, such as aircraft overflights, which generate similar sound levels at both monitor locations. This also confirms the field observations made at the Site, which were that the sound levels at the northern property line location are far more dependent on sounds from activities/events in the surrounding vicinity of the Site, rather than on the sounds related to the activities/events of the existing Wilmington Site facilities.

#### 3.7.1.8 Previous Sound Measurements Conducted at the Site

Sound levels were measured in 1989, 1995, and 2002 at 22 locations around the perimeter of the Wilmington Site (**Figure 3.7-15**) (GNF-A, 2007). **Table 3.7-2** lists the sound-level data in dBA for each of the 22 locations and each of the sound-sampling days (GNF-A, 2007). The sound-level values presented in **Table 3.7-2** represent single readings at each location on the days indicated. These values were obtained using a Quest Model 1900 handheld sound-level meter with a windscreen over the microphone.

The sound-level data in **Table 3.7-2** show a general Site-wide decrease in sound levels during the time period from 1995 to 2002. The few exceptions to this trend are increased noise levels at some locations that are associated with government highway construction using heavy equipment within the sampling area. However, the sound levels measured at these locations are still lower than the New Hanover County Noise Ordinance (described in **Section 3.7.2.1**) for both residentially and non-residentially zoned districts.

### 3.7.2 Community Sound Criteria

#### 3.7.2.1 New Hanover County

New Hanover County has been identified as the local authority for regulating community sound emissions in the vicinity of the Wilmington Site. Its criteria are set forth in Chapter 23 Environment,

Article II, *Noise*, of the County's Code of Ordinances (New Hanover County, 2007). The full text of this document, downloaded from the New Hanover County Web site, is included in **Appendix N**, *New Hanover County Noise Ordinance: Chapter 23, Article II. Noise*.

The portion of the ordinance applicable to this project is located in Section 23-33, Noises Prohibited Generally. This section indicates that non-residentially zoned districts shall not produce noise that exceeds 75 dBA when combined with the ambient sound levels during daytime hours, and no more than 70 dBA between 10:00 p.m. and 7:00 a.m. Residentially zoned districts have lower criteria of 65 dBA during the daytime and 50 dBA at night. These sound levels would be measured at the corner of the nearest primary structure, or the boundary of the public right-of-way.

The 2007 sound-survey results tabulated in **Table 3.7-3** indicate that the current operations at the existing Wilmington Site facilities are meeting these stricter residential criteria at the northern property line. The New Hanover County Noise Ordinance specifies an Average Day $L_{EQ}$ of 65 dBA and an Average Night $L_{EQ}$ of 50 dBA for residentially zoned districts; the corresponding values calculated from measurements made during the 2007 sound survey at Position A (northern property line) are 46 and 41 dBA, respectively.

#### 3.7.2.2 North Carolina State Noise Regulation

North Carolina General Statute 153A-133 addresses noise regulation for the State. This statute states the following:

> "A county may by ordinance regulate, restrict or prohibit the production or emission of noises or amplified speech, music or other sounds that tend to annoy, disturb, or frighten its citizens."

Therefore, because New Hanover County has a Noise Ordinance, the county ordinance would apply in this situation.

#### 3.7.2.3 Federal Noise Guidelines

Research conducted by EPA in the early to mid-1970s on the effects of noise on people led to the establishment of a broad-ranging set of guidelines for environmental noise levels, aimed, in EPA's words, "to protect the public health and welfare with an adequate margin of safety" (U.S. EPA, 1978, 1974).

In brief, EPA identified a continuous level of environmental noise of 70 dBA $L_{EQ}$ (an annual average 24-hour "energy-equivalent" noise level) as adequate to protect against the adverse effects of noise on human hearing, and a 55 dBA $L_{DN}$ (an annual average 24-hour $L_{EQ}$ level with a 10-dB subjective "penalty" applied to nighttime noise) outdoors (45 dBA $L_{DN}$ indoors) as adequate to protect against activity, interference, and annoyance. In addition, EPA states that outdoor areas where people spend various amounts of time, such as school yards and playgrounds, should have sound levels equal to or less than 55 dBA $L_{EQ}$ analyzed over a 24-hour period. EPA defines the nighttime hours as 10 p.m. to 7 a.m.

The 2007 sound-survey results tabulated in **Table 3.7-3** indicate that the current operations at the existing Wilmington Site facilities are meeting the EPA guidelines at the northern property line. The EPA guidelines specify an average 24-hour $L_{EQ}$ of 55 dBA and an $L_{DN}$ of 55 dBA; the corresponding values calculated from measurements made during the 2007 sound survey at Position A (northern property line) are 44 and 48 dBA, respectively.

# Tables

**Table es l s s e el e**

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$L_{DN}$ Da ni t avera e so n levels.
N Not applicable.
[a] See **e** .
Re erence: Ne anover o nt 2007.

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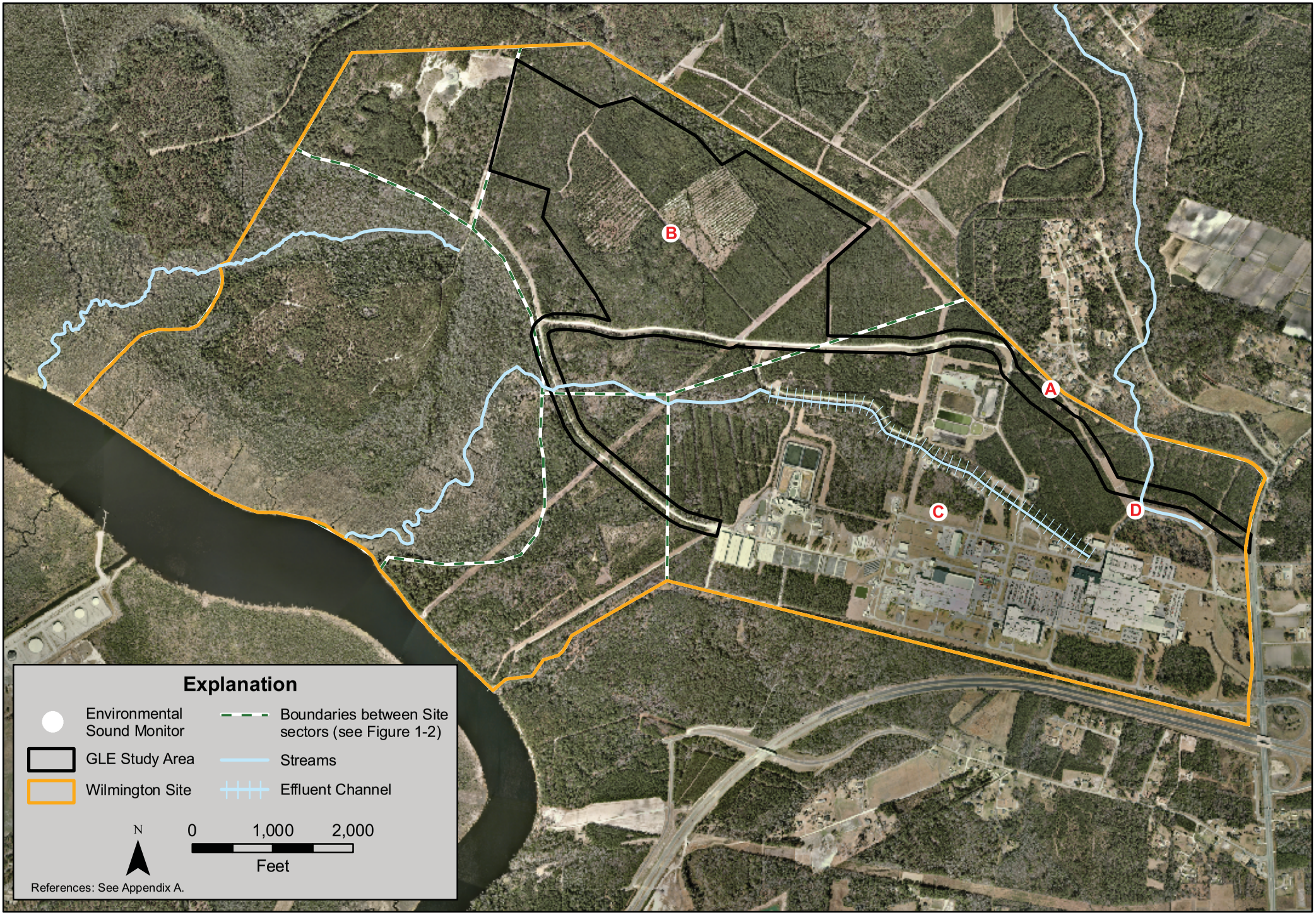



**Figure 3.7-1. Locations of environmental sound monitors on Wilmington Site.**

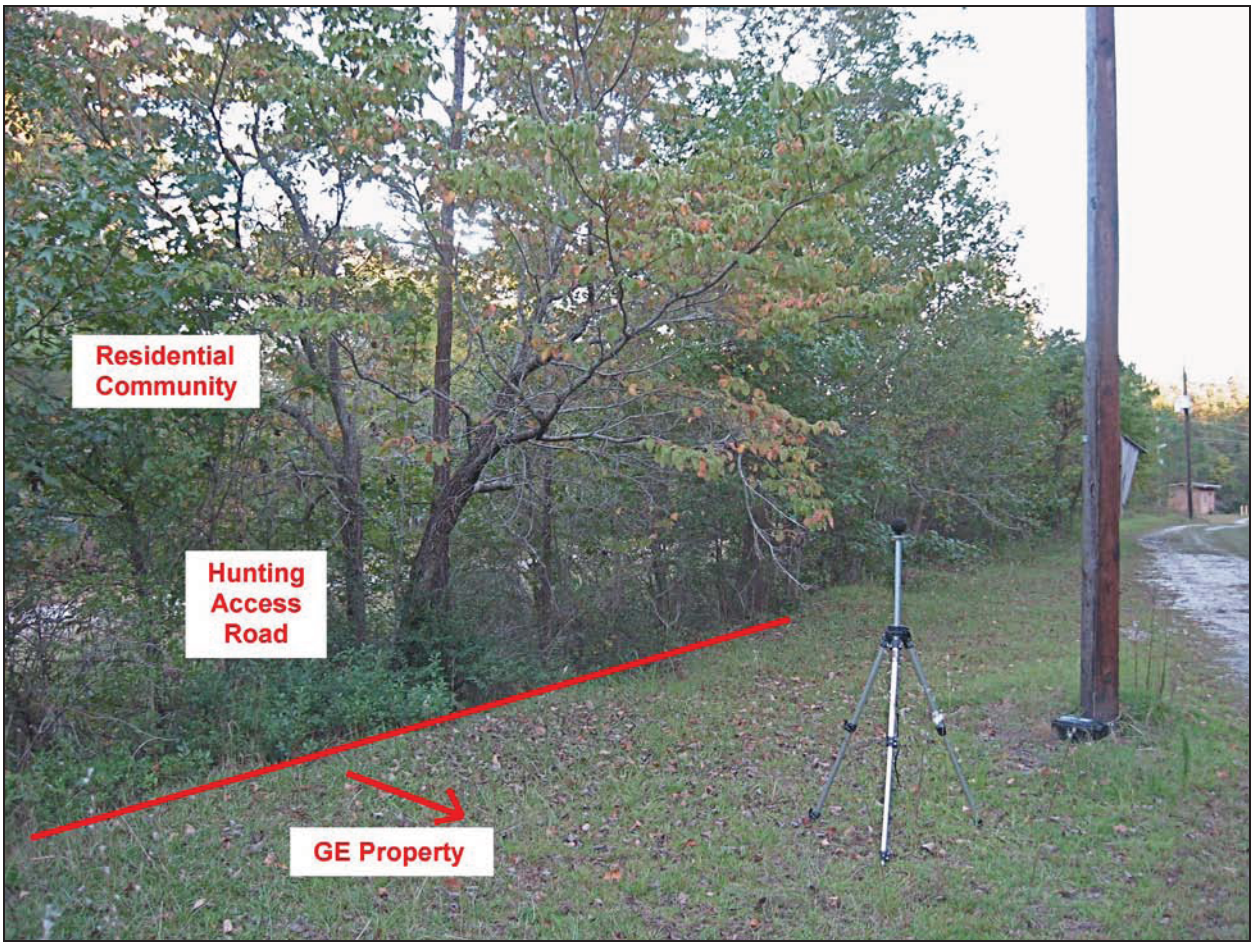



**Figure 3.7-2. Sound monitor at Position A near the adjacent residential community north of the Wilmington Site (photograph looking east).**

**Figure 3.7-3. Sound monitor at Position B in the location of the Proposed GLE Facility, which is currently a tree farm (photograph looking east).**

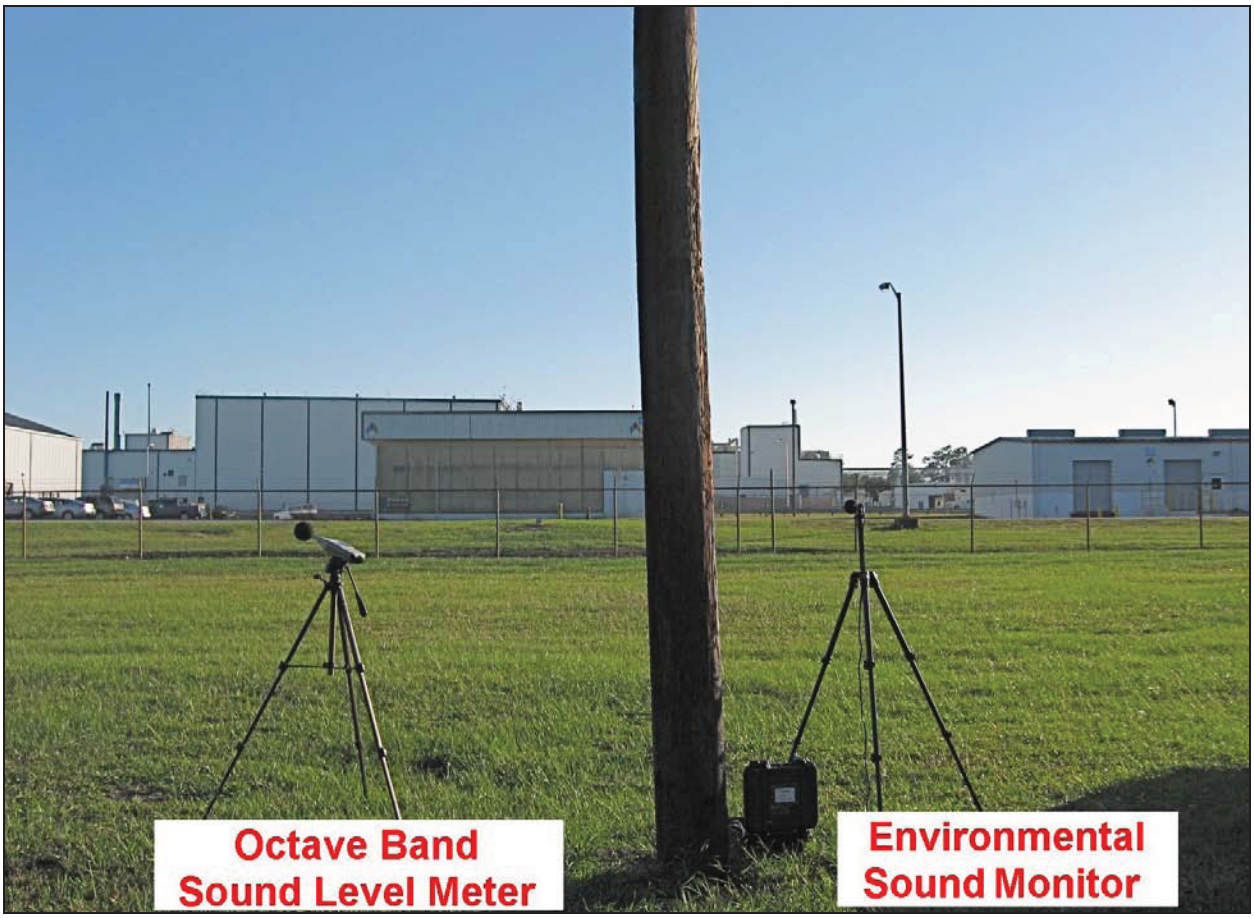



**Figure 3.7-4. Sound monitor (right) and octave-band sound-level meter (left) at Position C at the northern edge of the existing GE/GNF Facility and to the south of the Proposed GLE Facility (photograph looking south).**

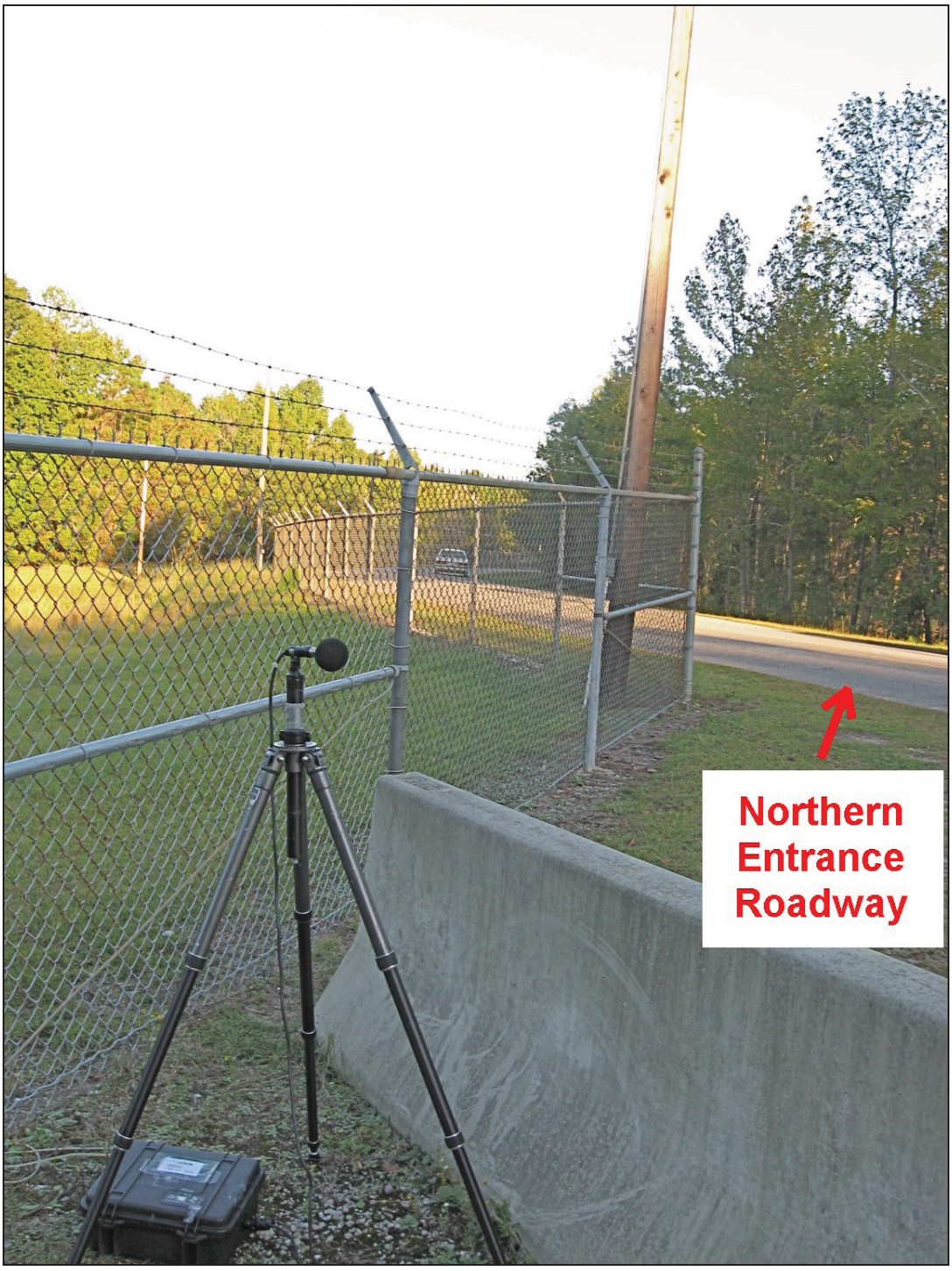
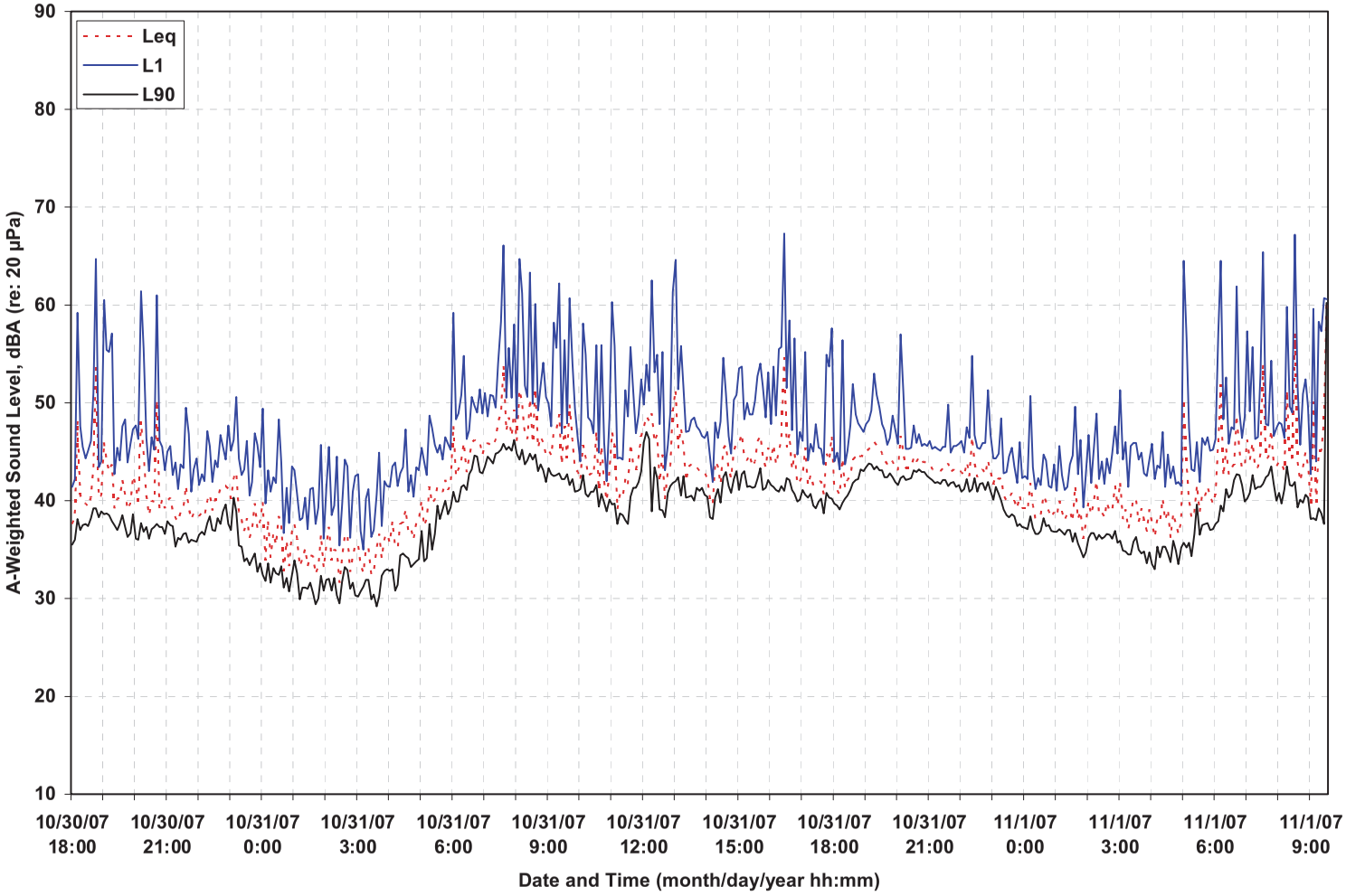


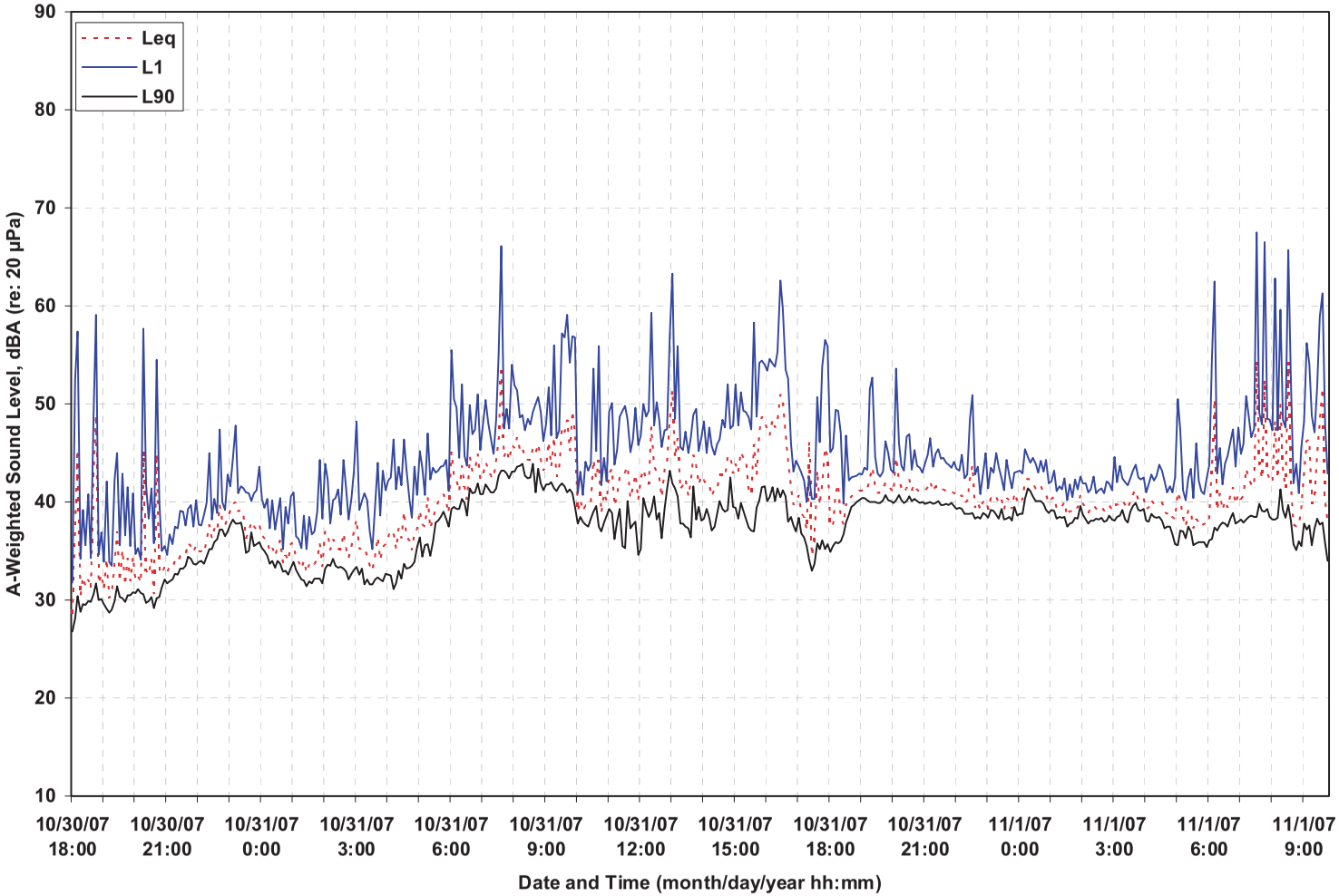

**Figure 3.7-5. Sound monitor at Position D, adjacent to the existing northern entrance roadway on the Wilmington Site (photograph looking east).**




Ambient Sound Survey at the Wilmington Site
Position A – Nearest Residential Property Line
October 30 – November 1, 2007 (5-minute intervals)

$L_{EQ}$ = Energy equivalent sound levels for each 5-minute period.
$L_1$ = Sound measurement exceeded for 1% of time in each 5-minute period.
$L_{90}$ = Sound level exceeded for 90% of time in each 5-minute period (i.e., ambient sound level).

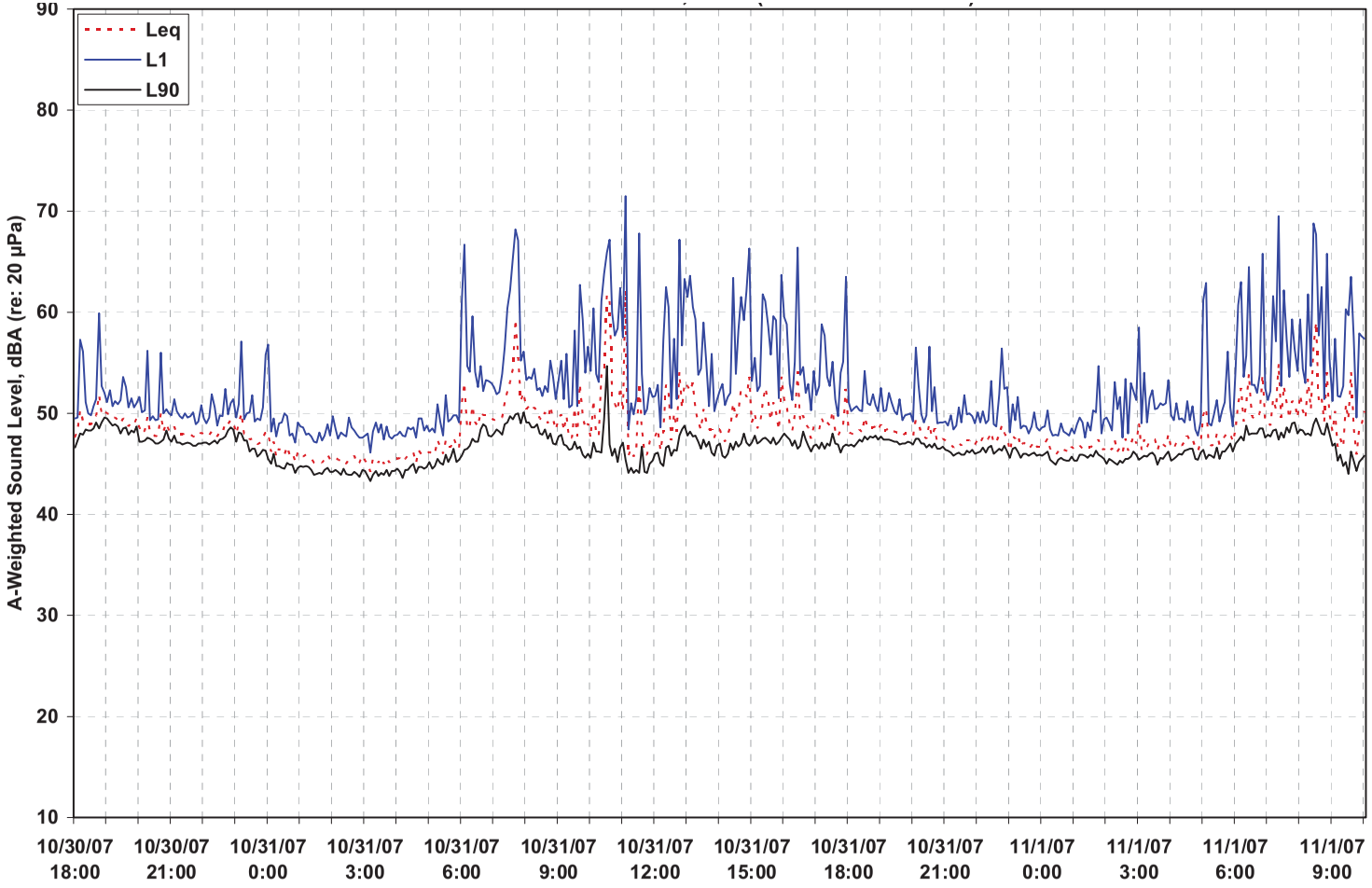
**Figure 3.7-6. Environmental sound-level data from Position A.**




Ambient Sound Survey at the Wilmington Site
Position B – Center of the Future Facility Site (existing tree farm)
October 30 – November 1, 2007 (5-minute intervals)

$L_{EQ}$ = Energy equivalent sound levels for each 5-minute period.
$L_1$ = Sound measurement exceeded for 1% of time in each 5-minute period.
$L_{90}$ = Sound level exceeded for 90% of time in each 5-minute period (i.e., ambient sound level).

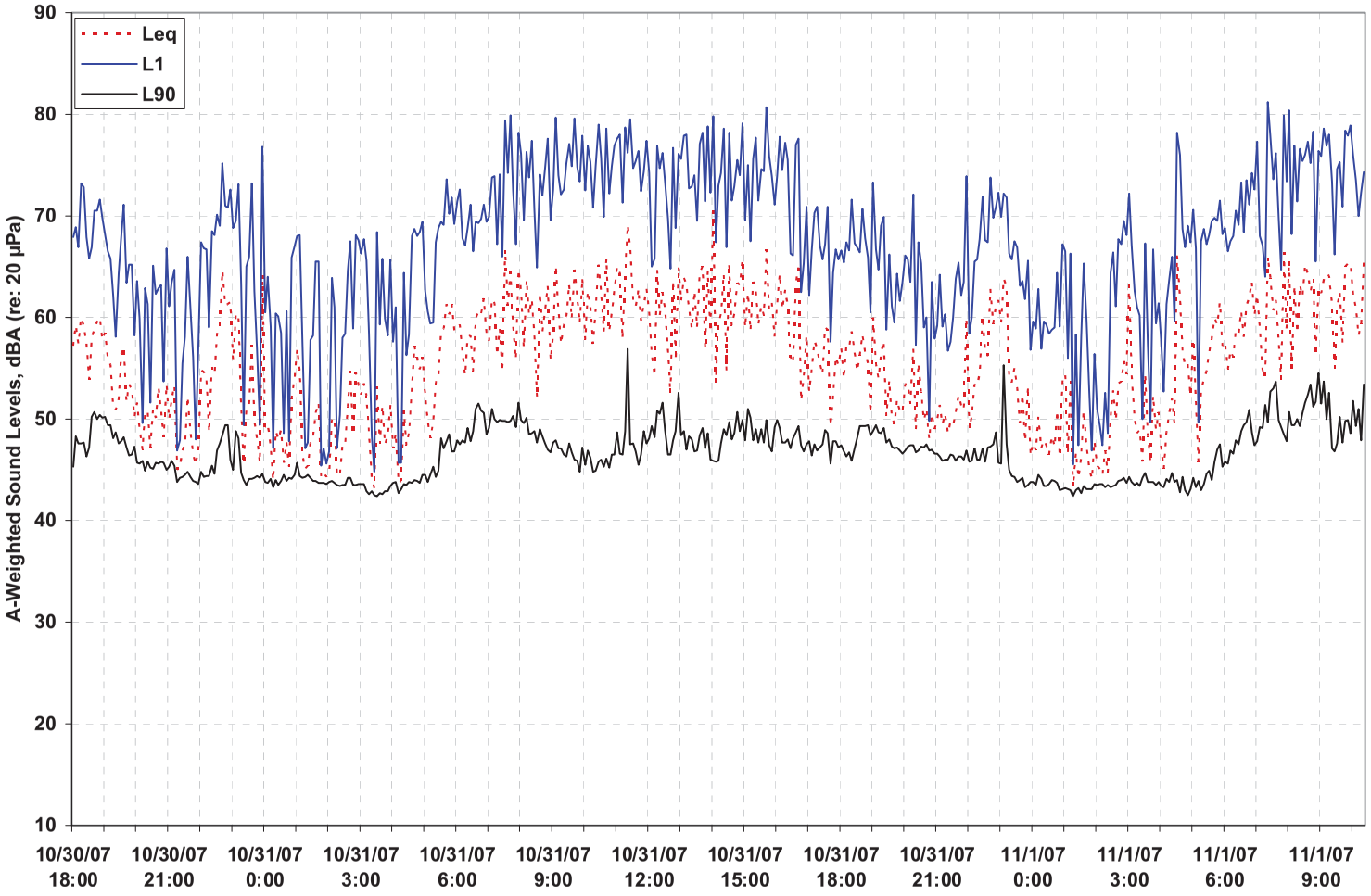
**Figure 3.7-7. Environmental sound-level data from Position B.**




Ambient Sound Survey at the Wilmington Site
Position C – Northern Edge of Existing Plant
October 30 – November 1, 2007 (5-minute intervals)

$L_{EQ}$ = Energy equivalent sound levels for each 5-minute period.
$L_1$ = Sound measurement exceeded for 1% of time in each 5-minute period.
$L_{90}$ = Sound level exceeded for 90% of time in each 5-minute period (i.e., ambient sound level).

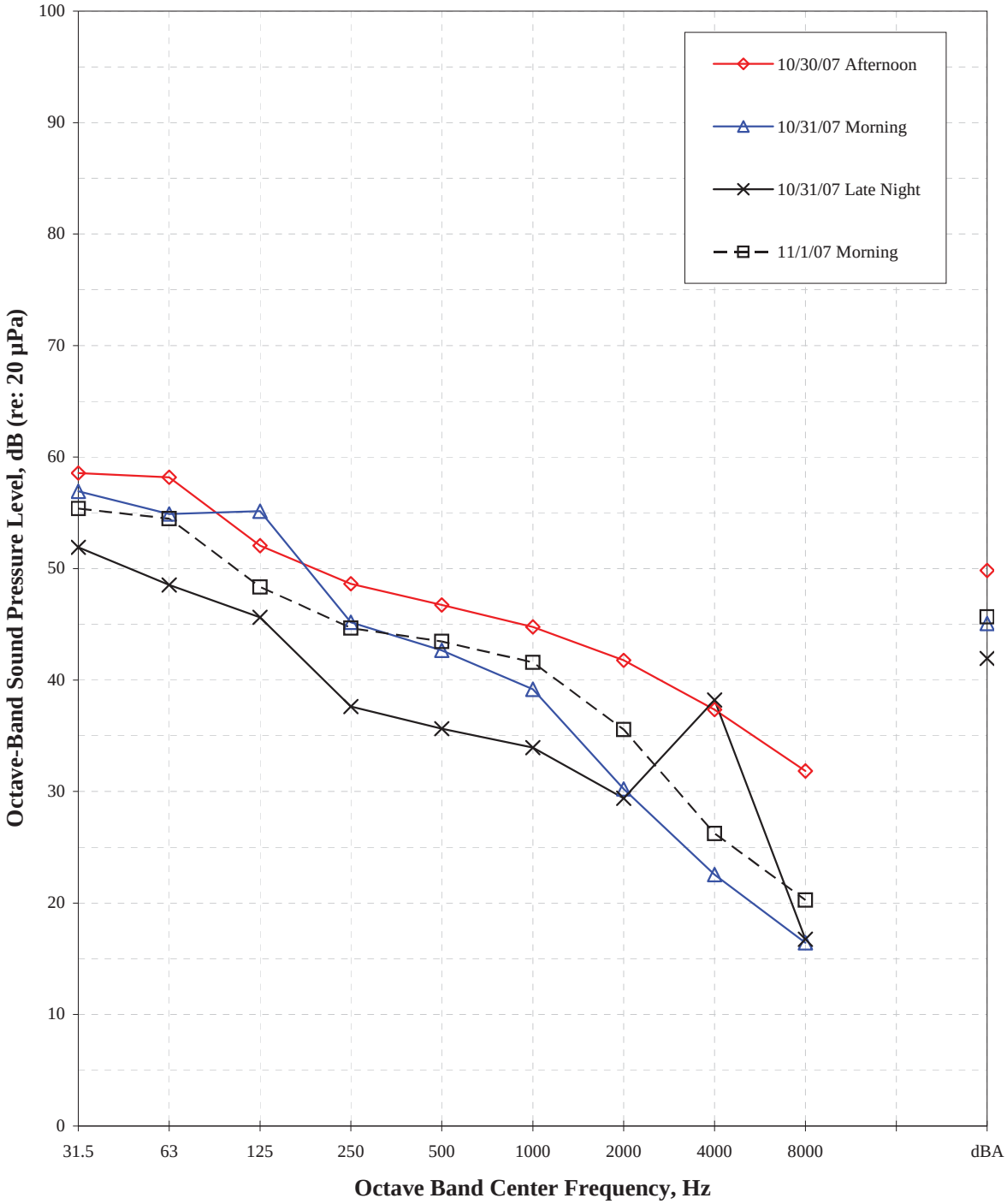
**Figure 3.7-8. Environmental sound-level data from Position C.**




Ambient Sound Survey at the Wilmington Site
Position D – Along Northern Entrance Roadway
October 30 – November 1, 2007 (5-minute intervals)

$L_{EQ}$ = Energy equivalent sound levels for each 5-minute period.
$L_1$ = Sound measurement exceeded for 1% of time in each 5-minute period.
$L_{90}$ = Sound level exceeded for 90% of time in each 5-minute period (i.e., ambient sound level).

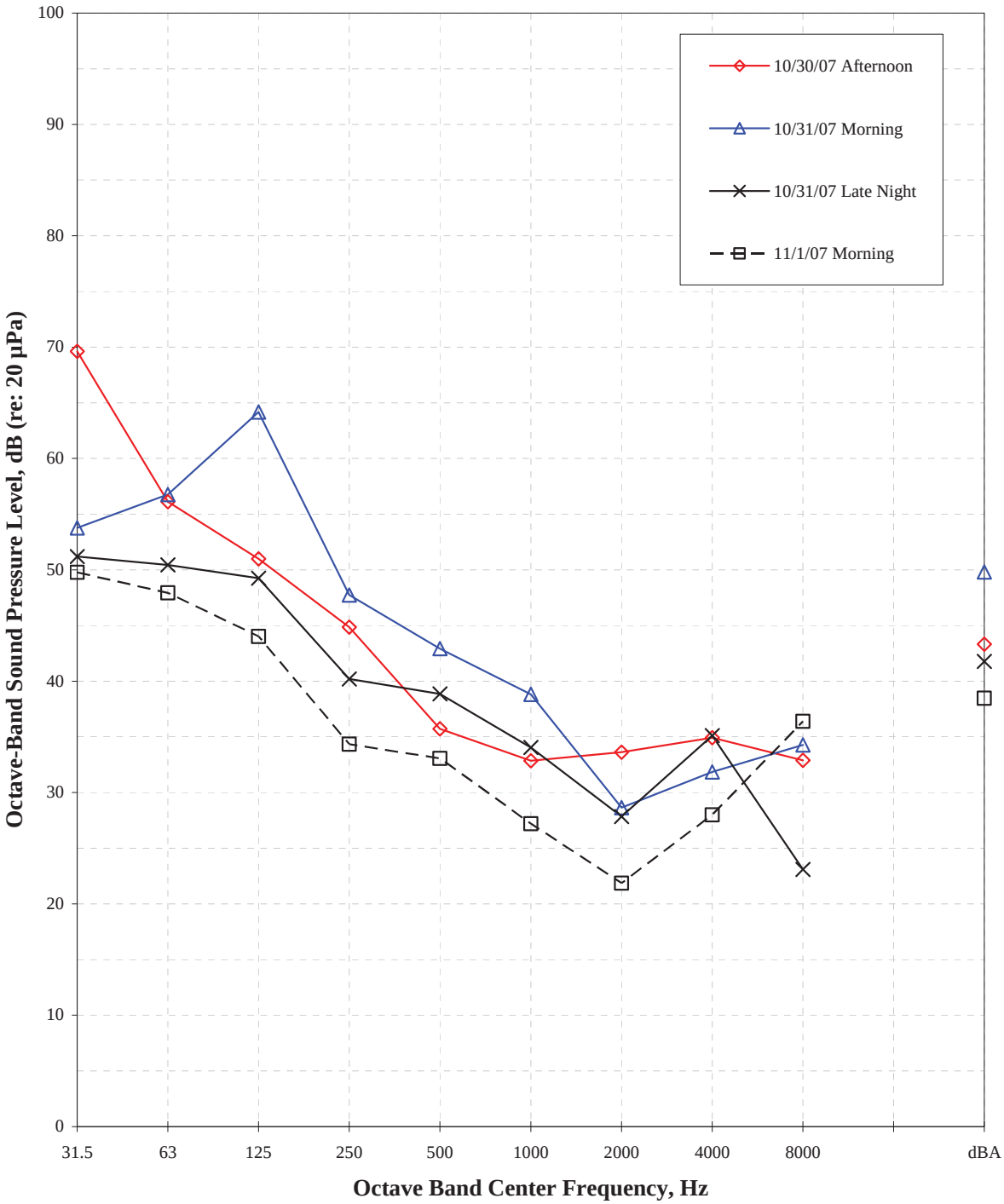
**Figure 3.7-9. Environmental sound-level data from Position D.**




Ambient Sound Survey at the Wilmington Site
Position A – Nearest Residential Property Line
October 30 – November 1, 2007 (5-minute measurements)

The dBA values plotted on the right axis depict the overall dBA that is representative of the measurements made across the octave band at the indicated time shown in the legend.

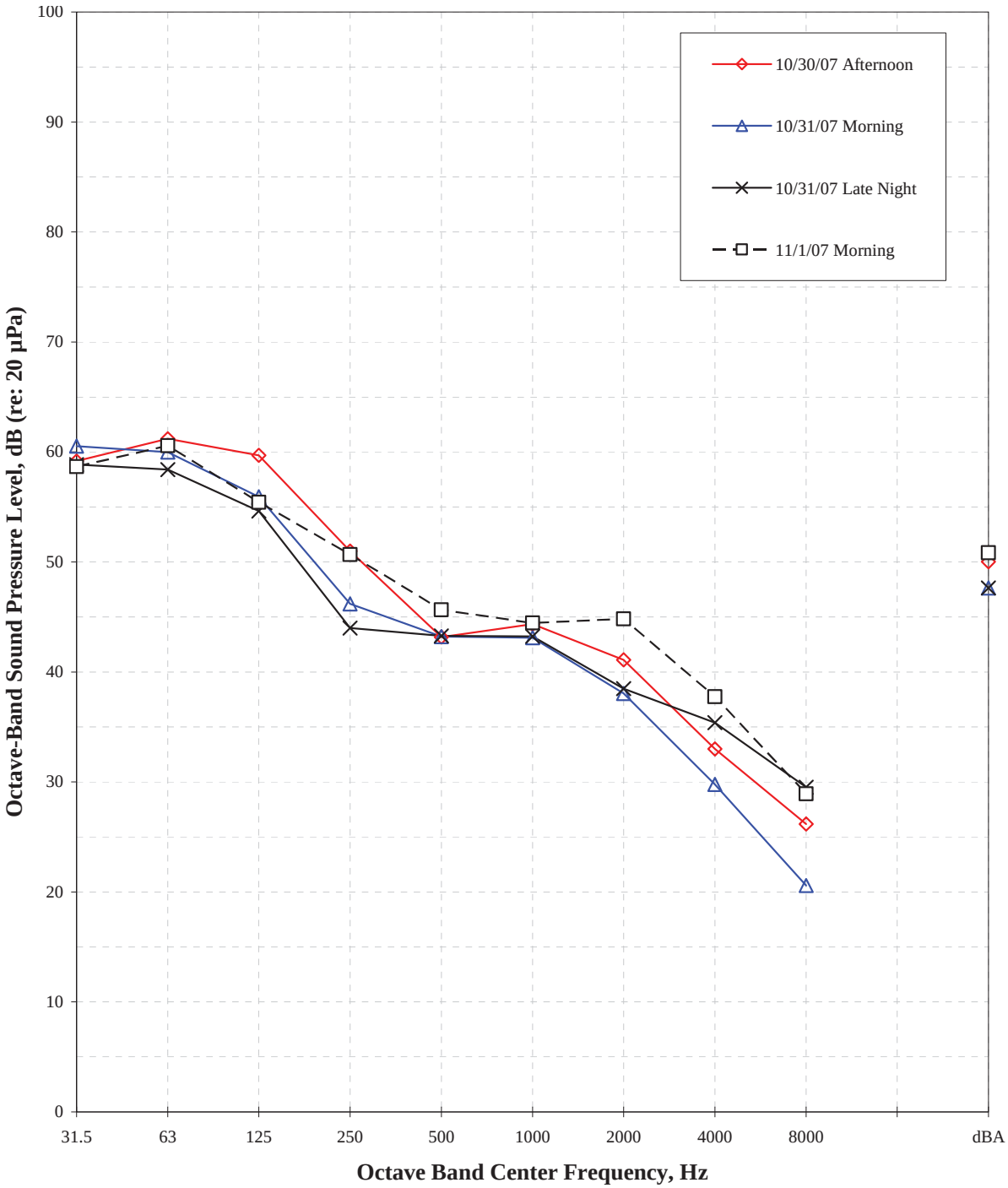
**Figure 3.7-10. Octave-band sound-level data from Position A.**




Ambient Sound Survey at the Wilmington Site
Position B – Center of the Future Facility Site (existing tree farm)
October 30 – November 1, 2007 (5-minute measurements)

The dBA values plotted on the right axis depict the overall dBA that is representative of the measurements made across the octave band at the indicated time shown in the legend.

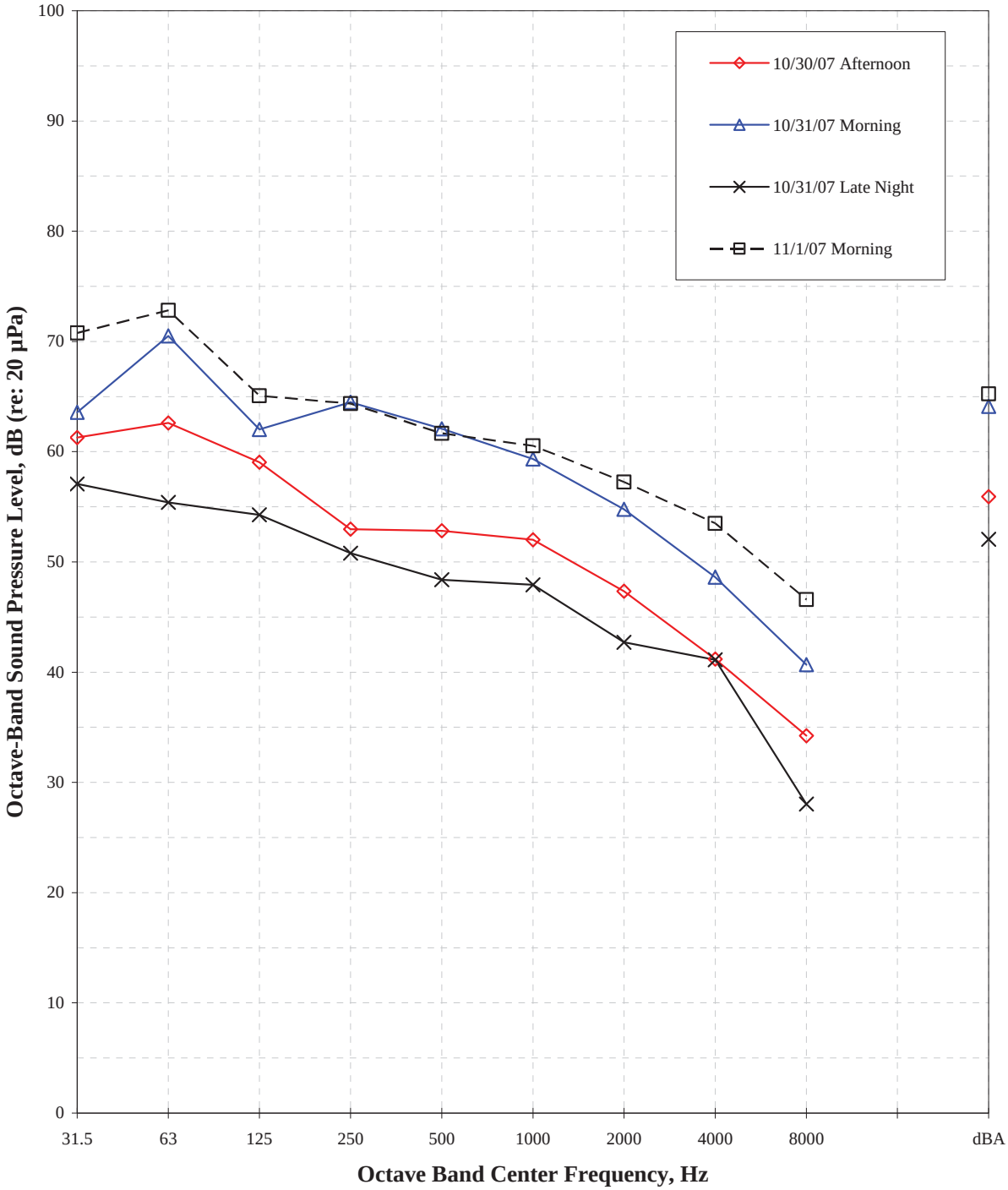
**Figure 3.7-11. Octave-band sound-level data from Position B.**




Ambient Sound Survey at the Wilmington Site
Position C – Northern Edge of Existing Plant
October 30 – November 1, 2007 (5-minute measurements)

The dBA values plotted on the right axis depict the overall dBA that is representative of the measurements made across the octave band at the indicated time shown in the legend.

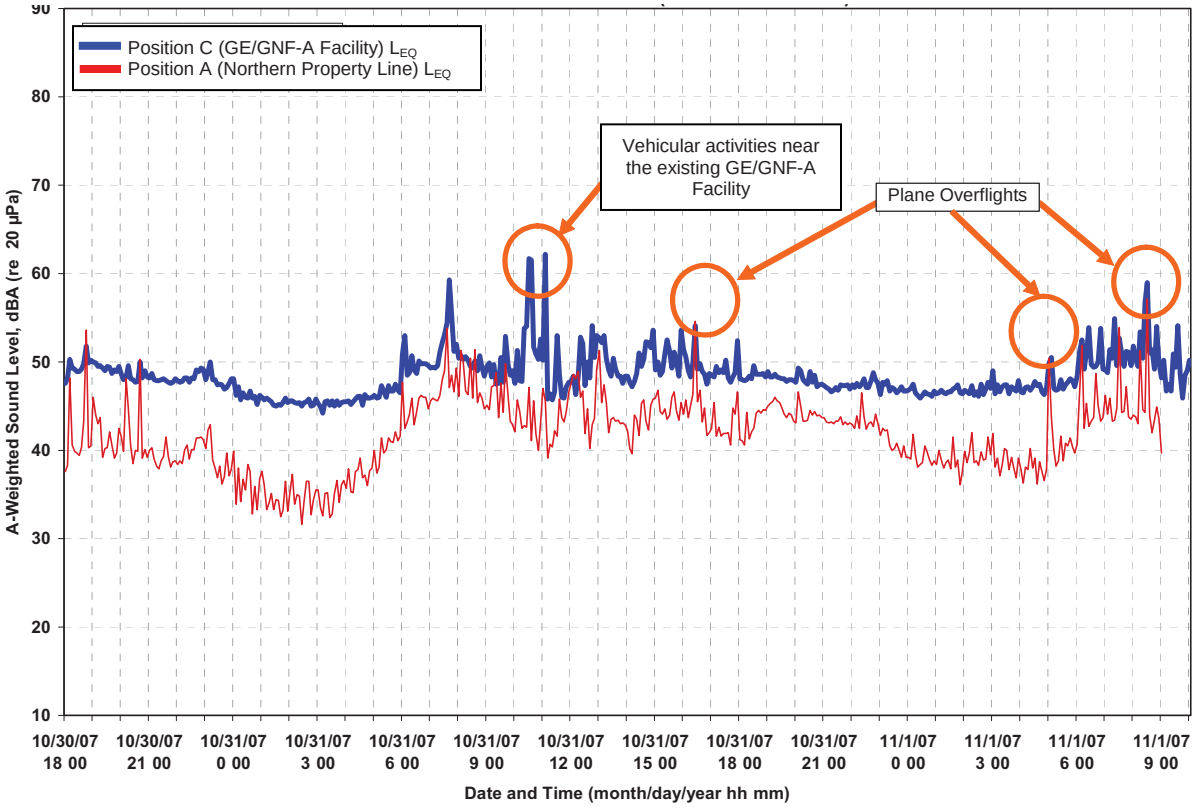
**Figure 3.7-12. Octave-band sound-level data from Position C.**




Ambient Sound Survey at the Wilmington Site
Position D – Along Northern Entrance Roadway
October 30 – November 1, 2007 (5-minute measurements)

The dBA values plotted on the right axis depict the overall dBA that is representative of the measurements made across the octave band at the indicated time shown in the legend.

**Figure 3.7-13. Octave-band sound-level data from Position D.**




Ambient Sound Survey at the Wilmington Site
October 30 – November 1, 2007 (5-minute intervals)

$L_{EQ}$ = Energy equivalent sound levels for each 5-minute period.

**Figure 3.7-14. Sound-level comparison of Positions A and C.**

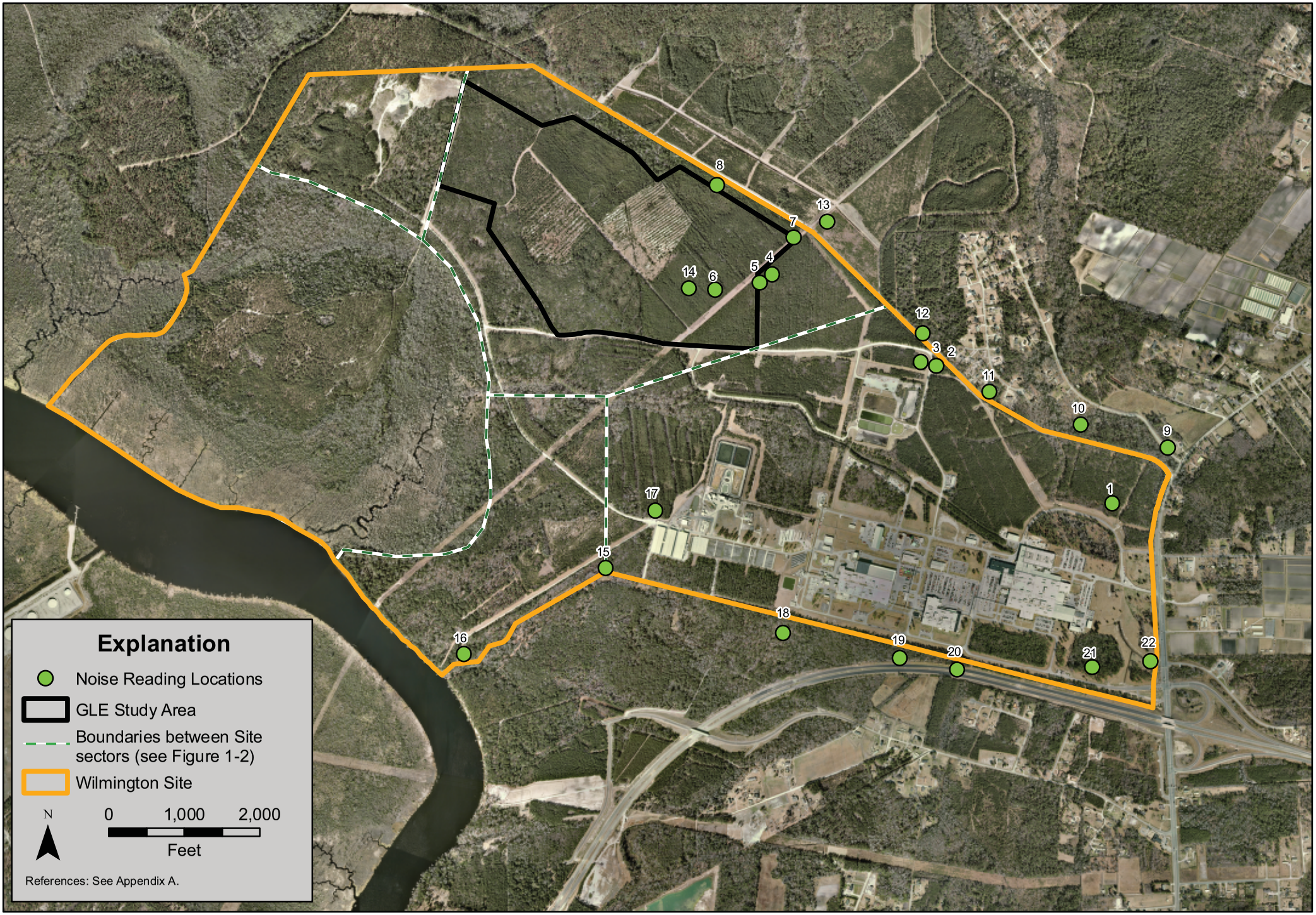



**Figure 3.7-15. Identification of 22 sound monitoring locations for sound assessments conducted in 1989, 1995, and 2002.**

# GLE Environmental Report

# Section 3.8 – Historical and Cultural Resources

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## 3.8 Historic and Cultural Resources

Cultural resources are defined as any prehistoric or historic district, archaeological site, building, structure, or object considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reason. When cultural resources meet any one of the National Register Criteria for Evaluation (36 CFR 60.4, *National Register of Historic Places*), they may be termed historic properties and be eligible for inclusion in the National Register of Historic Places (NRHP).

Initial cultural-resource activities conducted in support of this Environmental Report consisted of the determination of the Area of Potential Effect (APE), also referred to herein as the GLE Study Area; research to identify previously recorded cultural resources; and formal regulatory coordination with the North Carolina State Historic Preservation Office (NC SHPO). The cultural resources considered in these activities are locations or objects that retain evidence of historic or cultural activities that are 50 years of age or older. A significant cultural resource is defined as one that meets the criteria for significance under the NRHP.

The second component of cultural-resource activities conducted for this Report included an intensive survey to assess if there are any unrecorded cultural resources in the GLE Study Area or if there are any previously recorded cultural resources that extend into the GLE Study Area. Documented cultural resources were assessed for significance according to the criteria of the NRHP.

The cultural background of southeastern North Carolina includes human occupation beginning as early as 10,000 BC, although little material evidence remains from the Paleoindian Period (10,000 BC to 8,000 BC). These early people likely maintained a hunting and gathering technology, moving around to exploit different resources and having material possessions that were light and portable (Anderson et al., 1990). During the Archaic Period (8,000 BC to 1,000 BC), ways of life gradually evolved from highly mobile hunting and gathering to more settled regional cultures with habitat-specific adaptations and materials (Smith, 1986). During the Woodland Period (1,000 BC to 1,000 AD), population increased and lifestyles became more settled, with the emergence of small river valley “villages” (Smith, 1986). In addition to hunting, fishing, and gathering, there was an increased commitment to horticulture during this period. Specific pottery styles emerged during the Middle Woodland period and are used to define phases of this period, including the Cape Fear phase. Pottery styles associated with the Cape Fear phase include Hanover, which is grog tempered, and Cape Fear, which is sand tempered; both of these styles may exhibit cord and fabric marking and smoothed surfaces. Settlement during the Cape Fear phase focused on stream and river banks, estuarine shorelines, and the edges of inland swamps and pocosins (Ward and Davis, 1999).

Europeans first began to colonize the area at the mouth of the Cape Fear River in the early 1660s, and as the population increased, towns and homes were established throughout the region. Permanent settlers began living along the banks of the Cape Fear River and its tributaries during the 1720s (Lee, 1971). New Hanover County was created in 1729 and further subdivided into Duplin, Onslow, Bladen, and Brunswick counties during the 1700s. During this time, most residents relied on agriculture for subsistence and income, producing wheat, corn, rice, and indigo, as well as tobacco, which played an important role as a cash crop. The emergence of the cash crop economy led to the development of large plantations throughout the Cape Fear region, including Rose Hill plantation, located on the Wilmington Site approximately 2,300 ft (700 m) south of the South Road portion of the GLE Study Area.

Today, the area surrounding the Wilmington Site lies between the small towns of Castle Hayne (named for another early plantation) and Wrightsboro and is characterized by a mix of agriculture, silviculture, and residential use, with some commercial and industrial uses occurring nearby.

### 3.8.1 Defining the Area of Potential Effects

#### 3.8.1.1 Direct Effects

For this analysis, direct effects are defined as those that could damage or destroy the physical integrity of a significant cultural resource. As it relates to cultural resources, these effects would typically consist of construction activities. The current GLE Study Area covers 265 acres (107 ha), which includes the two access-road corridors, and is considered the APE for direct effects to significant cultural resources.

#### 3.8.1.2 Indirect Effects

An indirect effect is that which would not directly destroy the physical integrity of a significant cultural resource, but would either adversely affect an element or elements that contribute to the significance of the resource or would increase the risk of destruction by outside action. As it relates to cultural resources, this would typically consist of visual intrusions into the viewshed of the resource or increased access to the resource that would contribute to a higher risk of vandalism. Visual intrusions include a change in the physical surroundings of a resource that detract from the overall setting or context. A 3,280-ft (1,000-m) buffer zone around the current GLE Study Area is considered the APE for indirect effects to significant cultural resources.

### 3.8.2 Existing Conditions

Files at the North Carolina Office of State Archaeology (NC OSA) and its Survey and Planning Branch (SPB) were examined to determine if any previously recorded cultural resources are located within the GLE Study Area or in a 3,280-ft (1,000-m) radius of the GLE Study Area (NC OSA, 2007; NC SHPO, 2007).

#### 3.8.2.1 Archaeological Sites

The archaeological site maps at the NC OSA revealed that no previously recorded archaeological sites appear to be located within the GLE Study Area, whereas 22 previously recorded terrestrial archaeological sites are located within a 3,280-ft (1,000-m) radius of the Study Area (**Table 3.8-1**). A submerged archaeological site is located in the Northeast Cape Fear River within a 3,280-ft (1,000-m) radius of the Study Area. None of the previously recorded archaeological sites in **Table 3.8-1** have been assessed for their eligibility for listing in the NRHP.

All of the sites except for archeological site 0031NER (submerged site) appear to have been originally recorded in 1977 and 1978 during the New Hanover County Comprehensive Employment Training Act Survey (Wilde-Ramsing, 1978). Archaeological site 0031NER was originally recorded in 1987 and was revisited in 1988 and 1997 (Wilde-Ramsing, 1987, 1988; Wilde-Ramsing et al., 1992). Archaeological site forms could not be located at the NC OSA for 31NH418, 31NH455, 31NH463, 31NH467, 31NH488, and 31NH492. An area adjacent to the northern Wilmington Site boundary within a 3,280-ft (1,000-m) radius of the GLE Study Area was surveyed in 1994 for the then-proposed Wilmington Bypass (Klein et al., 1994). The survey relocated archaeological sites 31NH460/31NH474, 31NH467, 31NH472, and 31NH483/486, but did not assess them for NRHP eligibility.

**Figure 3.8-1** shows the location of all known archaeological sites within 1,640 ft (500 m) of the GLE Study Area boundary for which location information exists, plus two new sites located during the APE survey (see below for details). Although archaeological site 31NH529**[1] is greater than 1,640 ft (500 m) from the GLE Study Area boundary, it is nevertheless plotted because it is situated on the Wilmington Site. Based on OSA records, **Figure 3.8-1** shows the location of archaeological site 31NH404 fairly close

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

to the boundary of the South Road portion of the GLE Study Area. Although the plotted location of archaeological site 31NH404 was not field verified, the South Road portion of the GLE Study Area was intensively surveyed, and no cultural materials were found. Therefore, it is verified that archaeological site 31NH404 is not located within the GLE Study Area.

#### 3.8.2.2 Historic-Age Structures

The structure files at the SPB revealed one previously recorded historic-age structure within a 3,280-ft (1,000-m) radius of the GLE Study Area (**Table 3.8-2**). Structure NH556 is located along NC 133 (Castle Hayne Road) adjacent to the southeast corner of the Wilmington Site, approximately 3,200 ft (975 m) south of the junction of NC 133 (Castle Hayne Road) and the proposed access road. This structure's condition and NRHP eligibility status are unknown. No formally recorded structures dating prior to 1957 are within the boundaries of the GLE Study Area or on the Wilmington Site.

### 3.8.3 Regulatory Coordination

A formal coordination letter to the NC SHPO was submitted, dated October 1, 2007 (see **Appendix B**, *Regulatory Correspondence*). The purpose of this letter is to inform the NC SHPO of the Proposed GLE Facility and to ask for regulatory comment on the project pursuant to Section 106 of the National Historic Preservation Act. The NC SHPO was also informed that the Proposed GLE Facility is subject to the NEPA. A response from the NC SHPO was received in a letter dated November 19, 2007 (also in **Appendix B**). In this letter, the NC SHPO recommended a comprehensive archaeological survey to identify and evaluate the significance of archaeological remains that may be damaged or destroyed by the Proposed Action (the report on this survey is found in **Appendix O**, *Findings of Cultural Resources Investigation at the Wilmington Site*).

### 3.8.4 Survey of the Proposed Site

After reviewing existing information about cultural resources on and in the vicinity of the GLE Study Area, a thorough survey of the Study Area was conducted by qualified professionals[2] (see **Chapter 10** of this Report, *List of Preparers*) to further characterize it and to locate any as-yet-unidentified cultural resources within the Study Area.

#### 3.8.4.1 Methods

Background research was conducted at a variety of institutions, including the NC OSA and NC SPB. Field-survey methods employed during the investigation consisted of pedestrian inspection and shovel testing. Pedestrian inspection focused on areas with good surface visibility, including eroded uplands, dirt roads, and stream-cut banks. Vegetated areas were also inspected in an attempt to locate architectural features and abandoned cemeteries. Shovel tests were typically excavated at 98-ft (30-m) intervals for archaeological site discovery and, when archaeological sites were encountered, 49-ft (15-m) intervals for more detailed archaeological site boundary and intrasite investigation. No shovel tests were excavated in wetlands or on slopes greater than 15%. During the course of field investigations, a total of 305 shovel tests were excavated in the project area.

Significance testing of archeological site 31NH801 (a new site identified during the survey, see below) consisted of mapping the topographic structure of the site excavating three 3.3-by-3.3 ft (1-by-1 m)

[2] Field investigations occurred in October and November 2007 and were conducted by Ms. Terri Russ and Mr. Matt Postlewaite. Ms. Russ served as Field Director. She is a Registered Professional Archaeologist with a master's degree in Anthropology and has over 13 years of experience. Mr. Postlewaite served as Crew. He is currently in a master's degree program for Anthropology, with an anticipated graduation in 2008. He has more than 4 years of experience. Mr. Scott Seibel served as Principal Investigator. Mr. Seibel is a Registered Professional Archaeologist with a master's degree in Archaeomaterials and has more than 12 years of experience.

excavation units in 4-inch (10-cm) arbitrary levels within natural stratigraphic zones. Excavated soil from the shovel tests and excavation units was screened through 0.25-inch (0.64-cm) wire mesh, and artifacts were collected and placed in bags with specific provenience information.

Field notes, forms, maps, and recovered artifacts were transported to an archaeological laboratory in Raleigh, NC. During fieldwork, a catalog system was employed to ensure that provenience data was recorded for each recovered artifact. In the laboratory, the artifacts were brushed clean of soil and debris, washed, and allowed to air dry. No artifact required stabilization or conservation. Cultural materials were quantified, analyzed, and rebagged according to site number and provenience. Artifacts were analyzed according to accepted archaeological standards.

#### 3.8.4.2 Findings

The detailed survey of the Wilmington Site documented two new archaeological sites, 31NH800** and 31NH801, shown in **Figure 3.8-1**. Archaeological site 31NH800** (**Figure 3.8-2**) is a historic-age site dating from the late eighteenth century to the early twentieth century. It consists of a subsurface scatter of artifacts, including pearlware and earthenware ceramic sherds, fragments of olive and aqua glass, brick, one nail, and one metal fragment. Artifacts were mainly recovered from the disturbed upper soil zone. The archeological site, which covers about 1,476 $ft^2$ (137 $m^2$), likely represents the remains of a domestic house or farmstead. The Proposed Action will not impact this archeological site.

Archaeological site 31NH801 (**Figure 3.8-3**) is a prehistoric archaeological site dating to the Middle Woodland period on the edge of a bluff overlooking the floodplains of the Northeast Cape Fear River. Ten positive shovel tests yielded 52 prehistoric artifacts. Three 3.3-by-3.3 ft (1-by-1 m) excavation units yielded an additional 95 artifacts. Two possible cultural features, a pit and a posthole, were revealed in one of the excavation units. Prehistoric artifacts were concentrated along the western side of the site, near an existing gravel road. Artifacts were found in the upper three soil zones, but were concentrated in the second soil zone. The artifacts recovered from the site include ceramic sherds with both cord and fabric surface impressions, lithic tools (one projectile point and two modified flakes), lithic debitage, and animal bone fragments; charcoal was also recovered from both the excavation units and the features. The prehistoric ceramic sherds belong to the Cape Fear and New Hanover series, which date to the Middle Woodland period (ca. 300 BC to 1,000 AD). Archaeological site 31NH801 is adjacent to an existing gravel road, which will serve as an access road between the Proposed GLE Facility and the existing GNF-A Facility. As currently planned, this road will remain at its current width to avoid an impact to site 31NH801 because any expansion of this road to the east-northeast would partially destroy this prehistoric archaeological site.

### 3.8.5 Detailed Significance Assessment

#### 3.8.5.1 Methods

Both archaeological sites 31NH800** and 31NH801 were assessed for significance according to the criteria established in 36 CFR 60 (*National Register*) and 36 CFR 800 (*Protection of Historic Properties*). The evaluation of a prehistoric or historic archaeological site for inclusion on the NRHP rests largely on its research potential, that is, its ability to contribute important information through preservation and/or additional study (Criterion D).

The NRHP criteria for evaluation are stated as follows:

> "The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and;

> Criterion A: Properties associated with events that have made a significant contribution to broad patterns of our history;
>
> Criterion B: Properties associated with the lives of persons significant in our past;
>
> Criterion C: Properties that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; and
>
> Criterion D: Properties that have yielded, or may be likely to yield, important information in prehistory or history" (NRHP, 2008).

Although many archaeological sites are recommended as eligible to the NRHP under Criterion D, this criterion is not fully defined relative to the assessment for significance. In order to clarify the issue of site importance, the following attribute evaluations may be used to add a measure of specificity in assessing site significance and NRHP eligibility:

- **Site Integrity.** Does the site contain intact cultural deposits or is it disturbed?
- **Preservation.** Does the site contain material suited to in-depth analysis and/or absolute dating, such as preserved features, botanical and/or faunal remains, or human skeletal remains?
- **Uniqueness.** Is the information contained in the site redundant in comparison to that available from similar sites, or do the remains provide a unique or insightful perspective on research concerns of regional importance?
- **Relevance to Current and Future Research.** Would additional work at this site contribute to our knowledge of the past? Would preservation of the site protect valuable information for future studies? Although this category is partly a summary of the above considerations, it also recognizes that a site may provide valuable information regardless of its integrity, preservation, or uniqueness.

#### 3.8.5.2 Findings

Based on the lack of structural remains, the relatively low density of artifacts recovered, and the apparently disturbed context of the artifacts, archaeological site 31NH800** does not meet NRHP criteria for significance. The site lacks integrity and preservation, and because it does not have the potential to yield significant new information pertaining to the history of the area, this site is not considered eligible for listing in the NRHP.

Archaeological site 31NH801, on the other hand, was found to meet NRHP criteria for significance under Criterion D because it has the potential to yield important information pertaining to prehistory. The site meets the significance attributes for archaeological sites as follows:

- **Site Integrity.** The site contains intact cultural deposits, as evidenced by the concentration of prehistoric artifacts in the second soil stratigraphic zone and the presence of two subsurface cultural features.
- **Preservation.** The site is preserved, based on the presence of animal bone and charcoal and subsurface cultural features that would allow for in-depth analysis and absolute dating.
- **Uniqueness.** The site is considered appropriately unique because Middle Woodland period sites containing preserved animal bone are rare in the southern Coastal Plain of North Carolina.

- **Relevance.** The site does have relevance to current and future research because it dates to a single cultural period (Middle Woodland) and contains materials that would allow for both in-depth analysis and absolute dating.

# Tables

**Table 3.8-1. Previously Recorded Archaeological Sites Near[a] the GLE Study Area**

| Site No. | Distance to GLE Study Area Boundary (m)[b] | Component(s) | Condition | National Register Eligibility |
|---|---|---|---|---|
| 31NH404 | <500 | Woodland | Disturbed | Unassessed |
| 31NH405 | <500 | Woodland | Disturbed | Unassessed |
| 31NH406 | <500 | Woodland; Historic | Unknown | Unassessed |
| 31NH407 | <500 | Woodland | Disturbed | Unassessed |
| 31NH408 | 500 to 1,000 | Woodland | Unknown | Unassessed |
| 31NH418 | 500 to 1,000 | Woodland | Unknown | Unknown |
| 31NH454 | <500 | Lithic Prehistoric | Unknown | Unassessed |
| 31NH455 | <500 | Woodland | Unknown | Unknown |
| 31NH460/474 | <500 | Middle-Late Archaic, Middle Woodland | Undisturbed? | Unassessed |
| 31NH463 | 500 to 1,000 | Woodland | Unknown | Unknown |
| 31NH465 | <500 | Late Archaic, Early-Middle Woodland | Undisturbed | Unassessed |
| 31NH467 | 500 to 1,000 | Unknown | Unknown | Unknown |
| 31NH468 | <500 | Woodland | Unknown | Unassessed |
| 31NH471 | 500 to 1,000 | Woodland | Unknown | Unassessed |
| 31NH472 | <500 | Woodland | Unknown | Unassessed |
| 31NH476 | 500 to 1,000 | Woodland | Unknown | Unassessed |
| 31NH478 | 500 to 1,000 | Woodland | Unknown | Unassessed |
| 31NH483/486 | 500 to 1,000 | Woodland | Unknown | Unknown |
| 31NH488 | 500 to 1,000 | Unknown | Unknown | Unknown |
| 31NH492 | 500 to 1,000 | Unknown | Unknown | Unknown |
| 31NH529** [c] | 500 to 1,000 | 19th Century | Unknown | Unassessed |
| 31NH554 | 500 to 1,000 | Woodland | Unknown | Unassessed |
| 0031NER | 500 to 1,000 | Colonial Historic | Submerged | Unassessed |

[a] Within 3,280 feet (1,000 meters) of the GLE Study Area.

[b] **Figure 3.8-1** is a map showing the Wilmington Site and locations of previously recorded archaeological sites within 1190 ft (500 m) of the GLE Study Area Boundary. Although archaeological site 31NH529** is greater than 1190 ft (500 m) from the boundary, it is plotted because it is situated on the Wilmington Site. **Figure 3.8-1** also shows the location of two newly identified archaeological sites within the GLE Study Area, archeological site 31NH800** and archeological site 31NH801 (see **Section 3.8.4.2**).

[c] ** is a standard identifier used by the SHPO to designate historic archaeological sites in North Carolina.

**Table 3.8-2. Previously Recorded Historic-Age Structures Near[a] the GLE Study Area**

| Site No. | Distance to GLE Study Area Boundary (m) | Component(s) | Condition | National Register Eligibility |
|---|---|---|---|---|
| NH556 | 500 to 1,000 | Unknown | Unknown | Unassessed |

[a] Within 3,280 feet (1,000 meters) of the GLE Study Area.

# Figures

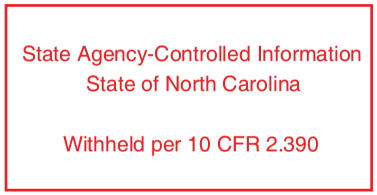


**Figure 3.8-1. Locations of known archeological sites within 1,640 ft (500 m) of the GLE Study Area boundary and newly identified archaeological sites within the GLE Study Area.**

**Figure 3.8-2. Photograph of archaeological site 31NH800**.**

**Figure 3.8-3. Photograph of archaeological site 31NH801.**

# GLE Environmental Report

# Section 3.9 – Visual/Scenic Resources

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## 3.9 Visual/Scenic Resources

This section describes the visual and scenic characteristics of the Wilmington Site and its vicinity. In addition to using the references cited at the end of this section, the basis for information and conclusions presented include interpretation of applicable maps/spatial data, as well as observations made during a visit to the Wilmington Site in July 2007.

### 3.9.1 Viewshed Boundaries

Viewshed boundaries were estimated for the Wilmington Site based on relative elevation differences between one or more designated observation points and grid cells that cover the landscape. The term "viewshed" refers to areas on the ground that are visible from a given vantage point. The spatial resolution of the topographic data is a key consideration for viewshed calculations because there is an inherent tradeoff between the size of the geographic area examined and the level of detail of the elevation data used. This estimate uses the highest-resolution topographic data available (2-ft [0.6 m] contours). Using this contour interval limits the size of the geographic area for which the calculations can be made to a 2-mile (3.2 km) radius around the Wilmington Site. Light Detection and Ranging (LiDAR) elevation data from the North Carolina Department of Emergency Management's (NC DEM's) North Carolina Flood Mapping Program (NC DEM, 2007) and geographic information systems (GIS) software were used to determine which areas of the surrounding landscape were visible from the Wilmington Site based solely on topographic elevations. The presence of the structures and vegetation in this area may alter the viewshed boundaries (visible areas) shown in **Figure 3.9-1**; however, the shown boundaries are consistent with the DOI's Bureau of Land Management (BLM) scenic-quality rating assessment described in **Section 3.9.10**.

### 3.9.2 Wilmington Site Photographs

The Wilmington Site is very large in area (1,624 acres [657 ha]). Extensive acreage within the Site is heavily forested, placing limitations on visibility distances. An aerial photograph of the Wilmington Site is shown in **Figure 1-2** in **Chapter 1** of this Report (*Introduction*). The developed Eastern Site Sector contains several large, multi-story buildings and other structures to support the existing Wilmington Site facilities. The existing main AE manufacturing building, water tower, security gates, and other buildings on the Site are visible from NC 133 (Castle Hayne Road), as well as from I-140 near its interchange with NC 133 (Castle Hayne Road). The 130-ft (39.6-m) water tower is currently the tallest structure on the Wilmington Site. **Figures 3.9-2 through 3.9-8** present views of the Wilmington Site photographed from different locations.

### 3.9.3 Residents and Visitors Potentially Affected by Aesthetics Impacts

#### 3.9.3.1 Affected Residents

Residents most likely to be potentially affected by aesthetics impacts live in the residential communities in the immediate vicinity of the Wilmington Site that are located predominantly to the north and south (see **Figure 3.9-9**). The nearest residents to the Wilmington Site live in the Wooden Shoe subdivision, which is located adjacent to the northern boundary to the Eastern Site Sector and accessed from NC 133 (Castle Hayne Road) by McDougald Drive. The water tower on the Wilmington Site is not visible from homes in this subdivision due to a buffer of trees between the homes and the water tower. Evergreen trees (pines) are dominant within the 209-acre (85-ha) Main portion of the GLE Study Area and mitigate visual impacts to surrounding areas through all seasons. This neighborhood is characterized by large homes on relatively small lots and is heavily forested. Further north along NC 133 (Castle Hayne Road) is Marathon Avenue, and another residential area off of this street to the west is located along Indian Corn Trail and Tall Oaks Drive (located directly north of the Wooden Shoe subdivision). Although many of these

residences are approximately 1 mile (1.6 km) from the Wilmington Site, the existing on-site water tower is not visible from these residences due to the visual buffer created by the many trees on and around the Site. Homes in this neighborhood are large, with several horse pastures in the area, and the lots are considerably larger than those along Dekker Road (i.e., Wooden Shoe subdivision).

More residential neighborhoods are in the Wilmington Site vicinity south of I-140 and accessed from NC 133 (Castle Hayne Road) by Chair Road. The water tower on the Wilmington Site and the stacks for the coal-fired boilers at Progress Energy's L.V. Sutton Steam Electric Plant are visible along the streets in these neighborhoods. Another residential neighborhood on Rock Hill Road is located further south off of NC 133 (Castle Hayne Road). The Wilmington Site's water tower is not visible from the street in this neighborhood. Visual impacts under current conditions on residents in the vicinity of the Wilmington Site are judged to be small.

#### 3.9.3.2 Affected Visitors

Wilmington and nearby barrier island beach communities are popular tourist destinations. In New Hanover County, key attractions include the *USS North Carolina* Battleship Memorial, Fort Fisher North Carolina Historical Site, EUE Screen Gems Studios, Ltd. (film industry), Bellamy Mansion Museum of History and Design Arts (downtown Wilmington), North Carolina Aquarium at Fort Fisher, Cape Fear Museum of History and Science, and the beaches of Wrightsville Beach, Carolina Beach, Wilmington, Beach, and Kure Beach. Brunswick County attractions include its many beach communities, Fort Caswell, and the Oak Island Lighthouse. Moores Creek National Battlefield and Topsail Island rank among the top tourist sites in Pender County. Distances from the Wilmington Site to major visitor destinations within the three-county Wilmington MSA are presented in **Table 3.9-1**. For the purposes of calculating these distances, the centroid of associated parcels or 2000 Decennial Census boundaries were used, with the exception of downtown Wilmington, where the intersection of Front and Market streets was used as the destination point. Visual impacts under current conditions on visitors and tourists in the Wilmington MSA are judged to be small.

### 3.9.4 Landscape Characteristics

The Wilmington Site is in the Coastal Plain physiographic province. The Site borders the Northeast Cape Fear River on its western edge. Detailed descriptions of the landscape characteristics for the Wilmington Site and its vicinity, as related to specific features, are presented in other sections of this chapter, as listed below.

- Open spaces and uncultivated land – **Section 3.1.3**, *Special Land Use Classifications*
- Recreational areas (parks and wilderness areas) – **Section 3.1.3**, *Special Land Use Classifications*
- Aesthetic features (historical, archaeological, cultural, and natural) that attract tourists – **Section 3.1.3**, *Special Land Use Classifications*
- Soils – **Section 3.3.4**, *Soils*
- Waterbodies (waterways and oceans) – **Section 3.4.2**, *Surface Waters*
- Ecological environment (flora, fauna, and ecosystems) – **Section 3.5**, *Ecological Resources*

The NCNHP is a part of NCDENR's Office of Conservation and Community Affairs (NCDENR, 2007a). The program inventories, catalogues, and supports conservation of the rarest and most outstanding elements of the natural diversity of the state. Natural heritage elements are defined by the NCNHP as actual locations of rare and endangered species, occurrences of exemplary or unique natural ecosystems (terrestrial or aquatic), and special animal habitats. These elements are identified in the Natural Heritage Element Occurrence (NHEO) dataset (NCDENR, 2007b). A second dataset maintained for the NCNHP,

the Significant Natural Heritage Area (SNHA) dataset, complements the NHEO data (NCDENR, 2007c). Instead of specific locations, the SNHA data identify larger areas that have particular biodiversity significance.

**Figure 3.9-10** shows the NHEOs and SNHAs identified by the NCNHP and located within a 5-mile (8-km) radius of the Wilmington Site. The Western Site Sector contains both an NHEO and an SNHA. The on-site NHEO (western corner) is the plant commonly known as spoonflower or white arrow arum (*Peltandra sagittifolia*). The NHEO on an adjacent parcel to the east of the North-Central Site Sector is the plant known as pondspice (*Litsea aestivalis*). The on-site SNHA is the Northeast Cape Fear River floodplain.

### 3.9.5 Location of Constructed Features

The 130-ft (39.6-m) water tower that serves the existing Wilmington Site facilities is the tallest structure on the Wilmington Site and is visible from I-140. Although some buildings and other structures associated with the existing Wilmington Site facilities are partially visible from NC 133 (Castle Hayne Road), no other structures can be seen from I-140 or the surrounding neighborhoods. The Wilmington Site is bisected by an electrical transmission power line corridor owned by Progress Energy. Aboveground utility power lines used to supply electrical power for on-site operations are visible along the unpaved roads that transect the Wilmington Site (see **Figure 3.9-6**).

A large number of wells are dispersed across the Wilmington Site parcel, with a few additional wells located off-site on adjacent parcels. Some of these wells have small, shed-like structures nearby. Aboveground power lines along the unpaved roads supply electricity to operate the well pumps on the Site. There is also a boat dock from the Wilmington Site located on the Northeast Cape Fear River.

### 3.9.6 Visibility from Access Roads

The primary public roads used by automobiles and trucks traveling to and from the Wilmington Site are I-140 and NC 133 (Castle Hayne Road) (see **Section 3.2**, *Transportation*). Approaching the Wilmington Site from the east along I-140, the on-site water tower and major buildings can be seen from motor vehicles traveling on the segment of the roadway in the vicinity of the NC 133 (Castle Hayne Road) interchange. Continuing past the Site on I-140, the L.V. Sutton Steam Electric Plant stacks, Port of Wilmington dock facilities, and other industrial manufacturing facilities are visible from motor vehicles crossing the Dan Cameron Bridge.

There is a private, unpaved road leading from NC 133 (Castle Hayne Road) to the undeveloped Sledge Tract land parcel located immediately north of the North-Central and Northwestern site sectors (see **Figure 3.9-1**). The Sledge Tract is the largest undeveloped parcel of land in New Hanover County and is currently used for hunting and timber-management purposes. There is no public access to this road because entry is restricted by locked gates.

### 3.9.7 High-Quality View Areas

The Wilmington Site and neighboring areas are heavily forested; therefore, visibility distances are limited. There are no scenic features or vistas on the Wilmington Site that are considered to be regionally or locally important or of high scenic quality. Both the vegetation and topography of the Wilmington Site are typical of other land parcels in northwest New Hanover County.

### 3.9.8 Regulatory Information

Inspection of the current New Hanover County zoning map shows that approximately 31% of the total acreage within a 5-mile (8-km) radius of the Wilmington Site within New Hanover County is zoned for

residential use (New Hanover County Information Technology Department, 2005a). **Table 3.9-2** provides a detailed overview of the New Hanover County zoning designations for the area by acreage and the number of parcels. The Wilmington Site is currently zoned I-2 (Heavy Industrial), which is the least-restrictive designation possible under the New Hanover County Zoning Ordinance.

A small proportion of the land within a 5-mile (8-km) radius of the Wilmington Site is also located within the jurisdiction of Pender County. Inspection of the current Pender County zoning map shows that approximately half of this land area is designated as a flood hazard district, within which development is discouraged (Pender County Information Technology Services, 2005). **Table 3.9-3** provides a detailed overview of the Pender County zoning designations by acreage and the number of parcels for the area.

Three parcels within Brunswick County are partially located within the 5-mile (8-km) radius of the Wilmington Site, as listed in **Table 3.9-4** (Brunswick County GIS Department, 2008). The parcels have a combined total area of approximately 3,400 acres (1,376 ha) and are situated along the southern banks of Northeast Cape Fear River. Two of these parcels fall within the Town of Navassa's jurisdiction. These parcels are zoned as RU for Rural uses (1,064 acres [430 ha]) and HM for Heavy Manufacturing uses (849 acres [345 ha]). The third parcel (1,514 acres [613 ha]) falls within the jurisdiction of Brunswick County and is zoned for general industrial uses (Brunswick County zoning designation CO-IG).

New Hanover County has a Local Emergency Planning Committee (LEPC) that is part of the county's Department of Emergency Management. The LEPC is tasked with planning for emergencies that involve hazardous materials. GE is listed as a member of the LEPC, which also maintains the *HAZMAT Incident Management Plan* for the entire county.

### 3.9.9 Coordination with Local Planners

Spatial zoning, roads, and land use datasets were obtained from the New Hanover County Information Technology Department for use in preparation of the land use, visual/scenic resources, and other sections of this Report (New Hanover County Information Technology Department, 2005a, 2005b, 2006, 2007). In addition, personal communications with the New Hanover County Planning Department staff members provided information used to help identify potential new residential developments within northwest New Hanover County for the purpose of evaluating cumulative impacts.

### 3.9.10 Aesthetic- and Scenic-Quality Rating

The BLM developed and uses its Visual Resource Management System (VRMS) to evaluate the aesthetic and scenic quality of public lands in the United States (BLM, 2007). This approach has two primary components: inventory and analysis. A modified version of the BLM methodology was used to rate the aesthetic and scenic quality of the Main portion of the GLE Study Area. The analysis component of the BLM methodology focuses on manipulating the design characteristics of planned buildings and supporting infrastructure (e.g., utility lines, roads) to minimize the contrast between natural and disturbed areas of the landscape. The inventory component involves assigning the visual resources of an area to an inventory class based on its visual appeal, public concern, and visibility from travel routes and key observation points. For this Report, only the inventory component of the BLM VRMS was used.

#### 3.9.10.1 Scenic-Quality Evaluation

Scenic quality is a measure of the visual appeal of a tract of land. In the BLM's visual resource inventory process, lands are designated as either scenic-quality rating A, B, or C based on the apparent scenic quality as assessed using seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. **Table 3.9-5** presents the BLM's explanation of the seven key factors used to assess the scenic-quality rating for a tract of land. For a given tract of land, a score is assigned for each of the seven key factors using the BLM's scoring criteria present in **Table 3.9-6.** The total score, obtained by

summing the individual scores for the seven key factors, is then used to apply a scenic-quality rating for the site using the following BLM rating designations: A = total score of 19 or more, B = total score 12 to 18, and C = total score 11 or less.

For the purposes of the scenic-quality evaluation, a single scenic-quality rating unit is considered—the Main portion of the GLE Study Area. Other areas of the Wilmington Site were not included in the scenic-quality evaluation due to environmental, required setback, and existing-use considerations. The results of the scenic-quality evaluation are presented in **Table 3.9-6**, with the assessed area assigned a total scenic quality score of 4, which places the Main portion of the GLE Study Area within the lowest BLM scenic-quality rating of C. Photographs of the forest and aboveground power lines at the Wilmington Site are shown in **Figures 3.9-6 and 3.9-7**.

### 3.9.10.2 Sensitivity-Level Analysis

The sensitivity-level analysis portion of the BLM methodology is designed for use on public lands. The Wilmington Site is privately owned; therefore, a large part of the sensitivity analysis is not directly transferable. However, key considerations identified by the BLM about sensitivity level include type of users, amount of use, public interest, adjacent land uses, and special areas.

Relevant users of the land within the Wilmington Site are on-site employees and affiliated on-site contractors. Employees who work at the Site are expected to be less sensitive to changes in visual quality than the general public. The GLE Study Area would experience an increase in the sensitivity level if the Proposed GLE Facility is constructed. The current effect on adjacent land uses is mitigated by the presence of significant amounts of trees and vegetation. In terms of special areas, there are no identified areas of concern within the GLE Study Area. Based on these considerations, the evaluated area is assigned a low sensitivity rating overall.

### 3.9.10.3 Distance-Zones Delineation

The BLM methodology also includes an assessment of the visibility of the area from travel routes and key observation points. The following three distance zones are identified: foreground-middleground, background, and seldom seen.

The foreground-middleground zone typically includes areas visible from 3 to 5 miles (5 to 8 km) away; the background zone includes areas visible from 6 to 15 miles (10 to 24 km) away; and the seldom-seen zone includes areas not visible from travel routes. Visibility is severely limited in and around the Wilmington Site by trees and other vegetation; therefore, the full BLM distance-zones delineation is not applicable.

The Wilmington Site's water tower is the tallest existing on-site structure and is visible from I-140, NC 133 (Castle Hayne Road; opposite the North and South gates), Chair Road (south of I-140), and Dan Cameron Bridge (I-140). The tower is not visible from the Wooden Shoe residential subdivision located along Dekker Road (off McDougald Drive) or from the area along Tall Oaks Drive and Indian Corn Trail (off Marathon Avenue). As previously noted, the water tower is visible from the neighborhood located along Chair Road, which is immediately south of I-140 off of NC 133 (Castle Hayne Road).

### 3.9.10.4 Determination of Visual Resource Inventory Classes

The BLM provides a framework for integrating the results of scenic-quality evaluation, sensitivity-level analysis, and distance-zones delineation. The scenic-quality rating of C and the low sensitivity rating place the GLE Study Area within Visual Resource Inventory Class IV for all three distance zones. Of the four visual resource inventory classes, Class IV allows for the greatest degree of landscape modification and is considered the least visual and scenic value. The BLM management objectives for Class-IV areas

allow for high levels of change, with the understanding that an attempt will be made to minimize the effect of the planned disturbance.

# Tables

**Table 3.9-1. Distance from the Wilmington Site to Selected Visitor Destinations**

| Destination | Distance (miles) | County |
|---|---|---|
| NCSU Horticulture Research Station | 1.8 | New Hanover |
| Wilmington International Airport (ILM) | 5.0 | New Hanover |
| USS. North Carolina Battleship Memorial | 6.6 | New Hanover |
| Downtown Wilmington | 6.8 | New Hanover |
| University of North Carolina –Wilmington | 8.8 | New Hanover |
| Port of Wilmington | 9.1 | New Hanover |
| Wrightsville Beach | 12.1 | New Hanover |
| Moores Creek National Battlefield | 12.7 | Pender |
| Masonboro NERR | 14.8 | New Hanover |
| Burgaw | 14.9 | Pender |
| Topsail Beach | 18.1 | Pender |
| Carolina Beach North Carolina State Park | 19.9 | New Hanover |
| Historic Brunswick Town | 20.2 | Brunswick |
| Carolina Beach | 20.5 | New Hanover |
| Bolivia (Brunswick County Seat) | 21.5 | Brunswick |
| Kure Beach | 23.1 | New Hanover |
| Surf City | 23.1 | Pender |
| North Carolina Aquarium | 25.6 | New Hanover |
| Fort Fisher North Carolina Historic Site | 26.5 | New Hanover |
| Zeke's Island NERR | 26.7 | New Hanover |
| Southport | 28.5 | Brunswick |
| Caswell Beach | 30.0 | Brunswick |
| Oak Island | 30.8 | Brunswick |
| Bald Head Island | 32.4 | Brunswick |
| Ocean Isle Beach | 41.2 | Brunswick |
| Sunset Beach | 45.3 | Brunswick |

Reference: U.S. Census Bureau, 2000a; U.S. Census Bureau, 2000b; NCDOA, 2007; New Hanover County Information Technology Department, 2007.

**Table 3.9-2. Zoning Designations for Land Parcels Located in New Hanover County within a 5-Mile (8-km) Radius of the Wilmington Site**

| Description | Zoning | Parcel Count | Total Acres | Acreage Percentage |
|---|---|---|---|---|
| Airport One Acre Lots (industrial) | A-I | 1 | 1,138 | 3.2 |
| Airport One Acre Lots (residential) | AR | 4 | 692 | 2.0 |
| Heavy Commercial | B-2 | 11 | 321 | 0.9 |
| Heavy Industrial | I-2 | 5 | 13,962 | 39.8 |
| Light Industrial | I-1 | 11 | 867 | 2.5 |
| Residential Lot Size ≥10,000 $ft^2$ | R-10 | 6 | 706 | 2.0 |
| Residential Lot Size ≥15,000 $ft^2$ | R-15 | 13 | 3,135 | 8.9 |
| Residential Lot Size ≥20,000 $ft^2$ | R-20 | 11 | 4,592 | 13.1 |
| Residential Lot Size ≥30,000 $ft^2$ | RA | 1 | 7,908 | 22.5 |
| Neighborhood Shopping | B-1 | 13 | 100 | 0.3 |
| Office & Institutional | O&I | 11 | 178 | 0.5 |
| Planned Unit Development | PD | 1 | 1,483 | 4.2 |
| Shopping Center | SC | 1 | 12 | <0.1 |
| | **Total** | **89** | **35,095** | **100.0** |

Reference: New Hanover County Information Technology Department, 2005a.

**Table 3.9-3. Zoning Designations for Land Parcels Located in Pender County within a 5-Mile (8-km) Radius of the Wilmington Site**

| Description | Zoning | Parcel Count | Total Acres | Acreage Percentage |
|---|---|---|---|---|
| Business District (Highway) | B-2 | 1 | 34 | 0.2 |
| Flood Hazard Area | FA | 2 | 6,809 | 50.0 |
| Light Industrial | I-1 | 2 | 249 | 1.8 |
| Heavy Industrial | I-2 | 2 | 1,551 | 11.4 |
| Planned Unit Development | PD | 1 | 560 | 4.1 |
| Residential Medium Density | R-15 | 1 | 41 | 0.3 |
| Residential Moderate Density | R-20 | 1 | 1,903 | 14.0 |
| Residential Rural Agricultural | RA | 3 | 2,389 | 17.6 |
| Residential Rural Transition | RT | 1 | 71 | 0.5 |
| | **Total** | **14** | **13,607** | **100.0** |

Reference: Pender County Information Technology Services, 2005.

**Table 3.9-4. Zoning Designations for Land Parcels Located in Brunswick County within a 5-Mile (8-km) Radius of the Wilmington Site**

| Description | Zoning | Parcel Count | Total Acres | Acreage Percentage |
|---|---|---|---|---|
| General Industrial (Brunswick County) | CO-IG | 1 | 1,514 | 44.2 |
| Heavy Manufacturing (Town of Navassa) | NA-HM | 1 | 849 | 24.8 |
| Rural (Town of Navassa) | NA-RU | 1 | 1,064 | 31.0 |
| **Total** | | **3** | **3,427** | **100.0** |

Reference: Brunswick County GIS Department, 2008.

**Table 3.9-5. BLM Scenic-Quality Evaluation Key Factor Explanation**

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

Reference: BLM, 2007.

**Table 3.9-6. Scenic-Quality Inventory Evaluation and Scoring for the Main Portion of the GLE Study Area**

| Key Factor | BLM Scenic-Quality Evaluation Scoring Criteria [a] | | | Evaluation and Assigned Score for the Main Portion of the GLE Study Area |
|---|---|---|---|---|
| Landform | High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations, including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing, such as glaciers. (5) | Steep canyons, mesas, buttes, cinder cones, and drumlins; interesting erosional patterns or variety in size and shape of landforms; detail features that are interesting, though not dominant or exceptional. (3) | Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features. (1) | ▪ The Wilmington Site contains bluff areas along the southwest corner and sand dune remnants (borrow).<br>▪ None of these landform features are within the GLE Study Area.<br>▪ Generally flat topography characterizes the GLE Study Area.<br>**Landform Score = 1** |
| Vegetation | A variety of vegetative types as expressed in interesting forms, textures, and patterns. (5) | Some variety of vegetation, but only one or two major types. (3) | Little or no variety or contrast in vegetation. (1) | ▪ The GLE Study Area is heavily forested.<br>▪ Pine and sweet gum dominate.<br>**Vegetation Score = 3** |
| Water | Clear and clean appearing, still, or cascading white water, any of which are a dominant factor in the landscape. (5) | Either flowing, or still, but not dominant in the landscape. (3) | Either absent, or present, but not noticeable. (0) | ▪ The Wilmington Site borders the Northeast Cape Fear River and several small creeks on-site.<br>▪ These waterbodies are not located within the GLE Study Area.<br>**Water Score = 0** |
| Color | Rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields. (5) | Some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element. (3) | Subtle color variations, contrast, or interest; generally mute tones. (1) | ▪ Green foliage and sandy soils dominate.<br>**Color Score = 1** |

*(continued)*

**Table 3.9-6. Scenic-Quality Inventory Evaluation and Scoring for the Main Portion of the GLE Study Area (continued)**

| Key Factor | BLM Scenic-Quality Scoring Criteria [a] | | | Evaluation and Assigned Score for the Main Portion of the GLE Study Area |
|---|---|---|---|---|
| Adjacent Scenery | Adjacent scenery greatly enhances visual quality. (5) | Adjacent scenery moderately enhances overall visual quality. (3) | Adjacent scenery has little or no influence on overall visual quality. (0) | ▪ Areas adjacent to the GLE Study Area to the west, north, and south are generally undeveloped, forested land.<br>▪ Adjacent areas to the east are generally developed for industrial and residential land uses.<br>**Adjacent Scenery Score = 0** |
| Scarcity | One of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing. (5) | Distinctive, though somewhat similar to others within the region. (3) | Interesting within its setting, but fairly common within the region. (1) | ▪ Vegetation and scenery in the GLE Study Area are typical of the surrounding land parcels.<br>**Scarcity Score = 1** |
| Cultural Modifications | Modifications add favorably to visual variety while promoting visual harmony. (2) | Modifications add little or no visual variety to the area and introduce no discordant elements. (0) | Modifications add variety, but are very discordant and promote strong disharmony. (-4) | ▪ Power lines are aboveground.<br>▪ Monitoring wells are widely distributed.<br>▪ Much of the GLE Study Area remains forested.<br>**Cultural Modification Score= -2** [b] |
| | | | | **Total Key Factor Score = 4** |

Reference: BLM, 2007.

Notes:

[a] The BLM Scenic-Quality Inventory protocol allows for assigning a score at any integer value within the maximum and minimum score range listed for an individual key factor.

[b] The existing power line corridors and monitoring well locations were assessed to have a negative visual impact on the forested areas of the GLE Study Area. However, given the large portions of the forested area within the GLE Study Area that are not disturbed by these man-made structures, these negative visual intrusions do not meet the scoring criteria of being "very discordant and promote strong disharmony" warranting the full scoring of a -4. Consequently a score of -2 is assigned.

# Figures

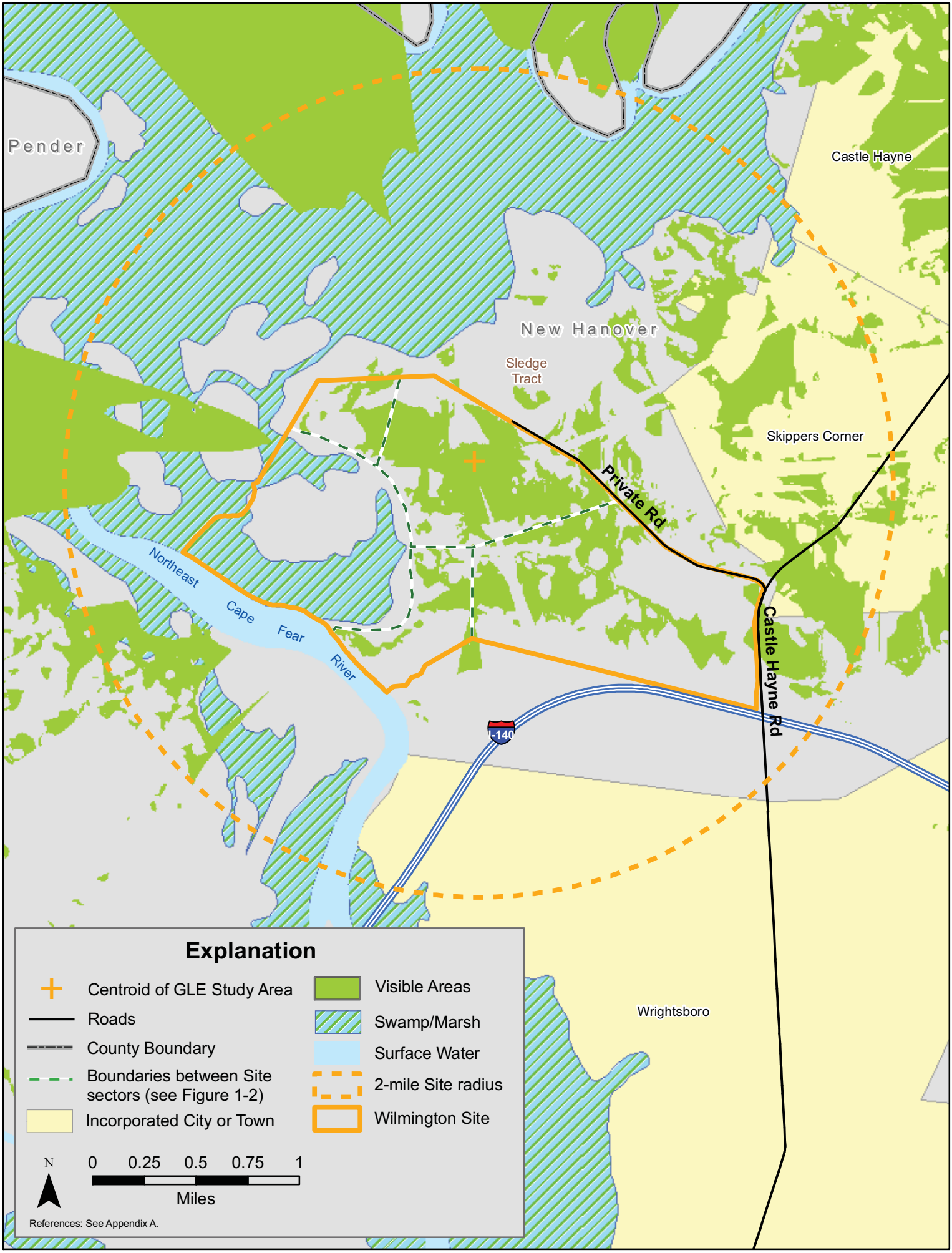


**Figure 3.9-1. Estimated viewshed boundaries for the Wilmington Site.**


**Figure 3.9-2. Wilmington Site access road from NC 133 (Castle Hayne Road).**

**Figure 3.9-3. Water tower from Chair Road, south of I-140.**

**Figure 3.9-4. NC 133 (Castle Hayne Road), south of I-140.**

**Figure 3.9-5. NC 133 (Castle Hayne Road), north of I-140.**

**Figure 3.9-6. Power lines along an unpaved road on the Wilmington Site.**

**Figure 3.9-7. Typical vegetation growth on undeveloped areas of the Wilmington Site.**

**Figure 3.9-8. Home visible from unpaved private road adjacent to northern property line of the Wilmington Site (Sledge Tract access).**

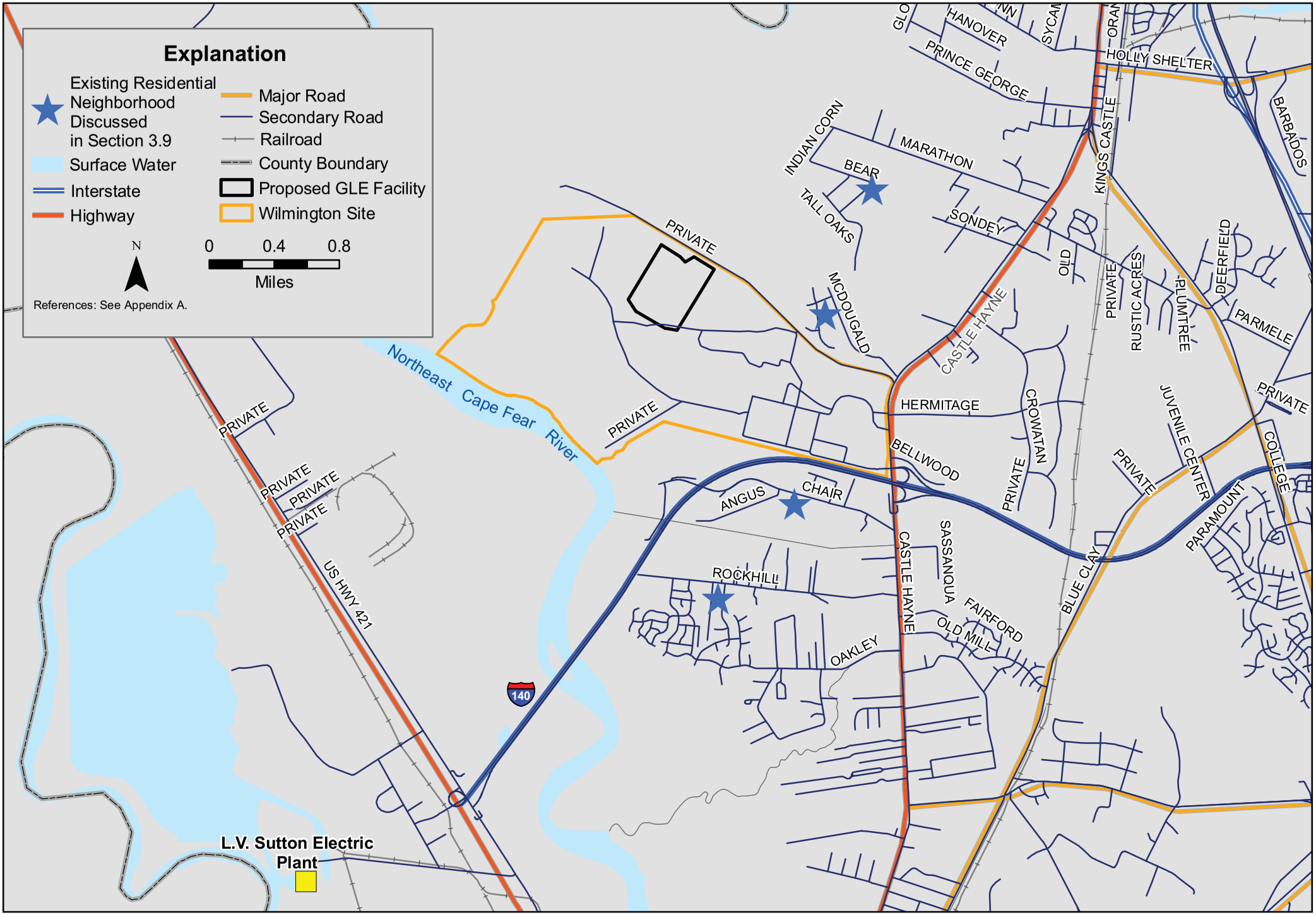


**Figure 3.9-9. Residential neighborhoods in the vicinity of the Wilmington Site.**

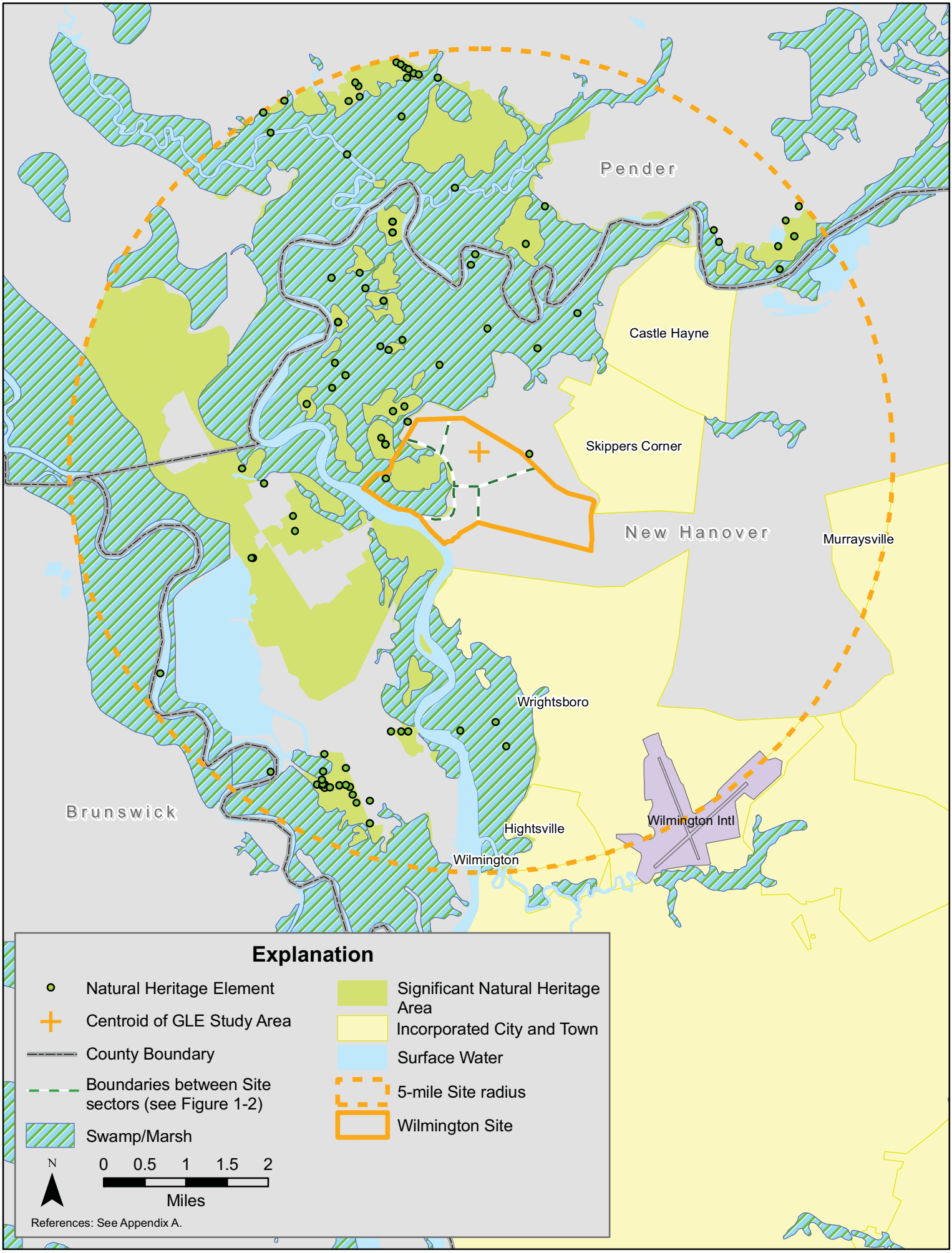


**Figure 3.9-10. North Carolina Natural Heritage Program- designated Natural Heritage Element Occurrences (NHEOs) and Significant Natural Heritage Areas (SNHAs) within 5-mile (8-km) radius of the Wilmington Site.**

# GLE Environmental Report
# Section 3.10 – Socioeconomic Environment

## Revision 0
## December 2008

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## 3.10 Socioeconomic Environment

This section studies the population, economic, and community characteristics of the region surrounding the Wilmington Site. For the majority of this section, this region will be defined as the three counties surrounding the Site that are most likely to incur economic, labor force, and infrastructure impacts due to the Proposed Action: Brunswick, New Hanover, and Pender counties; however, pursuant to NUREG 1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS (Nuclear Material Safety and Safeguards) Programs*, discussions regarding minority populations and households living below the poverty level will be focused on the 50-$mi^2$ (129.5-$km^2$) area (corresponding to a 4-mile [6.4-km] radius) surrounding the Wilmington Site, which includes only portions of these three counties.

The data used in this section are the most current and complete data identified to address each topic. In many cases, those data represent relatively current conditions in the region (for example, 2005), or projected conditions during the expected life of the proposed project. In some cases, such as detailed demographic data for small geographic areas (Census Block Groups or CBGs), the most current and complete data available are from the 2000 Census.

### 3.10.1 Population Characteristics

#### 3.10.1.1 Population and Projected Growth

In recent years, Brunswick, New Hanover, and Pender counties have grown much more rapidly than other counties in North Carolina. Between 1990 and 2000, the combined population in the region grew 37%, from 200,124 to 274,532. This is nearly twice the growth rate experienced by the rest of the state over the same time period. As a result, the portion of the state population occupying the region rose from 3% in 1990 to 3.4% in 2000 (**Table 3.10-1**). 2006 Census estimates reveal that population growth in the region of the GLE Study Area has continued to be considerably faster than growth in North Carolina as a whole. Between 2000 and 2006, the combined population of the region grew by 19%, whereas total state population grew by 10%.

Populations in these three counties are expected to continue growing faster than total state population for the foreseeable future. According to projections published by the NC Office of State Budget and Management's State Demographics unit, the combined populations in the region are expected to increase 87% by 2030 relative to populations in 2000. However, over this same time period, the total state population is expected to grow by only 52% (**Table 3.10-2**). As a result, populations in the region are expected to grow, as a percentage of North Carolina's total population, from 3.4% in 2000 to 4.2% in 2030 (NC OSBM, 2007).

Because of its coastal location, the region experiences substantial seasonal increases in population as tourists and families with vacation homes come into the counties during the summer season (April to September). For example, the North Carolina Highway Patrol's coastal evacuation plan shows that the seasonal population of the region exceeds the off-season population by 47,100 people, or 14.9% (NC CCPS, 2007). In addition to tourism and seasonal residents, the region has a small number of seasonal farm workers, as well as a number of seasonal workers in the construction and hospitality industries (Griffith, 2007).

Within the region, there is one city, Wilmington (estimated 2006 population 95,944), and several small towns. In Pender County, Burgaw is the county seat and had an estimated 3,904 residents in 2006. The largest town in Brunswick County is Oak Island, with 8,152 residents in 2005 (U.S. Census Bureau, 2007a). **Figure 3.10-1** is a map that shows population centers in the region.

### 3.10.1.2 Demographic Characteristics

According to Appendix C of NUREG 1748, which describes Environmental Justice Procedures as part of Environmental Reviews for Licensing Actions Affecting Nuclear Material Safety and Safeguards (NMSS) Programs, and NRC's *Policy Statement on Environmental Justice* (NRC, 2004), the NRC should determine if disproportionately high and adverse impacts affect any minority or low-income community as a part of the NRC's NEPA obligation to accurately identify and disclose all significant environmental impacts of a proposed action. The NRC recommends that poverty and minority characteristics be considered for an area within a 4-mile (6.4-km) radius of a proposed non-urban site (corresponding to 50 $mi^2$ [129 $km^2$] surrounding the Site). For the Proposed GLE project, this area includes parts of New Hanover, Brunswick, and Pender counties.

While 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.

#### *3.10.1.2.1 Minority Population*

Minority populations are defined to include members of racial and ethnic groups other than white, non-Hispanic populations. **Table 3.10-3** reports 2000 population data for minority groups in North Carolina, Brunswick County, New Hanover County, and Pender County, as well for each CBG lying at least partially within a 4-mile (6.4-km) radius of the Wilmington Site. The table also reports the percentage of the total population represented by minority ethnic groups. The combined minority population across the three-county region accounts for 22% of the region's population, approximately 7 percentage points less than the minority share of the state population.

Within the portion of the three counties that fall within 4 miles (6.4-km) of the Site, individual CBGs have minority population shares ranging from 4% to 62%. Although minorities represent only 18.3% of the population in the CBG in which the Wilmington Site is located, the CBG does include some neighborhoods with higher minority population shares and minority institutions and businesses, including a neighborhood south of the Wilmington Site, along Chair Road, that includes St. James AME Church. **Figure 3.10-2** provides a graphical representation of minority share of population by CBG. Three of the CBGs have aggregate minority population percentages and African-American population percentages that exceed their respective counties by 20 percentage points or more. These CBGs are Tract 020100, CBG 1; Tract 011500, CBG 5; and Tract 980600, CBG 1.Two of these CBGs have populations that are composed of more than 50% minorities and have aggregate minority population percentages that exceed that of their respective counties and the state of North Carolina (Tract 011500, CBG 5 and Tract 980600, CBG 1). Since only relatively small portions of Tract 020100, BG 1 are located within four miles of the Wilmington Site, only the two CBGs with minority populations comprising more than 50% of the population will be characterized in more depth. These CBGs have minority populations that are high relative to the state and county in which they are located, and also have more than 50% minority population. One of the two CBGs also has relatively high poverty. Although not all the residents of these CBGs are minority, and not all minority residents of the region live in these CBGs, special attention is warranted during the NEPA-mandated assessment of environmental impacts to ensure that these communities do not experience disproportionately high and adverse environmental impacts as a result of the Proposed GLE Facility. In addition to the two CBGs mentioned above, Tract 011500, CBG 1 will be discussed in detail, because it is the CBG in which the Proposed GLE Facility is located.

**NC Census Tract 011500, CBG 5**, is located in New Hanover County, southwest of the Proposed GLE Facility. It is home to 2,016 people, of whom 62% (1,248) are members of a minority. Seventy percent

(1,410) of this CBG's residents live in urbanized areas, whereas 30% (606) were identified as living in rural, non-farm areas (U.S. Census Bureau, 2000).

During the 2000 Census, detailed economic characteristics were collected on a sample of 948 individuals living in this block group. Of these 948 individuals, 835 (88%) worked at locations inside New Hanover County. Of the 948 individuals, 31% work in sales occupations; 23% work in management, professional, and related occupations; and 17% worked in service occupations (U.S. Census Bureau, 2000).

A map depicting NC Census Tract 011500, CBG 5, is available in **Figure 3.10-3**. Based on aerial photographs obtained through Google Earth (Google Earth, 2008), it appears that the majority of the population in this CBG is concentrated in the north–east quadrant around Walnut Hills.

Several industrial establishments appear to be located along US 421. The largest of these establishments is Progress Energy's L.V. Sutton steam-generating station. In addition to these industrial establishments, there were several small service establishments identified along US 421. These businesses included Eagle Island Seafood and Faye's Cafe. Also located along US 421, at the intersection of Sutton Lake Road, is the New Hanover Volunteer Fire Department Station 51. One church, Pine View Church (depicted in **Figure 3.10-3**), was identified as potentially being within this CBG. This church is located along US 421.

**NC Census Tract 980600, CBG 1**, is located in Pender County, northeast of the Proposed GLE Facility. This CBG is home to 827 people, of whom 55% (451) are members of a minority and 37% (302) are considered to be earning income below the poverty level. All 827 individuals were identified as living in rural, non-farm areas (U.S. Census Bureau, 2000).

During the 2000 Census, detailed economic characteristics were collected on a sample of 289 individuals living in this CBG. Of these 289 individuals, 225 (78%) worked at places outside Pender County. One fourth of these 289 individuals work in service occupations, primarily in personal care, construction and building, grounds cleaning, and maintenance occupations. 19% worked in construction and maintenance occupations and 20% worked in production, transportation, and material-moving occupations (U.S. Census Bureau, 2000).

A map depicting NC Census Tract 980600, CBG 1, is available in **Figure 3.10-4**. Although no major manufacturing or industrial establishments were identified in this CBG, several service establishments were identified located along US 117 South. These businesses included Dollar General and Dilsey's Old Southern Cooking.

One school, Rocky Point Elementary School, was identified as residing in CBG 1. According to the National Center for Educational Statistics, this school was attended by 428 students during the 2005–2006 school year; 265 (62%) of these students were White, 92 (21%) were Hispanic, 70 (16%) were Black, and 1 (0.2%) was American Indian/Alaskan Native (NCES, 2008).

In addition, two churches (not depicted in **Figure 3.10-4**), the Light House Worship Center, and Pike Rocky Point Presbyterian, were identified as potentially being within this CBG. Both of these churches are located along US 117 South.

**NC Census Tract 011500, CBG 1**, is located in the town of Castle Hayne, NC, shown in **Figure 3.10-5.** The Proposed GLE Facility would be located within NC Census Tract 100500, CBG 1.. As noted above, the CBG as a whole has moderate levels of minority population and relatively low poverty, compared to the county and state as a whole. The town of Castle Hayne is a small town with a commercial area located along NC 133 (Castle Hayne Road). Land use along the road is a mix of rural residential and commercial use. Businesses along NC 133 (Castle Hayne Road) include several commercial greenhouses or nurseries,

body shops, tire stores, and a mini-storage facility. About 1 mile north of the Proposed GLE Facility, St. Stanislaus Catholic Church is located at the corner of Marathon Road and NC 133 (Castle Hayne Road); reflecting a history of Polish immigrants, it hosts a Polish Festival in Castle Hayne each year. South of Marathon Road and across NC 133 (Castle Hayne Road), Hermitage House is a large (84 bed) long-term care facility. Residences along NC 133 (Castle Hayne Road) include a mix of new construction, older houses, and manufactured housing (single- and double-wide mobile homes of various ages). About a mile south of the Proposed GLE Facility, south of I-140, Chair Road is a neighborhood containing mostly older homes and manufactured housing. Residents of the neighborhood appear to have low to moderate income, and many of the residents may be minority and/or elderly. The Rock Hill Community Center occupies a small block building on Chair Road, and its sign states that it has Head Start classes. At the corner of Chair Road and NC 133 (Castle Hayne Road) is St. James AME Church, an historically black church with a history of service and activism on behalf of the community. The southern edge of CBG 1 is just south of Chair Road.

#### *3.10.1.2.2 Populati on with Income below Poverty Level*

Poverty status was determined in the 2000 Census for populations in North Carolina, Brunswick County, New Hanover County, Pender County, and each of the CBGs within 4 miles (6.4 km) of the Wilmington Site based on 1999 income. Poverty statistics for the region are reported in **Table 3.10-4**.

As **Table 3.10-4** shows, the share of the population living in poverty in the region (13% to 14%) is only slightly higher than the share of individuals living at or below poverty at the North Carolina state level (12%). Within the portions of the three counties that fall within the 4-mile (6.4-km) radius, individual CBGs have shares of the population with incomes below poverty ranging from 2 to 37%. Only one CBG in the 50-$mi^2$ (129-$km^2$) area, Census Tract 980600, CBG 1, has a poverty population share that exceeds that of the county and state by more than 20 percentage points; 37% of this CBG's population has income below the poverty level. As part of the NEPA-mandated assessment of environmental impacts, special attention is warranted to ensure that these communities do not experience disproportionately high and adverse environmental impacts as a result of the Proposed GLE Facility. **Figure 3.10-6** provides a graphical representation of the share of population with income below the poverty level, by CBG. For the CBG within which the Wilmington Site is located, only 7% of the population for which poverty status could be determined in 1999 had income below the poverty level.

### 3.10.1.3 Population Density

Population density varies widely among the three counties in the region of the Wilmington Site. In 2006, Brunswick and Pender counties had relatively low population densities, with less than 110 people/$mi^2$, whereas New Hanover County was much more densely populated, with more than 800 people/$mi^2$ (**Table 3.10-5**).

Population density also varies widely within the three counties. **Figure 3.10-7** provides a graphical illustration of population density by CBG by county in the year 2000. Within each county, there are CBGs with relatively dense population, and other areas that are sparsely populated. For example, in New Hanover County, there are some CBGs with population densities above 4,000 people/$mi^2$, whereas in the rural areas of all three counties, there are areas with fewer than 400 people/$mi^2$ . In 2000, the CBG within which the Wilmington Site is located (NC Census tract 011500, CBG 1) had a population density of only 130 residents/$mi^2$.

Over time, as all three counties in the region grow in population, their population densities will increase. By 2030, Brunswick County's population density is projected to approach 200 people/$mi^2$ (compared to a projected density for North Carolina of approximately 250 people/$mi^2$); New Hanover County is projected

to have a density of over 1300 people/mi$^2$; and Pender County is projected to remain much less densely populated at 90 people/mi$^2$ (NC OSBM, 2007).

### 3.10.2 Economic Characteristics

#### 3.10.2.1 Employment and Occupational Patterns

According to the 2000 Census, the total labor force across the three counties of the region included 139,955 individuals. This labor force was classified into three categories: labor force in the Armed Forces (887), employed civilian labor force (131,489), and unemployed civilian labor force (7,579). **Table 3.10-6** reports each of these regional labor force statistics by county.

The 2000 Census also provides data on the distribution of civilian employment across industry. These data are reported in **Table 3.10-7** for the region. The regional distribution of employment by industry in the three counties surrounding the Wilmington Site is generally similar to the distribution of employment in the state as a whole; however, there are several key differences. Across all three counties, there is a smaller portion of workers employed in manufacturing activities than the rest of North Carolina. Instead, a greater portion of workers are employed in the construction and retail trades. Also, in Brunswick and New Hanover counties, the portion of workers employed in the arts, entertainment, recreation, and accommodation sector is almost twice that of the state of North Carolina. These industries represent some of the region's largest employers.

#### 3.10.2.2 Income

**Table 3.10-8** reports per-capita income and median household income for the region relative to North Carolina from the 2000 Census. These statistics are two measures of the "typical" income received by residents of each county. The difference between these two statistics is that per-capita income is estimated by dividing total income generated in each county by the total county population, whereas median household income divides households into two equal segments, with the first half of households earning less than the median household income and the other half earning more.

Per-capita income in the region ranged from $17,882 in Pender County, to $19,857 in Brunswick County, to $23,123 in New Hanover County. These values are relatively close to per-capita income in North Carolina as a whole ($20,307). Per-capita income in Pender County is 12% below state per-capita income; Brunswick County's per-capita income is only 2% below state per-capita income; and New Hanover County's per-capita income is 14% greater than state per-capita income.

There is less difference between state and county incomes when using the median household income measure. Median household income was $35,902 in Pender County, $35,888 in Brunswick County, $40,172 in New Hanover County, and $39,184 in North Carolina as a whole.

To provide a better understanding of which industries are generating the income received by households, **Table 3.10-9** reports sales received by each industry in 2002 by county. The data reported in this table were compiled from two separate sources: sales for the agricultural sector were obtained from the 2002 Census of Agriculture (USDA, 2004) and all other revenue data were obtained from the 2002 Economic Census (U.S. Census Bureau, 2002).

The Economic Census does not disclose sales information for all industries in all counties to avoid disclosing data for individual companies (U.S. Census Bureau, 2002); however, these data are included at higher levels of geographical aggregation. Therefore, to account for this fact, sales data for the Wilmington MSA are also included in **Table 3.10-9**. An MSA is a geographic entity defined by the OMB for the use of compiling and reporting federal statistics. An MSA contains a core urban area with a

population of 50,000 or more. Each MSA consists of one or more counties and includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core. The Wilmington MSA's urban core is the city of Wilmington and includes the whole of Brunswick, New Hanover, and Pender counties.

#### 3.10.2.3 Tax Structure

Taxes on real estate (e.g., land and buildings) and personal property (e.g., boats, automobiles, and all machinery and equipment) are the principal sources of local revenue. The taxes applied are a composite of county and municipal levies (there is no state-wide property tax). As a result, tax rates vary from county to county and town to town (NCDOR, 2006). There are only a few exemptions and exclusions of interest to manufacturers. Among these exemptions, nuclear materials held for the purpose of, or in the process of, manufacture or processing, or held by the manufacturer for delivery are exempt from taxation (NCDOR, 2006).

The appraised value of property is determined by the county assessor and constitutes the base for all property taxes, including those of cities and towns on property located within the municipality. Although appraised value is to be "full value," this standard is not always achieved for real property because it is only required to be reassessed once every 8 years (NCDOR, 2006).

During FY2006 to FY2007, county-wide rates for North Carolina ranged from $0.26 to $1.10 per $100 of appraised valuation (with a state average of $0.67 per $100 of value). Municipal tax rates ranged from $0.02 to $0.82 per $100 during this same time period (with a state average rate of $0.41 per $100 of value) and were levied on top of county tax rates (NCDOR, 2007). **Table 3.10-10** provides county-wide tax rates for the region, as well as the ranges of tax rates for municipalities within the three counties. The tax rates for Pender and New Hanover counties are similar to the state average, whereas Brunswick County's tax rate is somewhat lower than the average across all 100 of the state's counties. The tax rate for property outside the city limits of Wilmington is $0.69 per $100 of assessed value.

North Carolina has a state-wide personal income tax, with tax rates, shown in **Table 3.10-11**, that vary depending on income. The corporate income tax rate is 6.9% of corporate income. The state-wide sales and use tax rate is 4.25% of sales, with a local sales and use tax rate in most areas of 2.5%, for a total of 6.75% (NCDOR, 2006).

### 3.10.3 Community Characteristics

This section discusses various characteristics of the communities located in the region. These characteristics include housing, education, health care, public safety, and transportation. A graphical illustration of the location of facilities offering services related to these characteristics, such as schools, police and fire stations, hospitals, and nursing homes, is provided in **Figure 3.10-8**.

#### 3.10.3.1 Housing

**Table 3.10-12** presents regional housing characteristics by county based on the 2000 Census. In 2000, the three counties had a total of nearly 152,000 housing units, with more than half of these located in New Hanover County and another third in Brunswick County. The vast majority of housing units in the region are single-family structures, but the number of multi-family structures is increasing as the region develops. The region's housing is roughly two-thirds urban, with much of the urban housing located in New Hanover County, which had 96% urban housing units. Occupancy was 85% in New Hanover County and 77% in Pender County, but only 60% in Brunswick County, which had 15,000 seasonal, recreational, or occasional-use units standing vacant at the time of the Census. Owner-occupied units

comprise 82% of the occupied units in Brunswick and Pender counties, but only 65% of the occupied units in New Hanover County.

**Table 3.10-13** shows estimated housing values for owner-occupied units in the region. New Hanover County has the highest housing values, with a median value of $128,000 in 2000, and more than 1,700 units (4% of owner-occupied units in the county) valued above $500,000. By contrast, Brunswick and Pender counties each had fewer than 2% of their owner-occupied units valued over $500,000, and each had roughly 20% of their homes valued less than $50,000. Approximately 60% of owner-occupied homes in Pender County were valued less than $100,000 in 2000, compared to 50% in Brunswick County and 30% in New Hanover County.

As described in **Section 3.10.1**, the three counties in the region are among the fastest-growing counties in the state. This continuing trend is illustrated in the number of building permits for new, privately owned residential buildings, shown in **Table 3.10-14**. Over the period of 2000 to 2006, the annual number of permits in the region more than doubled and the value of the structures permitted roughly tripled. New Hanover led the region until 2000 in terms of both the number of units permitted and the value of the units; however, since 2001, Brunswick County has taken the lead. In 2006, roughly twice as many permits were issued in Brunswick County as in New Hanover County. The number of permits issued in Pender County grew rapidly during the years 2000 through 2006, although it is still small relative to the other two counties. All three counties experienced a decline in the number of units permitted in 2006, relative to 2005.

### 3.10.3.2 Education

There are a total of 90 public and private elementary, middle, and high schools in the region. In addition to these primary and secondary schools, colleges such as the University of North Carolina at Wilmington, Brunswick Community College, and Cape Fear Community College are located in the region. A summary of these numbers of schools is provided in **Table 3.10-15**. Also, an estimate of the number of individuals attending these schools by grade level can be found in **Table 3.10-16**. These data reflect enrollment in 2000; however, it is certain that enrollment has increased in all three counties because of the population growth experienced since 2000.

Out of the 90 schools in the region, only 1 is within a 4-mile (6.4-km) radius of the GLE Study Area (Wrightsboro Elementary) and 21 additional schools are within an 8-mile (12.8-km) radius of the Site. **Table 3.10-17** details the location and the enrollment of each of these schools during the 2005–2006 school year. **Figure 3.10-8** graphically illustrates the location of these schools, as well as other schools in the region.

In general, the population of Brunswick and Pender counties has less advanced education than the general population in the state (**Table 3.10-18**). According to the 2000 Census, 22% of individuals living in North Carolina had received a bachelor's or more advanced degree, whereas only 16% and 14% of individuals in Brunswick and Pender counties had received similar degrees. On the other hand, the population of New Hanover County appears to have more formal education than the state because 31% of the population in this county had received a bachelor's degree or higher in 2000.

### 3.10.3.3 Health Care, Public Safety, and Transportation Services

#### *3.10.3.3.1 Health Care*

As shown in **Table 3.10-19**, health care in the region is provided by several hospitals, primary care centers, and specialty care centers (NHHN, 2007a). The majority of the healthcare facilities identified are located in New Hanover County, with all of those being located in Wilmington. The New Hanover

Regional Medical Center in Wilmington is a large regional medical center with more than 600 beds, offering a variety of services, including specialized and highly technical surgery with 23 operating rooms; cardiac, cancer, and rehabilitation services; four intensive care units; and mental health care (NHHN, 2007b). The New Hanover Regional Medical Center is a Level II trauma center, able to provide specialized emergency medical services to patients who have suffered life-threatening injuries. Also in Wilmington are Cape Fear Hospital and Cornelia Nixon Davis Health Care Center, along with numerous primary care facilities. Brunswick County has two hospitals, Dosher Memorial Hospital and Brunswick Community Hospital. Pender County has Pender Memorial Hospital and Maple Hill Medical Center.

In addition to hospitals and other medical facilities, the three counties have numerous facilities to serve seniors, including adult care homes, nursing homes, and senior centers. These facilities are shown in **Table 3.10-20**. To further convey a sense of the availability of healthcare resources to residents of the region, **Table 3.10-21** provides a summary of the number of residents per healthcare professional in each county. These data were collected by the NC Department of Health and Human Services. As one can see, New Hanover County has substantially more healthcare personnel than the other two counties. Specifically, there are only 788 people per primary care physician, 70 people per registered nurse, and 1,443 people per dentist. Although the fewer number of healthcare professionals in Brunswick and Pender counties could imply that residents of these counties have less access to healthcare, it could also mean that a substantial number of Brunswick and Pender residents travel to New Hanover County for medical care and therefore require fewer healthcare professionals in their respective counties.

#### *3.10.3.3.2 Public Safety*

The Fire Support Service closest to the Wilmington Site is the Castle Hayne Volunteer Fire & Rescue (CH VFR), which is approximately 3 miles (4.8 km) to the northeast (see **Figure 3.10-8**). The station is staffed by 3 full-time firefighters who are employed by New Hanover County and 10 volunteer firefighters. CH VFR is equipped with the following: 2 pumper trucks (each of which carries 1,000 gallons [3785 liters] of water with the ability to pump 1,250 gallons [4732 liters] per minute); 2 water trucks (one with a 2,000-gallon [7571 liters] holding capacity and the other with 2,500-gallon [9464 liters] holding capacity); 1 squad truck (equipped with a 300-gallon [1136-liter] water tank); and 1 heavy rescue truck (CH VFR, 2008).

If additional equipment or manpower is needed, CH VFR has mutual aid agreements with the six remaining fire stations in New Hanover County. The Wrightsboro Volunteer Fire Department, the second-closest station, is 3.7 miles (5.9 km) southeast of the Wilmington Site.

The New Hanover County Sheriff's Office is the principal law enforcement agency of New Hanover County, servicing 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). Since the Wilmington Site lies outside of an urban area, the Sheriff's department would provide the bulk of the Site's law enforcement services. However, the City of Wilmington's police department, which employs more than 300 personnel (252 of which are law enforcement officers), is also relatively close and could provide additional resources (City of Wilmington Police Department, 2007).

#### *3.10.3.3.3 Transportation Services*

There are several transportation facilities within the three-county study area of the Wilmington Site. The closest of these is an airport facility, Wilmington International Airport, which is located approximately 5 miles (8 km) southeast of the Wilmington Site. The airport has two runways and a single terminal with eight gates (ILM, 2007). The airport is also home to three fixed-base operators, which currently house and serve more than 100 private aircraft (FAA, 2007). There is also a 24-hour U.S. Customs ramp for international flights that need to stop at Wilmington International Airport. In addition to these

transportation options, the Port of Wilmington is approximately 9 miles (14.5 km) south of the Wilmington Site, and the closest rail terminal is 10.1 miles (16.3 km) away. For greater detail on transportation services and infrastructure near the Wilmington Site, please see **Section 3.2**, *Transportation*.

# Tables

**Table 3.10-1. Population in Region (1990 to 2007)**

| County | 1990 | 2000 | 2006 | Percent Change, 1990–2000 | Percent Change, 2000–2007 | Percent Change, 1990–2007 |
|---|---|---|---|---|---|---|
| Brunswick | 50,985 | 73,143 | 94,945 | 43.5 | 29.8 | 86.2 |
| New Hanover | 120,284 | 160,307 | 182,591 | 33.3 | 13.9 | 51.8 |
| Pender | 28,855 | 41,082 | 48,630 | 42.4 | 18.4 | 68.5 |
| **Three-County Total** | 200,124 | 274,532 | 326,166 | 37.2 | 18.8 | 63.0 |
| North Carolina | 6,632,448 | 8,049,313 | 8,856,505 | 21.4 | 10.0 | 33.5 |

Reference: U.S. Census Bureau, 2000; U.S. Census Bureau, 2007a.

**Table 3.10-2. Population Projections for Region**

| County | 2000 | 2015 | 2030 | Percent Change, 2000–2015 | Percent Change, 2015–2030 | Percent Change, 2000–2030 |
|---|---|---|---|---|---|---|
| Brunswick | 73,143 | 125,107 | 164,165 | 71.0 | 31.2 | 124.4 |
| New Hanover | 160,307 | 219,531 | 271,030 | 36.9 | 23.5 | 69.1 |
| Pender | 41,082 | 61,200 | 78,479 | 49.0 | 28.2 | 91.0 |
| **Three-County Total** | 274,532 | 405,838 | 513,674 | 47.8 | 26.6 | 87.1 |
| North Carolina | 8,049,313 | 10,178,807 | 12,274,433 | 26.5 | 20.6 | 52.5 |

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

**Table 3.10-3. Regional Minority Population by Census Block (2000)**

| Area | Total Minority | Total Population | Minority Percent of Population |
|---|---|---|---|
| North Carolina | 2,402,158 | 8,049,313 | 29.8 |
| Brunswick County | 13,789 | 73,143 | 18.9 |
| New Hanover County | 33,854 | 160,307 | 21.1 |
| Pender County | 11,641 | 41,082 | 28.3 |
| NC Census Tract 020100, Census Block Group 1 (Brunswick County) | 900 | 1,983 | 45.4 |
| NC Census Tract 011500, Census Block Group 5 (New Hanover County) | 1,248 | 2,016 | 61.9 |
| NC Census Tract 011604, Census Block Group 1 (New Hanover County) | 34 | 155 | 21.9 |
| NC Census Tract 011500, Census Block Group 1 (New Hanover County)[a] | 402 | 2,193 | 18.3 |
| NC Census Tract 011604, Census Block Group 2 (New Hanover County) | 287 | 2,429 | 11.8 |
| NC Census Tract 011603, Census Block Group 1 (New Hanover County) | 401 | 1,079 | 37.2 |
| NC Census Tract 011500, Census Block Group 2 (New Hanover County) | 232 | 1,665 | 13.9 |
| NC Census Tract 011603, Census Block Group 2 (New Hanover County) | 621 | 3,285 | 18.9 |
| NC Census Tract 011500, Census Block Group 4 (New Hanover County) | 40 | 957 | 4.2 |
| NC Census Tract 011603, Census Block Group 3 (New Hanover County) | 577 | 1,410 | 40.9 |
| NC Census Tract 011500, Census Block Group 3 (New Hanover County) | 93 | 494 | 18.8 |
| NC Census Tract 980500, Census Block Group 4 (Pender County) | 835 | 1,992 | 41.9 |
| NC Census Tract 980600, Census Block Group 3 (Pender County) | 538 | 1,232 | 43.7 |
| NC Census Tract 980600, Census Block Group 1 (Pender County) | 451 | 827 | 54.5 |
| NC Census Tract 980600, Census Block Group 2 (Pender County) | 1,492 | 4,993 | 29.9 |

Reference: U.S. Census Bureau, 2000.

[a] Census Block Group within which the Wilmington Site is located.

**Table 3.10-4. Regional Population below Poverty (1999)**

| Area | Population for Whom Poverty Status Is Determined: Total | Population for Whom Poverty Status Is Determined: Income in 1999 Below Poverty Level | Percent of Population with 1999 Income Below the Poverty Level |
|---|---|---|---|
| North Carolina | 7,805,328 | 958,667 | 12 |
| Brunswick County | 72,293 | 9,095 | 13 |
| New Hanover County | 156,609 | 20,445 | 13 |
| Pender County | 39,956 | 5,429 | 14 |
| NC Census Tract 020100, Census Block Group 1 (Brunswick County) | 1,952 | 283 | 14 |
| NC Census Tract 011500, Census Block Group 1 (New Hanover County)[a] | 2,168 | 146 | 7 |
| NC Census Tract 011500, Census Block Group 2 (New Hanover County) | 1,665 | 139 | 8 |
| NC Census Tract 011500, Census Block Group 3 (New Hanover County) | 494 | 8 | 2 |
| NC Census Tract 011500, Census Block Group 4 (New Hanover County) | 957 | 79 | 8 |
| NC Census Tract 011500, Census Block Group 5 (New Hanover County) | 2,016 | 324 | 16 |
| NC Census Tract 011603, Census Block Group 1 (New Hanover County) | 1,054 | 76 | 7 |
| NC Census Tract 011603, Census Block Group 2 (New Hanover County) | 3,285 | 258 | 8 |
| NC Census Tract 011603, Census Block Group 3 (New Hanover County) | 1,012 | 171 | 17 |
| NC Census Tract 011604, Census Block Group 1 (New Hanover County) | 155 | 29 | 19 |
| NC Census Tract 011604, Census Block Group 2 (New Hanover County) | 2,411 | 258 | 11 |
| NC Census Tract 980500, Census Block Group 4 (Pender County) | 1,932 | 231 | 12 |
| NC Census Tract 980600, Census Block Group 1 (Pender County) | 826 | 302 | 37 |
| NC Census Tract 980600, Census Block Group 2 (Pender County) | 4,958 | 789 | 16 |
| NC Census Tract 980600, Census Block Group 3 (Pender County) | 1,232 | 108 | 9 |

Reference: U.S. Census Bureau, 2000.

[a] Census Block Group within which the Wilmington Site is located.

**Table 3.10-5. Population Density in Region (2007)**

| County | Total 2006 Population | Total 2030 Population | Land Area (mi2) | Population per Square Mile (2006) | Population per Square Miles (2030) |
|---|---|---|---|---|---|
| Brunswick County | 94,945 | 164,165 | 864 | 109.9 | 190.0 |
| New Hanover County | 182,591 | 271,030 | 207 | 882.1 | 1309.3 |
| Pender County | 48,630 | 78,479 | 871 | 55.8 | 90.1 |
| **Three-County Total** | 326,166 | 513,674 | 1,942 | 168.0 | 264.5 |

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

**Table 3.10-6. Employment Characteristics of Region (2000)**

| County | Total Labor Force | Labor Force in Armed Services | Employed Civilian Labor Force | Unemployed Labor Force | Percent Unemployed Labor Force[a] |
|---|---|---|---|---|---|
| Brunswick County | 34,240 | 318 | 32,355 | 1,567 | 4.58 |
| New Hanover County | 86,628 | 454 | 81,238 | 4,936 | 5.70 |
| Pender County | 19,087 | 115 | 17,896 | 1,076 | 5.64 |
| **Three-County Total** | 139,955 | 887 | 131,489 | 7,579 | 5.42 |

Reference: U.S. Census Bureau, 2000.

[a] Percent Unemployed Labor Force is calculated by dividing the number of unemployed workers in each county by the total labor force in that county.

**Table 3.10-7. Employment by Industry in Region (2000)**

| Industry | Brunswick County | | New Hanover County | | Pender County | | Three-County Total | | North Carolina | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| Agriculture, forestry, fishing and hunting, and mining | 422 | 1.3 | 369 | 0.5 | 630 | 3.5 | 1,421 | 1.1 | 61,185 | 1.6 |
| Construction | 5,375 | 16.6 | 8,130 | 10.0 | 2,468 | 13.8 | 15,973 | 12.1 | 312,038 | 8.2 |
| Manufacturing | 2,660 | 8.2 | 8,001 | 9.8 | 2,632 | 14.7 | 13,293 | 10.1 | 755,252 | 19.7 |
| Wholesale trade | 799 | 2.5 | 2,480 | 3.1 | 645 | 3.6 | 3,924 | 3.0 | 131,330 | 3.4 |
| Retail trade | 4,301 | 13.3 | 11,407 | 14.0 | 2,367 | 13.2 | 18,075 | 13.7 | 439,868 | 11.5 |
| Transportation and warehousing, and utilities | 2,027 | 6.3 | 3,349 | 4.1 | 984 | 5.5 | 6,360 | 4.8 | 176,412 | 4.6 |
| Information | 451 | 1.4 | 2,013 | 2.5 | 253 | 1.4 | 2,717 | 2.1 | 89,797 | 2.3 |
| Finance, insurance, real estate, and rental and leasing | 1,930 | 6.0 | 5,060 | 6.2 | 749 | 4.2 | 7,739 | 5.9 | 231,222 | 6.0 |
| Professional, scientific, management, administrative, and waste management services | 2,469 | 7.6 | 7,693 | 9.5 | 1,313 | 7.3 | 11,475 | 8.7 | 296,075 | 7.7 |
| Educational, health and social services | 4,779 | 14.8 | 16,202 | 19.9 | 2,704 | 15.1 | 23,685 | 18.0 | 733,440 | 19.2 |
| Arts, entertainment, recreation, accommodation and food services | 3,957 | 12.2 | 8,761 | 10.8 | 953 | 5.3 | 13,671 | 10.4 | 265,585 | 6.9 |
| Other services (except public administration) | 1,675 | 5.2 | 4,408 | 5.4 | 1,089 | 6.1 | 7,172 | 5.5 | 176,908 | 4.6 |
| Public administration | 1,510 | 4.7 | 3,365 | 4.1 | 1,109 | 6.2 | 5,984 | 4.6 | 155,629 | 4.1 |
| **Total** | 32,355 | 100 | 81,238 | 100 | 17,896 | 100 | 131,489 | 100 | 3,824,741 | 100 |

Reference: U.S. Census Bureau, 2000.

**Table 3.10-8. Income Data for Region**

| | Brunswick County | New Hanover County | Pender County | North Carolina |
|---|---|---|---|---|
| Per capita income in 1999 | $19,857 | $23,123 | $17,882 | $20,307 |
| Percent of State per capita income | 98% | 114% | 88% | 100% |
| Median household income in 1999 | $35,888 | $40,172 | $35,902 | $39,184 |
| Percent of State median household income | 92% | 103% | 92% | 100% |

Reference: U.S. Census Bureau, 2000.

**Table 3.10-9. Measures of Economic Output by Sector and County for Counties in the Region (2002)**

| NAICS[a] | Description | Units ($1,000) | Brunswick County, NC | New Hanover County, NC | Pender County, NC | Three-County Total | Wilmington, NC Metropolitan Statistical Area |
|---|---|---|---|---|---|---|---|
| 11 | Agriculture | Sales | 34,856 | 3,345 | 101,662 | 139,863 | N/A |
| 31-33 | Manufacturing | Total value of shipments | 653,606 | 1,919,162 | 111,443 | 2,684,211 | 2,684,211 |
| 42 | Wholesale Trade | Sales | 68,970 | 1,229,257 | 289,834 | 1,588,061 | 1,588,061 |
| 44-45 | Retail Trade | Sales | 648,538 | 2,993,200 | 172,901 | 3,814,639 | 3,814,639 |
| 51 | Information | Receipts | N/A | N/A | N/A | N/A | N/A |
| 53 | Real Estate and Rental and Leasing | Revenue | D | 179,303 | D | 179,303 | 289,648 |
| 54 | Professional, Scientific, and Technical Services | Receipts | D | 690,626 | D | 690,626 | 741,996 |
| 56 | Administrative and Support and Waste Management and Remediation Services | Receipts | 45,625 | 264,734 | 7,962 | 318,321 | 318,321 |
| 61 | Education Services | Receipts | D | D | D | D | 25,646 |
| 62 | Health Care and Social Assistance | Receipts | 142,796 | 1,029,389 | 52,152 | 1,224,337 | 1,224,337 |
| 71 | Arts, Entertainment, and Recreation | Receipts | 44,407 | 65,013 | 4,253 | 113,673 | 113,673 |
| 72 | Accommodation and Food Services | Sales | 92,047 | 350,447 | 19,214 | 461,708 | 461,708 |
| 81 | Other Services (except Public Administration) | Receipts | 29,820 | 181,773 | 13,220 | 224,813 | 224,813 |
| **Total** | | | 1,725,809 | 8,902,904 | 670,979 | 11,299,692 | 11,487,053 |

Notes: D = Withheld by the U.S. Census Bureau to avoid disclosing data for individual companies; N/A = Not available or not comparable.

Reference: U.S. Census Bureau, 2002; USDA, 2004.

[a] North American Industry Classification System. http://www.census.gov/epcd/www/naics html

**Table 3.10-10. Property Tax Rates in Region (Fiscal Year 2006 to 2007)**

| County | County Property Tax Rate ($/$100 of value) | Range of Tax Rates for Municipalities inside County ($/$100 of value) |
|---|---|---|
| Brunswick County | 0.54 | 0.05 to 0.465 |
| New Hanover County | 0.685 | 0.143 to 0.46 |
| Pender County | 0.65 | 0.05 to 0.66 |

Reference: NCDOR, 2007.

**Table 3.10-11. North Carolina Personal Income Tax Rates (Fiscal Year 2006 to 2007)**

| Income | Income Tax Rate |
|---|---|
| $0 to $12,750 | 6% |
| $12,751 to $60,000 | $765 + 7% of income over $12,750 |
| $60,001 to $120,000 | $4,072.50 + 7.75% of income over $60,000 |
| Over $120,001 | $8,722.50 + 8.25% of income over $120,000 |

Reference: NCDOR, 2006.

**Table 3.10-12. Housing Characteristics in Region (2000)**

| | Brunswick County | New Hanover County | Pender County | 3-County Total |
|---|---|---|---|---|
| Total | 51,431 | 79,616 | 20,798 | 151,845 |
| Urban | 20,494 | 76,291 | 987 | 97,772 |
| Percent urban | 40% | 96% | 5% | 64% |
| Rural | 30,937 | 3,325 | 19,811 | 54,073 |
| Percent rural | 60% | 4% | 95% | 36% |
| Occupied | 30,438 | 68,183 | 16,054 | 114,675 |
| Owner occupied | 25,013 | 44,109 | 13,260 | 82,382 |
| Renter occupied | 5,425 | 24,074 | 2,794 | 32,293 |
| Vacant | 20,993 | 11,433 | 4,744 | 37,170 |
| For rent | 2,134 | 3,946 | 438 | 6,518 |
| For sale only | 981 | 1,470 | 322 | 2,773 |
| Rented or sold, not occupied | 389 | 541 | 177 | 1,107 |
| For seasonal, recreational, or occasional use | 15,540 | 4,387 | 2,881 | 22,808 |
| For migrant workers | 23 | 2 | 29 | 54 |
| Other vacant | 1,926 | 1,087 | 897 | 3,910 |

Reference: U.S. Census Bureau, 2000.

**Table 3.10-13. Value of All Owner-Occupied Housing Units in Region (2000)**

| Value | Number of Units | | | |
|---|---|---|---|---|
| | Brunswick County | New Hanover County | Pender County | Region Total |
| Less than $24,999 | 2,002 | 1,771 | 1,315 | 5,088 |
| $25,000 to $49,999 | 2,955 | 1,417 | 1,408 | 5,780 |
| $50,000 to $99,999 | 8,414 | 10,951 | 5,268 | 24,633 |
| $100,000 to $199,999 | 7,846 | 20,172 | 3,545 | 31,563 |
| $200,000 to $499,999 | 3,376 | 8,034 | 1,597 | 13,007 |
| Over $500,000 | 427 | 1770 | 127 | 2,324 |
| Total Owner-Occupied Units | 25,020 | 44,115 | 13,260 | 82,395 |
| **Median Value** | | | | |
| Median value for all Owner-Occupied Housing Units | $95,200 | $127,900 | $86,900 | |

Reference: U.S. Census Bureau, 2000.

**Table 3.10-14. Privately Owned Residential Building Permits in Region[a]**

| Year | Brunswick County | | | New Hanover County | | | Pender County | | | Regional Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bldgs | Units | Construction Cost | Bldgs | Units | Construction Cost | Bldgs | Units | Construction Cost | Bldgs | Units | Construction Cost |
| 2000 | 1,354 | 1,449 | 161,460,915 | 1444 | 1860 | 207,884,861 | 302 | 348 | 53,954,610 | 3,100 | 3,657 | 423,300,386 |
| 2001 | 2,035 | 2,104 | 258,948,811 | 1604 | 2459 | 258,610,440 | 324 | 330 | 50,604,333 | 3,963 | 4,893 | 568,163,584 |
| 2002 | 2,483 | 2,642 | 353,737,759 | 1893 | 2432 | 349,512,815 | 423 | 423 | 62,556,363 | 4,799 | 5,497 | 765,806,937 |
| 2003 | 2,841 | 2,870 | 399,326,970 | 2132 | 2904 | 410,707,087 | 645 | 681 | 72,734,164 | 5,618 | 6,455 | 882,768,221 |
| 2004 | 3,599 | 3,829 | 529,518,553 | 2601 | 3594 | 548,287,493 | 868 | 909 | 108,229,724 | 7,068 | 8,332 | 1,186,035,770 |
| 2005 | 4,320 | 4,710 | 724,937,974 | 2560 | 3401 | 594,003,743 | 1,068 | 1,095 | 145,927,904 | 7,948 | 9,206 | 1,464,869,621 |
| 2006 | 4,163 | 4,418 | 721,389,626 | 1526 | 2011 | 417,281,551 | 597 | 678 | 85,435,124 | 6,286 | 7,107 | 1,224,106,301 |

Reference: U.S. Census Bureau, 2007b.

[a] Represents new buildings or units per month.

**Table 3.10-15. Number of Schools in Region by Type**

| County | Elementary | Middle | Secondary | Combined | Post Secondary |
|---|---|---|---|---|---|
| Brunswick | 11 | 3 | 3 | 5 | 1 |
| New Hanover | 36 | 6 | 3 | 5 | 5 |
| Pender | 6 | 3 | 2 | 1 | 0 |
| **Total** | 53 | 12 | 8 | 11 | 6 |

Reference: ESRI, 2007.

**Table 3.10-16. Enrollment by Level of School in Region (2000)**

| | Brunswick County | New Hanover County | Pender County |
|---|---|---|---|
| Enrolled in nursery school, preschool | 869 | 2,921 | 479 |
| Enrolled in kindergarten | 838 | 1,893 | 569 |
| Enrolled in grade 1 to grade 4 | 3,434 | 8,068 | 2,223 |
| Enrolled in grade 5 to grade 8 | 3,876 | 7,065 | 2,480 |
| Enrolled in grade 9 to grade 12 | 3,514 | 7,384 | 2,113 |
| Enrolled in college, undergraduate years | 1,853 | 13,664 | 1,178 |
| Enrolled in graduate or professional school | 209 | 1,298 | 161 |
| **Total** | 14,593 | 42,293 | 9,203 |

Reference: U.S. Census Bureau, 2000.

**Table 3.10-17. Educational Facilities in the Vicinity of Wilmington Site[a]**

| Name | Type | Public or Private | Distance (miles) | Total Students | Teachers (FTEs) | Student to Teacher Ratio |
|---|---|---|---|---|---|---|
| Wrightsboro Elementary | Elementary | Public | 3.35 | 584 | 34 | 17.2 |
| Emma B. Trask Middle | Middle | Public | 4.14 | 804 | 50 | 16.1 |
| Emsley A. Laney High | Secondary | Public | 4.55 | 1938 | 106 | 18.3 |
| Sonshine Academy | Combined | Private | 5.36 | NA | NA | NA |
| D. C. Virgo Middle | Middle | Public | 6.13 | 365 | 31 | 11.8 |
| Dorothy B. Johnson Elementary | Elementary | Public | 6.23 | 270 | 18 | 15.0 |
| Wilmington Christian Academy | Combined | Private | 6.34 | NA | NA | NA |
| Kings Memorial Christian Academy | Elementary | Private | 6.38 | NA | NA | NA |
| Calvary Education Center (Calvary Christian Schools) | Elementary | Private | 6.66 | 96 | 13 | |
| Cape Fear Community College | Post Secondary | Public | 6.82 | 7,501 | NA | NA |
| Annie H. Snipes Elementary | Elementary | Public | 6.97 | 424 | 28 | 15.1 |
| William H. Blount Elementary | Elementary | Public | 7.00 | NA | NA | NA |
| Wilmington Academy Of Arts & Sciences | Elementary | Private | 7.04 | 58 | 6 | 9.7 |
| New Hanover High | Secondary | Public | 7.10 | 1855 | 94 | 19.7 |
| Wilmington Seventh Day Adventist (SDA) School | Elementary | Private | 7.12 | 18 | 2.4 | 7.5 |
| Mr. Davids School Of Hair Design | Post Secondary | Private | 7.27 | 14 | NA | NA |
| St. Mary Elementary School (St. Mary Catholic School) | Elementary | Private | 7.35 | 178 | 13.8 | 12.9 |
| Rocky Point Elementary (Rocky Point Primary) | Elementary | Public | 7.36 | 428 | 30 | 14.3 |
| Gregory Elementary | Elementary | Public | 7.41 | 570 | 37 | 15.4 |
| Williston Middle | Middle | Public | 7.48 | 907 | 45 | 20.2 |
| Forest Hills Elementary | Elementary | Public | 7.76 | 374 | 29 | 12.9 |
| Dr. Hubert Eaton, Sr. Elementary | Elementary | Public | 7.98 | 596 | 34 | 17.5 |

Reference: ESRI, 2007; NCES, 2008.

N/A = Not available, FTE = Full Time Equivalent Employee (part-time workers are reported as a fraction of one full-time worker).

[a] Within 8 miles of Wilmington Site.

**Table 3.10-18. Level of Educational Attainment in Region (2000)**

| Level Attained | Brunswick County | | New Hanover County | | Pender County | | North Carolina | |
|---|---|---|---|---|---|---|---|---|
| | Number | % of Total | Number | % of Total | Number | % of Total | Number | % of Total |
| No schooling completed | 524 | 1 | 585 | 1 | 236 | 1 | 62,106 | 1 |
| Nursery to 4th grade | 292 | 1 | 269 | 0 | 231 | 1 | 39,672 | 1 |
| 5th and 6th grade | 784 | 1 | 881 | 1 | 497 | 2 | 101,549 | 2 |
| 7th and 8th grade | 1,737 | 3 | 2,083 | 2 | 1,166 | 4 | 210,168 | 4 |
| 9th grade | 1,939 | 4 | 2,070 | 2 | 990 | 3 | 173,305 | 3 |
| 10th grade | 2,546 | 5 | 2,918 | 3 | 1,205 | 4 | 214,182 | 4 |
| 11th grade | 1,878 | 4 | 2,826 | 3 | 1,355 | 5 | 181,982 | 3 |
| 12th grade, no diploma | 1,735 | 3 | 3,124 | 3 | 936 | 3 | 171,760 | 3 |
| High-school graduate (includes equivalency) | 17,482 | 33 | 26,327 | 24 | 9,574 | 34 | 1,502,978 | 28 |
| Some college, less than 1 year | 4,313 | 8 | 7,532 | 7 | 2,273 | 8 | 362,337 | 7 |
| Some college, 1 or more years, no degree | 7,508 | 14 | 17,235 | 16 | 4,409 | 15 | 718,167 | 14 |
| Associate degree | 3,417 | 6 | 8,481 | 8 | 1,822 | 6 | 358,075 | 7 |
| Bachelor's degree | 5,774 | 11 | 23,985 | 22 | 2,840 | 10 | 808,070 | 15 |
| Master's degree | 1,854 | 4 | 6,149 | 6 | 635 | 2 | 253,794 | 5 |
| Professional school degree | 561 | 1 | 2,055 | 2 | 260 | 1 | 78,279 | 1 |
| Doctorate degree | 261 | 0 | 1,151 | 1 | 137 | 0 | 46,570 | 1 |
| **Total** | 52,605 | 100 | 107,671 | 100 | 28,566 | 100 | 5,282,994 | 100 |

Reference: U.S. Census Bureau, 2000.

**Table 3.10-19. Regional Health Care Facilities**

| **Brunswick County** | | |
|---|---|---|
| **The Brunswick Community Hospital**<br>1 Medical Center Drive<br>P.O. Box139<br>Supply, NC 28462<br>910-755-812 | **J. Arthur Dosher Memorial Hospital**<br>924 Howe St.<br>Southport, NC 28461<br>910-457-5271 | **Coastal Primary & Immediate Care**<br>4654 Long Beach Rd.<br>Southport, NC 28461<br>910-457-0055 |
| **New Hanover County** | | |
| **Cape Fear Hospital**<br>5301 Wrightsville Ave.<br>Wilmington, NC 28403<br>910-452-8100 | **Family Medicine**<br>2523 Delaney Avenue<br>Wilmington, NC 28401<br>910-763-5522 | **The Oaks Behavioral Health Center**<br>2131 S. 17th Street<br>Wilmington, NC 28401<br>910-343-7787 |
| **Coastal Rehabilitation Hospital**<br>2131 S.17th Street<br>Wilmington, NC 28401<br>910-343-7845 | **New Hanover Regional Medical Center**<br>2131 South 17th Street<br>Wilmington, NC 28401<br>910-343-7000 | **Zimmer Cancer Center**<br>2131 S. 17th Street<br>Wilmington, NC 28401<br>910-342-3000 |
| **Cornelia Nixon Davis Health Care Center**<br>1011 Porter's Neck Rd.<br>Wilmington, NC 28405<br>910-686-7195 | | |
| **Pender County** | | |
| **Maple Hill Medical Center**<br>4811 N.C. Highway 50<br>Maple Hill, NC 28454<br>910-259-6444 | **Pender Memorial Hospital**<br>507 Freemont Street<br>P.O. Box 835<br>Burgaw, NC 28425<br>910-259-5451 | |

Reference: NHHN, 2007a

**Table 3.10-20. Regional Facilities Serving Senior Citizens and Those Needing Rehabilitation**

| Assisted Living Facilities | | |
|---|---|---|
| **Brunswick County** | | |
| **Carillon Assisted Living**<br>1125 East Leonard Street<br>Southport, NC 28461<br>910-454-4001<br>Adult Care: 72; Alzheimer's Care: 24 | **Eldo #1 Family Care Home**<br>2180 Maco Road<br>Leland, NC 28451<br>910-655-4102<br>Adult Care: 6 | **Shallotte Assisted Living**<br>P.O. Box 1559, 424 Mulberry<br>Shallotte, NC 28459<br>910-754-6621<br>Adult Care: 80 |
| **Corinthian Place Assisted Living**<br>1935 Lincoln Road<br>Leland, NC 28451<br>910-383-6235 | | |
| **New Hanover County** | | |
| **Alterra-Clare Bridge Memory**<br>Impairment Facility<br>3501 Converse Dr.<br>Wilmington, NC 28403<br>910-790-8664<br>Dementia Care: 38 | **Judge Family Care Home #1**<br>400 Judges Road, P.O. Box 3463<br>Wilmington, NC 28406<br>910-791-4862<br>Adult Care: 6 | **Port South Village**<br>210 Covil Avenue, P.O. Box 4669<br>Wilmington, NC 28406<br>910-762-4550<br>Adult Care: 72; Cottages: 6 |
| **Champion's Assisted Living**<br>1007 Porter's Neck Road<br>Wilmington, NC 28411<br>910-686-6462<br>Adult Care: 125; Dementia Care: 23 | **Judge Family Care Home #4**<br>400 Judges Road, P.O. Box 3468<br>Wilmington, NC 28406<br>910-395-4314<br>Adult Care: 5 | **Sherwood Manor Rest Home**<br>1605 Robinhood Rd.<br>Wilmington, NC 28401<br>910-762-9531<br>Adult Care: 40 |
| **Diversicare of Carolina Beach**<br>400 Goldsboro Ave., P.O. Box 1309<br>Carolina Beach, NC 28428<br>910-458-5833<br>Adult Care: 61 | **Lowe's Family Care Home #1**<br>6961 Carolina Beach Road,<br>Wilmington, NC 28412<br>910-799-9164<br>Adult Care: 5 | **Spring Arbor of Wilmington**<br>809 John D. Barry Drive<br>Wilmington, NC 28412<br>910-799-4999<br>Adult Care: 54; Dementia Care: 12 |
| **Eldo Family Care Home**<br>1803 Castle Street, P.O. Box 2028<br>Wilmington, NC 28403<br>910-772-8052<br>Adult Care: 6 | **Lowe's Family Care Home #2**<br>132 McQuillan Drive<br>Wilmington, NC 28412<br>910-791-2852<br>Adult Care: 6 | **The Commons at Brightmore**<br>2320 41st Street<br>Wilmington, NC 28403<br>910-392-6899<br>Adult Care: 169; Dementia Care: 32 |
| **Fannie Norwood Memorial Home**<br>501 S. 15th Street<br>Wilmington, NC 28401<br>910-762-0209<br>Adult Care: 16 | **Lowe's Family Care Home #3**<br>136 McQuillan Drive<br>Wilmington, NC 28412<br>910-791-7067<br>Adult Care: 6 | **The Kempton at Brightmore**<br>2298 41st Street<br>Wilmington, NC 28403<br>910-332-6899<br>Adult Care: 136 |
| **Hermitage House**<br>4724 Castle Hayne Road<br>Castle Hayne, NC 28429<br>910-675-2988<br>Adult Care: 84 | **Oakdale Heights**<br>2744 S. 17th Street<br>Wilmington, NC 28412<br>910-452-1114<br>Adult Care: 75; Dementia Care: 26 | **The Meadows of Wilmington**<br>4200 Jasmine Cove Way<br>Wilmington, NC 28408<br>910-395-5220<br>Adult Care: 64 |
| **Jordan's Family Care Home**<br>502 Manley Avenue<br>Wilmington, NC 28406<br>910-763-2761<br>Adult Care: 6 | | |

*(continued)*

**Table 3.10-20. Regional Facilities Serving Senior Citizens and Those Needing Rehabilitation (continued)**

| Assisted Living Facilities (continued) | | |
|---|---|---|
| **Pender County** | | |
| **DaySpring of Burgaw**<br>300 West Ashe St., P.O. Box 129<br>Burgaw, NC 28425<br>910-259-8070<br>Adult Care: 62 | **Forest Lane Family Care Home #1**<br>71 Forest Lane, Highway 133<br>Rocky Point, NC 28457<br>910-675-2835<br>Adult Care: 5 | **Karon's Family Care Home**<br>570 Oak Tree Road<br>Willard, NC 28478<br>910-285-3246<br>Adult Care: 6 |
| **Edith's Family Care Home**<br>4477 Shiloh Church Road,<br>Watha, NC 28478<br>910-283-9988<br>Beds: 3 | **Forest Lane Family Care Home #2**<br>71 Forest Lane, Highway 133, Rocky Point, NC 28457<br>910-675-3091<br>Adult Care: 6 | **PenDu Rest Home**<br>685 North Carolina Hwy. 50,<br>Wallace, NC 28466<br>910-259-4469<br>Adult Care: 19 |
| **Nursing Facilities** | | |
| **Brunswick County** | | |
| **Autumn Care Nursing and Rehab Center of Shallotte**<br>237 Mulberry Street<br>P.O. Box 2337<br>Shallotte, NC 28459<br>910-754-8858<br>Skilled: 130; Dementia Care: 40 | **Dosher Memorial Hospital Extended Care**<br>924 N. Howe Street<br>Southport, NC 28461<br>910-454-4607 or 457-7696<br>Skilled: 50; Adult Care: 14 | **Ocean Trail Convalescent Ctr**<br>430 Fodale Ave., P.O. Box 10249<br>Southport, NC 28461<br>910-457-9581<br>Skilled: 99; Adult Care: 17 |
| **Brunswick Cove Nursing Center**<br>1478 River Road, Hwy. 133 S.<br>P.O. Box 916<br>Winnabow, NC 28479<br>910-371-9894<br>Skilled: 175; Adult Care: 40 | | |
| **New Hanover County** | | |
| **Autumn Care of Myrtle Grove**<br>5725 Carolina Beach Road<br>Wilmington, NC 28412<br>910-792-1455<br>Skilled: 90; Adult Care: 20 | **Cypress Pointe Rehabilitation and Health Care Centre**<br>2006 S. 16th Street<br>Wilmington, NC 28401<br>910-763-6271<br>Skilled: 100 | **Mariner Health Care of Wilmington**<br>820 Wellington Ave.<br>Wilmington, NC 28401<br>910-343-0425<br>Skilled: 120; Adult Care: 30 |
| **Britthaven of Northchase**<br>3015 Enterprise Drive<br>Wilmington, NC 28405<br>910-791-3451<br>Skilled: 110; Adult Care: 20 | **Davis Health Care Center**<br>1011 Porter's Neck Road<br>Wilmington, NC 28411<br>910-686-7195<br>Skilled: 159; Dementia Care: 40 | **Silver Stream Nursing & Rehab. Ctr**<br>2305 Silver Stream Drive<br>Wilmington, NC 28401<br>(910) 362-3621<br>Skilled: 110 |
| **Britthaven of Wrightsville**<br>221 Summer Rest Road<br>Wilmington, NC 28405<br>910-256-3733<br>Skilled: 80 | **Liberty Commons Nursing Center**<br>121 Racine Drive<br>Wilmington, NC 28403<br>910-452-4070<br>Skilled: 100; Adult Care: 40 | |

*(continued)*

**Table 3.10-20. Regional Facilities Serving Senior Citizens and Those Needing Rehabilitation (continued)**

| Nursing Facilities (continued) | | |
|---|---|---|
| **Pender County** | | |
| **Huntington Health Care and Retirement Center**<br>311 S. Campbell Street<br>Burgaw, NC 28425<br>910-259-6007<br>Skilled: 121; Adult Care: 23 | **Pender Memorial Hospital Extended Care Skilled Nursing Unit**<br>507 E. Fremont St.<br>Burgaw, NC 28425<br>910-259-5451<br>Skilled: 43 | **Woodbury Wellness Center**<br>2778 Country Club Drive<br>Hampstead, NC 28443<br>910-270-1443<br>Skilled: 88; Adult: 24 |
| **Senior Citizen Centers** | | |
| **Brunswick County** | | |
| **Leland Senior Center**<br>1490 Village Rd. NE<br>Leland, NC 28451<br>910-371-3560 | **Shallotte Senior Citizens Center**<br>450 Main Street<br>P.O. Box 295<br>Shallotte, NC 28470<br>910-754-8776 | |
| **New Hanover County** | | |
| **Katie B. Hines Center**<br>308 Cape Fear Blvd.<br>Carolina Beach, NC 28428<br>910-458-6609 | **New Hanover County Senior Center**<br>New Hanover County Dept. of Aging<br>2222 S. College Road<br>Wilmington, NC 28403<br>910-798-6400 | |
| **Pender County** | | |
| **Heritage Place, Pender Adult Services**<br>P.O. Box 1251, 901 S. Walker Street<br>Burgaw, NC 28425<br>877-259-9119 toll free, 910-259-9119 | **Maple Hill Senior Center**<br>545 Maple Hill School Road<br>Maple Hill, NC 28454<br>910-259-8282 | **Topsail Senior Center**<br>20959 U.S. Highway 17 N.<br>Hampstead, NC 28443<br>910-270-0708 |

Reference: NHHN, 2007b.

**Table 3.10-21. Number of Persons per Type of Health Care Personnel in the Region**

| County | Primary Care Physicians | Registered Nurses | Dentists |
|---|---|---|---|
| Brunswick | 2,294 | 210 | 3,441 |
| New Hanover | 788 | 70 | 1,443 |
| Pender | 3,878 | 304 | 4,654 |

Reference: NCSCHS, 2005.

# Figures


**Figure 3.10-1. Population centers in the three counties surrounding the Wilmington Site.**

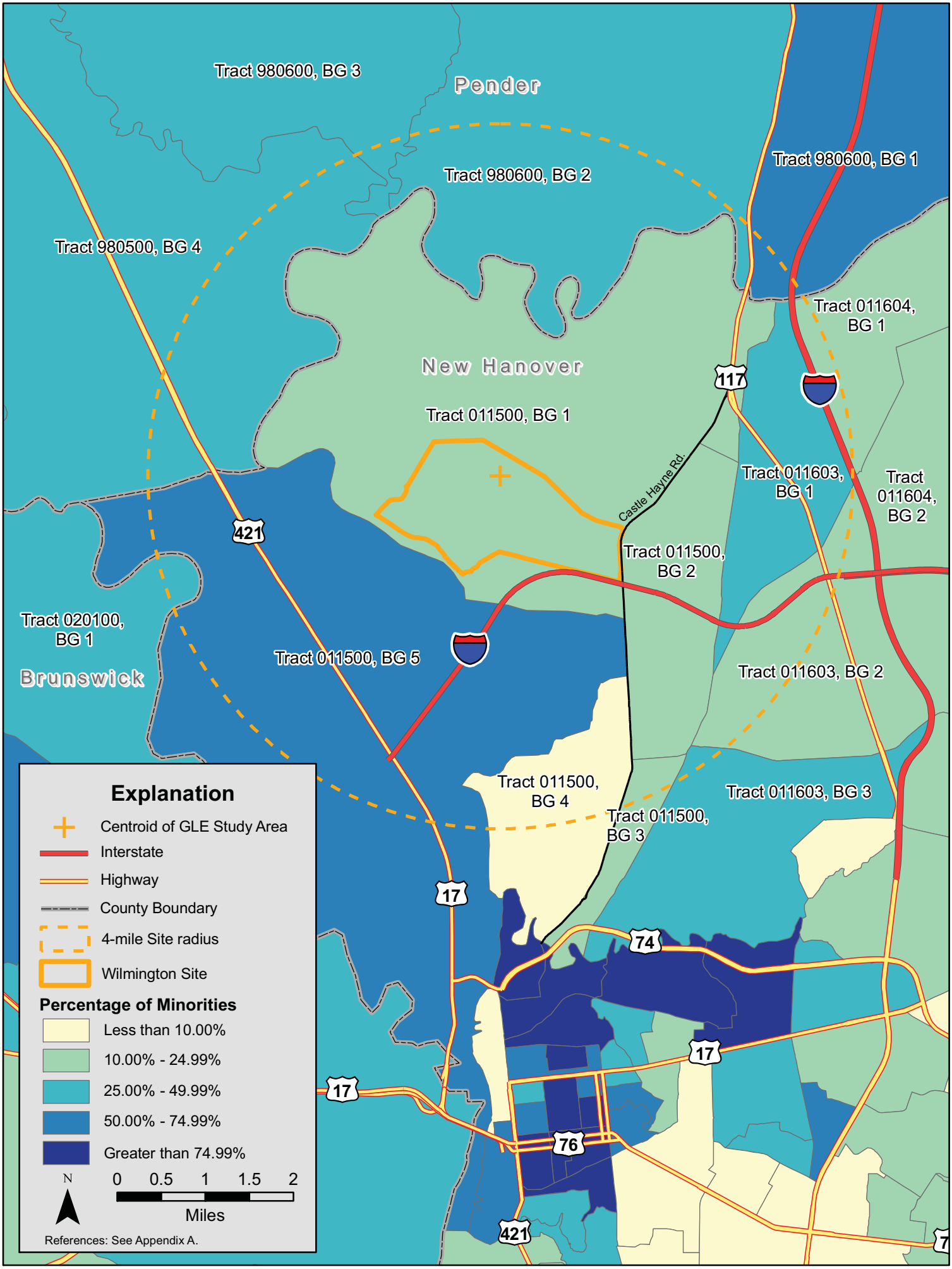


**Figure 3.10-2. Minority share of population by census block group within 4 miles (6.4 km) of the Wilmington Site.**

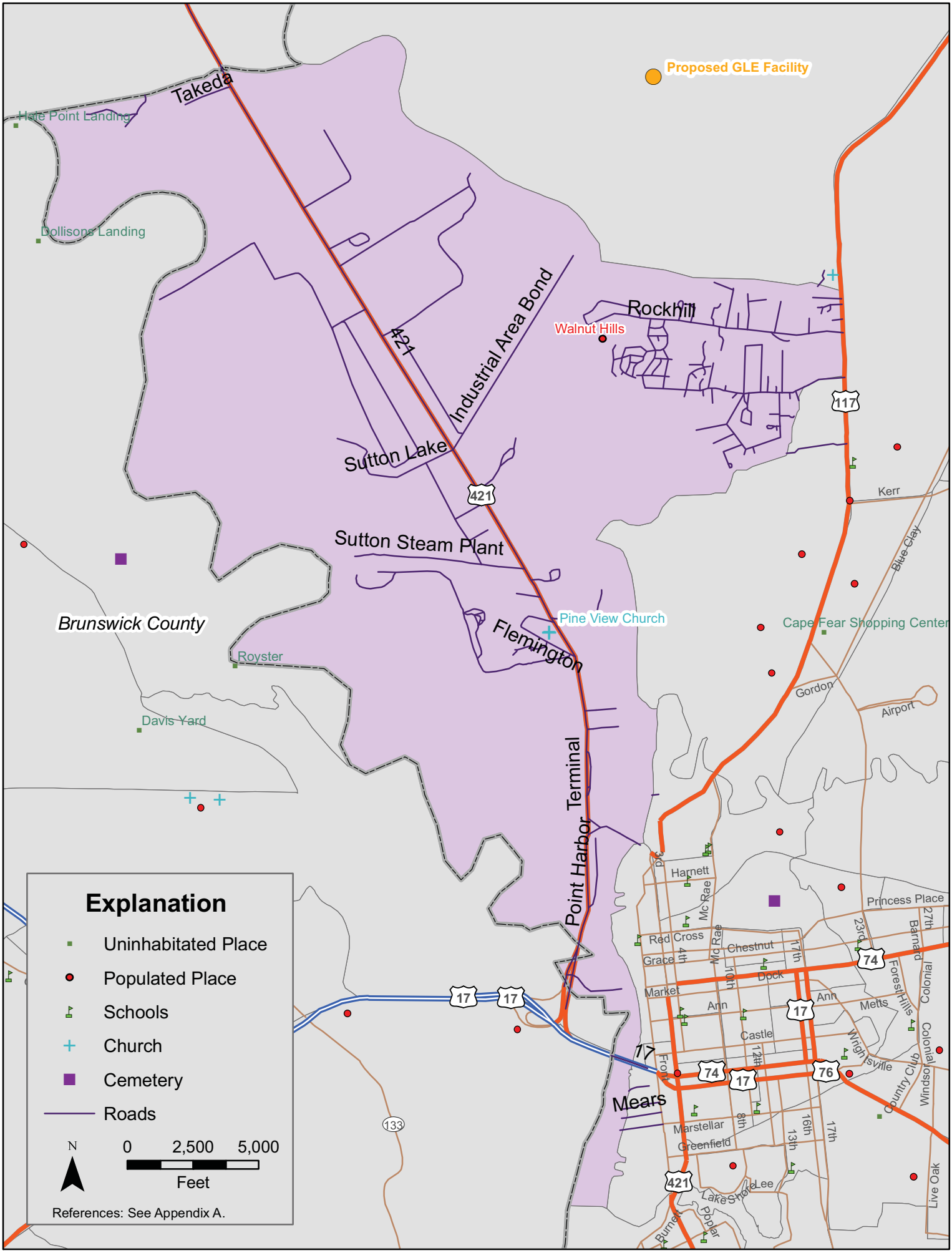


**Figure 3.10-3. Map of Census Tract 011500, Census Block Group 5.**

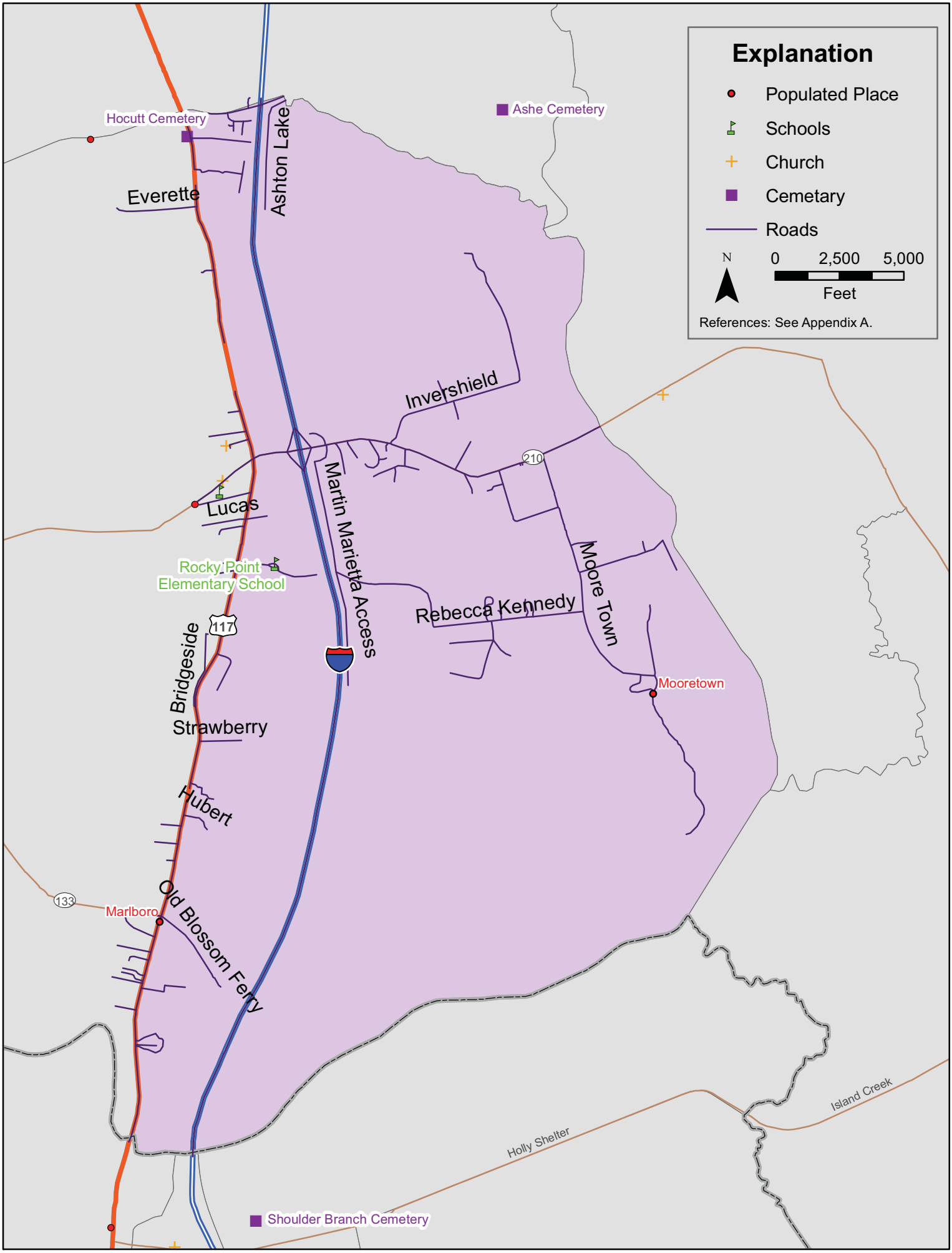


**Figure 3.10-4. Map of Census Tract 980600, Census Block Group 1.**

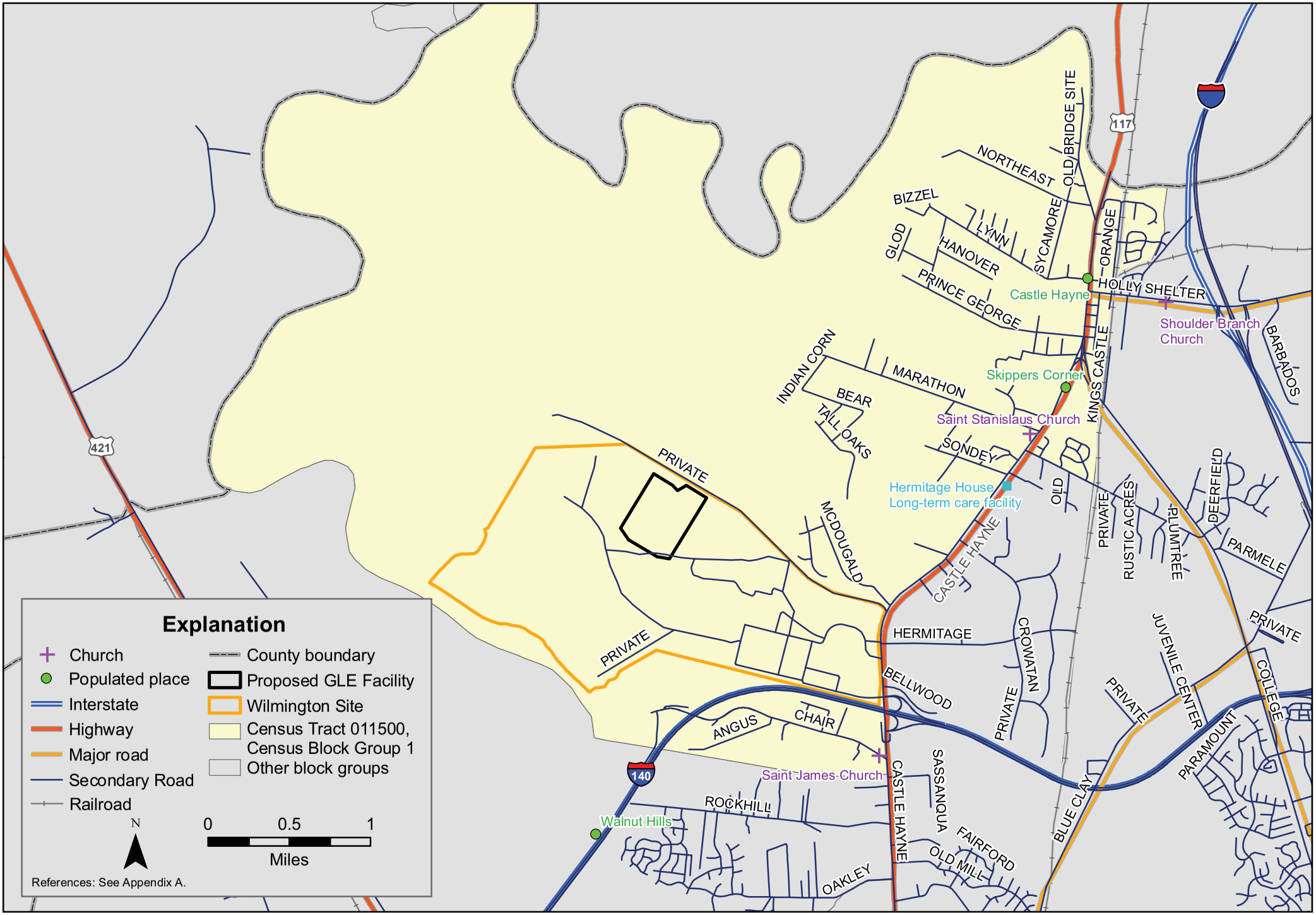


**Figure 3.10-5. Map of Census Tract 011500, Census Block Group 1.**

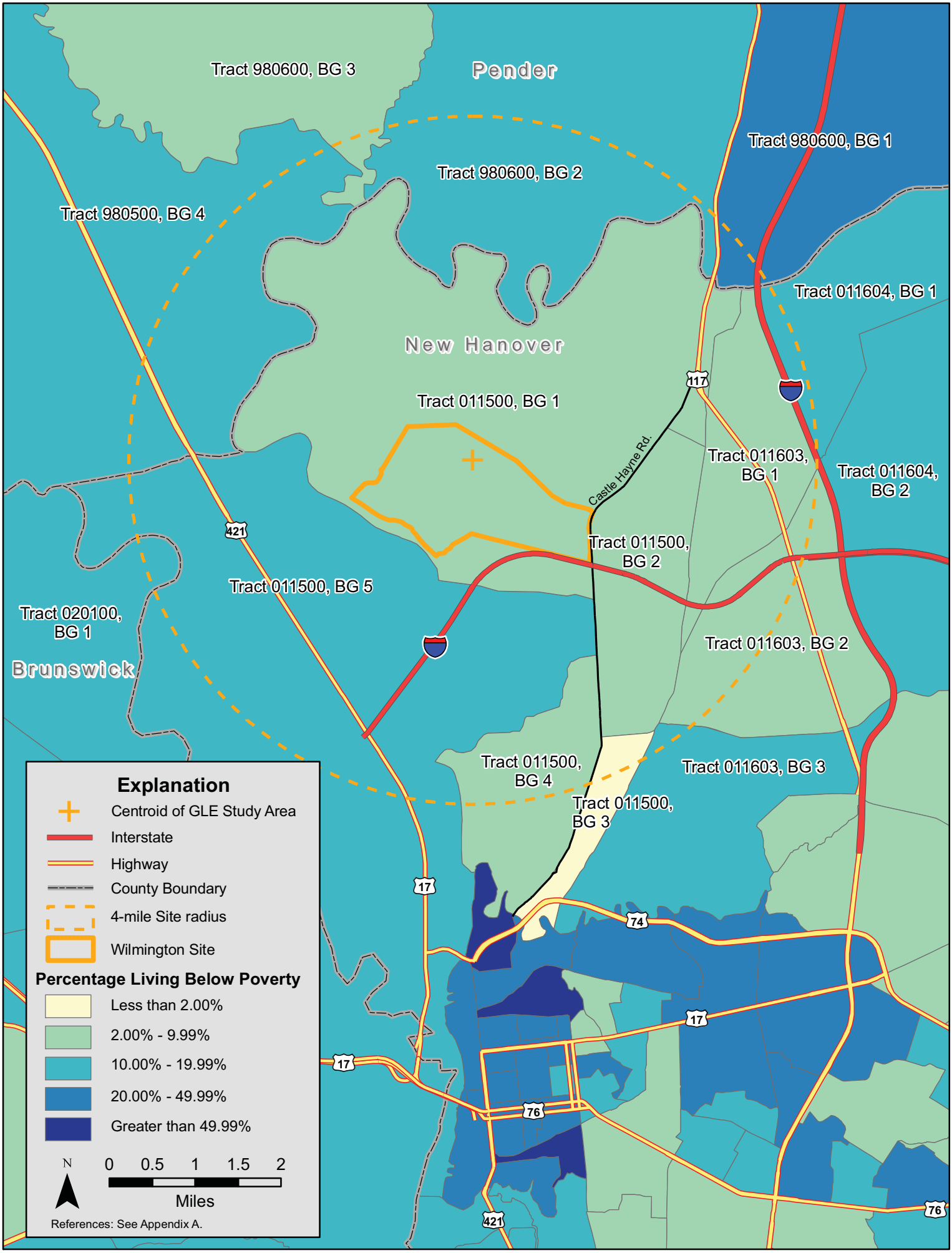


**Figure 3.10-6. Population with income below poverty in counties within 4 miles (6.4 km) of the Wilmington Site by census block group.**

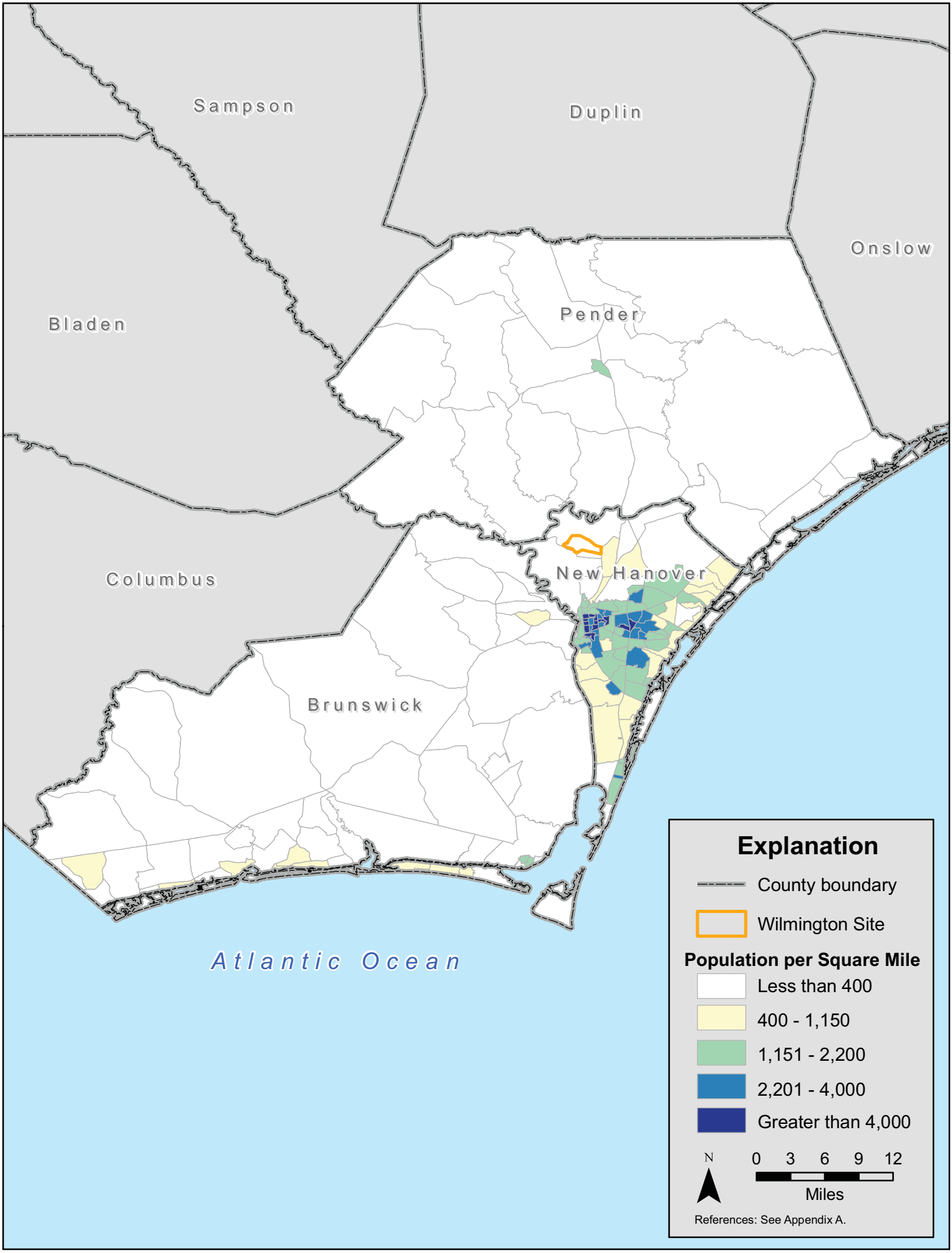


**Figure 3.10-7. Population density by census block group within the three-county study area.**

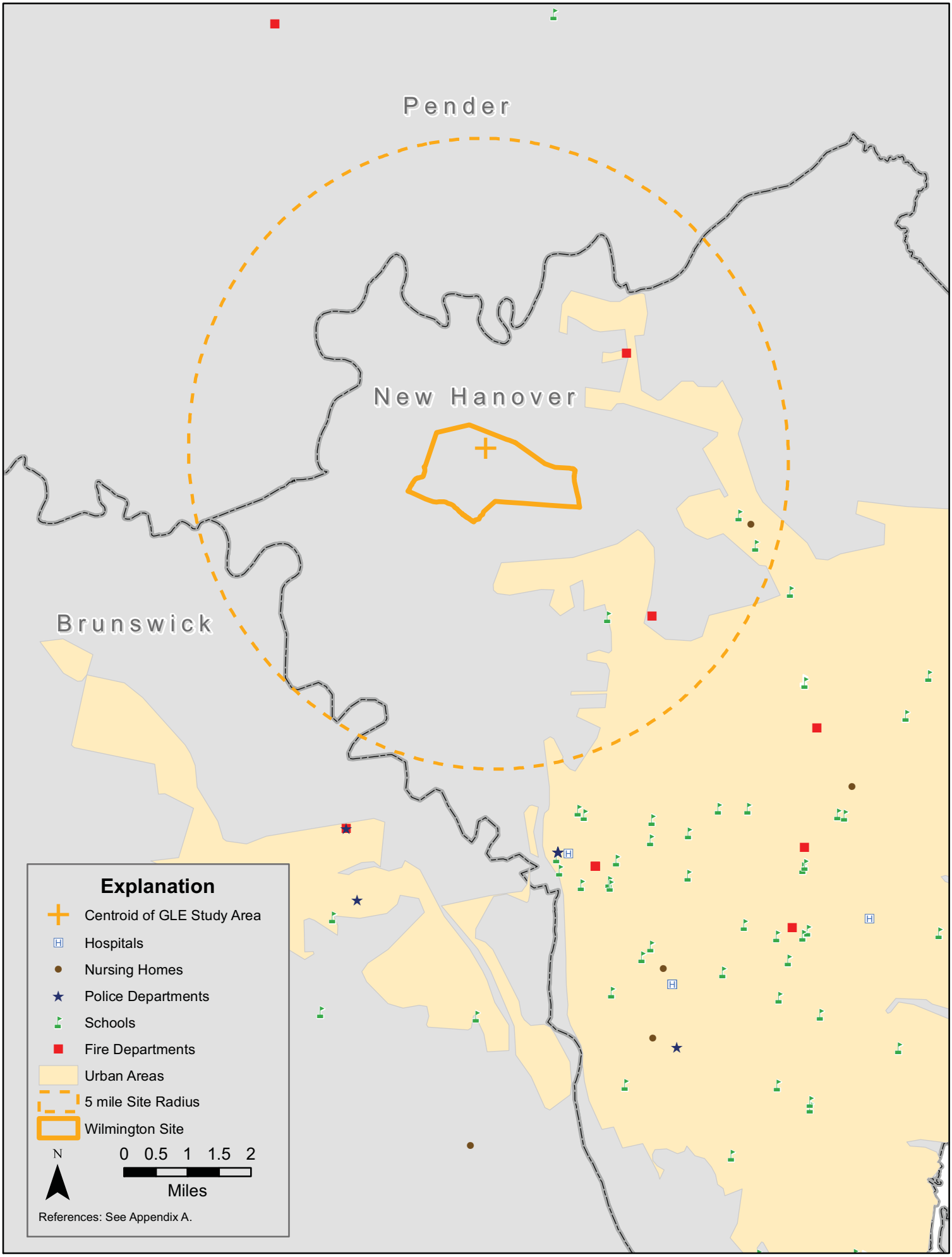


**Figure 3.10-8. Community characteristics of the three-county study area.**

# GLE Environmental Report

# Section 3.11 – Public and Occupational Health

## Revision 0

## December 2008

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## 3.11 Public and Occupational Health

There are two potential exposure hazards at the Wilmington Site that are described in this section: radiation and hydrogen fluoride (HF). Existing sources of radiation at the Site include natural background radiation sources and the man-made sources associated with the existing GNF-A nuclear FMO facility. The most significant potential non-radiological exposure hazard at the Site is HF; all other chemicals currently used at the FMO facility are used only in laboratory or cleaning agent quantities.

### 3.11.1 Major Sources and Levels of Background Radiation Exposure

Background radiation is defined by the NRC to be the following:

> "Radiation from cosmic sources; naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material) and global fallout as it exists in the environment from the testing of nuclear explosive devices. It does not include radiation from source, by-product, or special nuclear materials regulated by the Nuclear Regulatory Commission. The typically quoted average individual exposure from background radiation is 360 millirem (mrem) per year" (NRC, 2007).

Natural radiation sources are either primordial or cosmogenic. Primordial radionuclides are left over from when the earth and the universe were formed. They have long half-lives on the order of hundreds of millions of years and include the progeny or decay products of the long-lived radionuclides. Some common primordial radionuclides include uranium-235 ($^{235}$U), uranium-238 ($^{238}$U), thorium-232 ($^{232}$Th), radium-226 ($^{226}$Ra), radon-222 ($^{222}$Rn), and potassium-40 ($^{40}$K). Alpha, beta, and gamma radiation is emitted from these radionuclides, which eventually decay to a stable nuclide. Naturally occurring radioactivity in soil or rock is primordial in origin, varies with location, and constitutes a significant component of natural background radiation exposure to the public. In particular, radon, a gas from the earth's crust, is responsible for much of the public's exposure to natural radiation. Of an individual's approximate average annual radiation exposure of 300 millirems (mrem) (3 millisieverts [mSv]) from natural sources, radon gas accounts for 200 mrem (2 mSv; NRC, 2004), whereas terrestrial radiation (rocks and soil) accounts for an average annual dose of 28 mrem (0.28 mSv) (Idaho State University, 2007).[1]

Cosmogenic radiation permeates all of space and primarily originates from outside the earth's solar system. From high-speed heavy particles to high-energy photons and muons, cosmic radiation interacts mainly in the upper atmosphere, producing radioactive nuclides, usually with shorter half-lives than the primordial nuclides. The average annual dose attributable to cosmogenic sources is 28 mrem (0.28 mSv) (Idaho State University, 2007).

Additional background radiation exposure for the public from man-made sources includes exposure from medical x-rays, nuclear medicine, and some consumer products. Diagnostic medical procedures account for about 40 mrem (0.4 mSv) each year. Some consumer products such as tobacco, fertilizer, welding rods, gas mantles, luminous watch dials, and smoke detectors contribute another 10 mrem (0.1 mSv) to the public's annual radiation exposure. Natural background radiation contributes about 82% (~300 mrem [~3 mSv]) of the average annual dose received, whereas medical procedures contribute most of the remaining 18% (~60 mrem [~0.6 mSv]) for a total annual average radiation exposure of 360 mrem (3.6 mSv) (NRC, 2004).

[1] As noted in **Section 3.3.1.6** (and shown in **Figure 3.3-14**), the Mid-Atlantic Coastal Plain physiographic province counties are in a Low Potential zone for the presence of radon gas relative to other areas of North Carolina.

### 3.11.2 Current Sources and Levels of Exposure to Radioactive Materials

A radiation monitoring program has been established for the existing FMO facility at the Wilmington Site. The primary pathway for potential impacts on the general public is via radioactive gaseous emissions to the atmosphere through vent stacks associated with the FMO facility located on the southern portion of the Eastern Site Sector (see **Figure 1-2)**. These vent stacks are sampled continuously to assess the uranium concentration in the vent-exhaust gas stream. The collection filter in the stack-sampling system is removed on either a daily or weekly schedule and analyzed for gross alpha activity concentration. Stacks that are sampled daily, as opposed to those that are sampled weekly, are selected on the basis of their past contribution to the total emission levels (i.e., stacks with historically higher concentrations are sampled daily instead of weekly).

Emissions monitoring data presented in **Table 3.11-1** for the years 1995 through 2005 show that the total gross alpha activity released from the FMO facility vent stacks ranged from approximately 15 to 197 microcuries (μCi) per year. For reference purposes, 40 CFR 190 (*Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle, Final Environmental Statement, Volume 1*) requires written reporting if the gaseous emissions exceed 1,250 μCi per quarter (5,000 μCi per year). Gaseous emissions peaked at 197 μCi in 1997, which was the year that the FMO facility switched from a wet process of converting uranium hexafluoride ($UF_6$) to uranium dioxide ($UO_2$) to a Dry Conversion Process (DCP). The gaseous emissions data show a decreasing trend in total gross alpha activity since that year. In the most-recent data available, the gaseous emissions were 22 μCi in 2005, or 0.5% of the reporting threshold value. Between 1995 and 2005, the average gross alpha concentrations have varied from $0.004 \times 10^{-12}$ to $0.057 \times 10^{-12}$ μCi/cc. A conservative dilution factor of 100 at the Site boundary decreases the values to well below the most conservative regulatory limit (10 CFR 20, Appendix B, *Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage*) of $5 \times 10^{-14}$ μCi/cc for uranium 234 ($^{234}U$) (Class Y) (GNF-A, 2007a).

Ambient air radiation levels are monitored by the North Carolina Division of Radiation Protection (NCRP). Results of the ambient air samples taken at four sampling locations are presented in **Tables 3.11-2 through 3.11-5**. These sampling locations are shown relative to the FMO facility on **Figure 3.11-1**. Annual averages and maximum values are shown on these tables for each year for gross alpha and isotopic concentrations. Less than values (e.g., <0.02 μCi/cc) were treated as a real number (e.g., 0.02 μCi/cc) for averaging purposes, which tended to bias the average in a conservative (high) direction. Operations at the GNF-A FMO facility do not influence ambient air concentrations. Natural background levels of gross alpha particulate activity measured at the GE Dock (i.e., GEDK) on the Northeast Cape Fear River located 1 mile (1.6 km) west of the FMO facility (location AADK) and the activities measured in the vicinity of the FMO building were similar, typically ranging between 2 and $3.5 \times 10^{-15}$ μCi/cc from 1995 to 1999 (GNF-A, 2007a).

Available NCRP radiological analyses of vegetation samples collected from locations approximately 2 miles (3.2 km) northeast and 0.5 miles (0.8 km) south of the Wilmington Site (**Figure 3.11-2**) show very low gross alpha activity concentrations, thus indicating no radiological impact from Site operations (GNF-A, 2007a). Based on these data, no future radiological impact from the FMO facility to cropland and agricultural areas in the vicinity of the Site would be expected.

Soil samples have been collected to measure uranium concentrations on the Wilmington Site, as well as in the vicinity of the Site, as shown by the current (2005) soil-sampling locations indicated in **Figure 3.11-3** (GNF-A, 2007a). Average uranium concentrations for these current on-site and off-site locations and previous sampling locations are summarized in **Tables 3.11-6 and 3.11-7**, respectively. Data for uranium concentrations in soil at off-site locations for the years 1995 through 2005 are consistent with data from

prior years (e.g., 1989 through 1995, as provided by GE, 1997) and represent background levels. During re-licensing of the FMO facility in 1996, the total number of sampling locations was reduced because of consistent non-detectable levels. Samples from location ID No. 1A are from the sediment in the stormwater channel draining the controlled-access FMO facility area. Sample-site locations ID No. 20 and ID No. 21 were in the waste box storage pad areas (GNF-A, 2007a).

As discussed in **Section 3.4.1.2.2**, *Castle Hayne Aquifer (Regional Aquifers and Confining Layers)*, and **Section 3.4.2.2.2.1**, *Radiological Monitoring (GEH Monitoring Data)*, there are no public gross alpha exposure issues of concern related to groundwater and surface water quality, respectively. Similarly, there are no occupational gross alpha exposure issues of concern related to the Wilmington Site's potable groundwater supply (see **Section 3.4.1.2.2**, *Wilmington Site Groundwater Impacts*).

### 3.11.3 Major Sources and Levels of Chemical Exposure

The FMO facility at the Wilmington Site currently (since 1997) uses a DCP to convert $UF_6$ to $UO_2$. This conversion process offers an environmental advantage over the ammonium diuranate (ADU) process due to the elimination of liquid waste other than a small stream of dilute HF (typically 1%–2%), which can be neutralized through the Site's NPDES–permitted waste treatment operations. A by-product of the process is HF gas. Continuous fluoride monitoring is conducted on the vent stacks for the FMO facility DCP, uranium-recycle process, laboratory, and waste incinerator to measure fluoride releases to the atmosphere. The collection filter used in the stack-sampling system is a Whatman 41 filter impregnated with calcium carbonate or equivalent. The filter is removed either daily or weekly and analyzed for fluoride content. The quantity of fluoride released from the stack is calculated using the analytical results and total daily or weekly exhaust gas volume and the associated stack sampler volume (in ratio). Total annual fluoride emissions from the FMO facility for the years from 1995 through 2005 are summarized in **Table 3.11-8**. The total annual fluoride emissions values range from 1,383 grams (approximately 3 pounds) in the year 2002 to 3,296 grams (approximately 7.3 pounds) in the year 1999. Total annual fluoride emissions in the year 2005 were 1,505 grams (approximately 3.3 pounds) (GNF-A, 2007a). Under the current air quality permit issued by the NC DAQ to GNF-A for operation of air emission sources associated with the FMO facility (Permit No. 1161R19), total HF emissions from the DCP are limited to no greater than 0.63 lb per day (i.e., 24-hour period) and no greater than 0.064 lb in any one hour during the day (see **Table 3.6-23** in **Section 3.6.3.5**, *Wilmington Site Existing Air Emission Sources and Controls*). Monitoring data records demonstrate that the facility is in compliance with the air quality permit levels.

Several other TAPs are emitted from existing stationary sources at the Wilmington Site. These TAPs are discussed in **Section 3.6.3.5**, *Wilmington Site Existing Air Emission Sources and Controls*.

### 3.11.4 Historical Exposure to Radioactive Materials

#### 3.11.4.1 Public Exposure

As discussed further below, to minimize the possibility of accidental releases of radioactive and chemical gaseous materials to the atmosphere, the licensed material processing portion of the FMO facility is maintained under a negative pressure with respect to the outside environment. For the potentially exposed public, direct inhalation of routine, low-level airborne releases is the most-likely intake pathway. Using the nearest population center 2 miles (3.4 km) south of the Site and 2005 air stack releases, an individual dose of $8.5 \times 10^{-4}$ mrem was calculated using EPA's COMPLY code (GNF-A, 2007a), and releases were conservatively assumed to be $^{234}U$ (Class Y). Applying the individual dose to the entire 200,000 persons living in the area modeled, 0.17 person-rems was estimated for the surrounding population in the vicinity of the Site, which is several orders of magnitude lower than the annual average 60,000 person-rems received by this population due to natural background radiation. The annual natural background radiation

dose for the region of the Site is typical of that received from natural background radiation elsewhere in the United States (GNF-A, 2007a).

Using EPA's COMPLY code, annual radiation doses (1995–2005) to the nearest resident are shown in **Table 3.11-9**. The nearest known resident (current as of 2006) is located between 426 and 1260 ft (130 to 384 m) south of the FMO facility release points (i.e., stacks). Annual doses for the 1995–2005 period ranged from 0.03 mrem to 0.4 mrem. The NRC off-site individual exposure limit (10 CFR 20.1301, *Dose limits for individual members of the public*) is 100 mrem (1 mSv) per year. The dose has been decreasing over time, which coincides with GE's installation in 1997 of the DCP that eventually replaced the ADU process. In 2005, the dose to the nearest resident was 0.03% of the NRC limit (GNF-A, 2007a).

Direct irradiation of the public from the GNF-A FMO facility is not significant because gamma radiation exposure levels measured at the Site boundary are at background levels. Gross alpha ambient airborne concentrations measured at the southern fenceline are typically on the order of $4x10^{-15}$ µCi/cc (see **Table 3.11-4**). The air submersion dose for this concentration of mixtures of uranium isotopes is insignificant (GNF-A, 2007a).

### 3.11.4.2 Occupational Exposure

Worker health and safety at the Wilmington Site is protected as a result of the Industrial Safety Program and a Nuclear Safety Program administered by GNF-A. These programs comply with applicable state, NRC (10 CFR 20), and OSHA (29 CFR 1910, *Occupational Safety and Health Standards*) requirements.

The manager for Industrial Hygiene and Safety (IHS) is responsible for implementing the Industrial Safety Program. This individual's responsibilities include exposure assessment and monitoring, communication, training, program assessment, and recordkeeping. Any 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. All 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 equipment is assigned to workers. Shop-wide assessments are conducted every 2 years. Processes are also assessed upon installation of new equipment or introduction of a new chemical. Continuing efforts are made to further reduce or eliminate the hazards associated with the use of chemical and physical agents. The Industrial Safety Program is evaluated on an annual basis (GNF-A, 2007b).

The Nuclear Safety Function at the Wilmington Site is responsible for implementing the Nuclear Safety Program and maintaining criticality and radiological safety for all aspects of the nuclear fuel processes. This includes the receipt, conversion, fabrication, storage, and shipment of radioactive material. The Radiation Protection group within the Nuclear Safety Function provides support to operations, manages nuclear instrumentation, inventories radioactive material, and monitors State and federal radiation programs to ensure that worker dose is maintained As Low As Reasonably Achievable (ALARA). Exposure monitoring is conducted on radiation workers to evaluate the potential for personal exposure; if personal monitoring is not feasible for some reason, area monitoring in the work area may be used as representative of personal exposure. Time-weighted average and peak exposure doses are determined. Exposure monitoring records are maintained for a minimum of 30 years.

Operations are conducted under procedures that are written, reviewed, and verified by appropriate individuals in the Nuclear Safety Function to ensure worker dose at the Wilmington Site is ALARA. Any operational changes are reviewed to ensure that safe conditions are maintained. Radiation Work Permits (RWPs) are required for non-routine activities, particularly those performed by non-GNF-A employees, which generally are not covered by documented procedures. RWPs are issued by a radiation safety technician or supervisor for non-routine operations not addressed by an operating procedure when special

radiation-control requirements are necessary. The RWP specifies the necessary radiation safety controls, as appropriate, including personnel monitoring devices, protective clothing, and measures to be taken. RWPs are reviewed by a radiation safety supervisor. The RWP requirements are reviewed by each affected individual, and a copy of the RWP is made available to the affected workers throughout the duration of the activity. Work is monitored by the radiation safety technician or supervisor as required. RWPs have expiration dates, and the status of issued RWPs is reviewed on a weekly basis by a radiation safety technician or supervisor (GNF-A, 2007c).

Personal protective equipment (PPE) requirements are based on the nature of the work and chemical and/or radiological hazards present. PPE and personal safety systems are inspected and tested periodically and include the following:

- Protective clothing (e.g., anti-contamination clothing, gloves, shoe covers, hats, steel-toe shoes, hard hat, safety glasses, respirators)
- Self-contained breathing air supply and respirators (i.e., air purifying and air supplying)
- Safety showers and eyewash stations
- Stationary air samplers at work locations throughout the uranium-processing areas (samplers are read each shift)
- Bioassay monitoring program for workers working in radiological areas
- Time-in-area recording for each worker working in each radiological area
- Availability of first aid kits, on-location assistance for all shifts by emergency medical treatment team, on-site medical clinic for first-aid treatment, and special chemical exposure kits
- Health and hygiene programs, including periodic workplace monitoring for occupational exposure levels (GNF-A, 2007b).

Standard operating procedures (SOPs) used in the FMO facility specify confinement of uranium to process equipment, containers, or ventilated enclosures. Hoods and other localized ventilation designs are utilized to minimize personnel exposure to airborne uranium. Uranium-processing equipment is physically isolated in ventilated rooms. A defined controlled area provides physical isolation of uranium processing areas via access control, change rooms, and ventilation. The Radiation Protection group determines the appropriate PPE requirements for routine and non-routine tasks involving radiological hazards. Operators wear appropriate PPE when working in a radiological area, including anti-contamination clothing, gloves, shoe covers, and hats. 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 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).

Equipment maintenance includes periodic walkthroughs by personnel inspecting for leaks or other abnormalities and checking local instrumentation. Preventive-maintenance systems include documented routine inspections, calibrations, and periodic maintenance program; lubrication schedule; and records of equipment failures (GNF-A, 2007b, 2007c).

Because process spills or spills during container transport are unlikely and most equipment is contained in hoods, exposure among workers inside the building due to airborne $UO_2$ and triuranium octaoxide ($U_3O_8$) powder (Class-Y compounds) has been well below regulatory limits. Powder is stored in unicone, bicone, and hybrid containers, as well as Favorable Geometry Hybrid Containers (FGHC). Powder containers are closed when not in process, and the integrity of these containers has been certified and tested. Process rooms are enclosed in concrete walls with negative air pressure. Air exits the room through air exhausts into high-efficiency particulate air (HEPA) filters. The FMO building design and negative air pressure are barriers for powder containment (GNF-A, 2007b, 2007c).

The fire protection installation and testing at the FMO facility complies with NFPA Standards, North Carolina State Building Code system, and Factory Mutual requirements. Sprinkler protection in moderator-restricted areas is prohibited because the presence of water is contrary to nuclear criticality moderation-control requirements. Fire alarm initiating devices and signaling devices are controlled and monitored through the FMO facility's fire alarm system, which will signal at the local annunciator on the DCP control room panel and simultaneously alarm at the Emergency Control Center in the event of fire (GNF-A, 2007b, 2007c).

### 3.11.5 Occupational Injury Rates

The occupational injury rate at the Proposed GLE Facility is expected to be similar to that at the GNF-A facility. Recordable accidents, recordable injury and illness rates, lost-time accidents, and number of first aids for the GNF-A facility are summarized in **Table 3.11-10**. In 2006, 40% of first-aid injuries were to the hands, 20% were to the arms, and the rest were miscellaneous. The recordable injury and illness rate (1.01) at the GNF-A facility in 2006 was lower than the U.S. average (5.0). The recordable accidents in 2006 consisted of a finger fracture, finger laceration, cut to a hand, hand laceration, head gash, torn rotator cuff, abdominal strain, lower back strain, and ankle fracture. No fatalities have occurred in the nuclear facilities on the Wilmington Site.

For chemical exposures from 2000 to 2006, most were minor allergic reactions that resulted in skin irritations from unspecified chemicals. There were several acid burns and a few cases of chemical burns from caustics. All of the chemical exposures were treated with minor first aid. None required hospitalization.

### 3.11.6 Summary of Health Effects

#### 3.11.6.1 Health Effects from Radiological Source Exposures

Uranium may cause health effects in humans due to its chemical toxicity or its radioactive properties, and ingesting large amounts of uranium may damage the kidneys (ATSDR, 1999). Because the body has repair mechanisms against damage from radiation and chemical carcinogens, the biological effects of radiation on living cells may result in three outcomes: 1) injured or damaged cells repair themselves, resulting in no residual damage; 2) cells die, but are replaced through normal biological processes; or 3) cells incorrectly repair themselves, resulting in a biophysical change (NRC, 2004).

Studies of the association between radiation exposure and cancer development are mostly based on populations exposed to high levels of ionizing radiation, such as survivors of the atomic bombs dropped on Japan and recipients of selected diagnostic or therapeutic medical procedures. Cancers associated with high-dose exposure (>50,000 mrem [500 mSv]) include leukemia, breast, bladder, colon, liver, lung, esophagus, ovarian, multiple myeloma, and stomach cancers. There may also be an association between ionizing radiation exposure and cancers of the prostate, nasal cavity/sinuses, pharynx and larynx, and pancreas (NRC, 2004).

The time between radiation exposure and detection of cancer is known as the latent period and can be many years. Cancers that are the result of radiation exposure are indistinguishable from those that occur naturally or a result of chemical exposures. The National Cancer Institute suggests that other chemical and physical hazards and lifestyle factors significantly contribute to many of the same diseases. Although radiation may cause cancers at high doses, there are currently no data to unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, i.e., below about 10,000 mrem (100 mSv) (NRC, 2004). Populations in areas having high background levels, above 1,000 mrem (10 mSv) per year, such as Denver, have shown no adverse biological effects (NRC, 2004).

Radiation exposure limits for the general public have been established by the NRC in 10 CFR 20 and by EPA in 40 CFR 190. These limits are based on health-effects data from animal and human epidemiological studies. Exposure limits for the general public and occupational exposures are summarized in **Table 3.11-11**. The NRC limits annual exposure on a total-dose-equivalent exposure (100 mrem or 1 mSv), which includes external plus internal radiation exposures and a dose-equivalent rate (2 mrem or 0.02 mSv) in any 1-hour period in unrestricted areas accessible by members of the public who are not employees, but who may be present during the year at an enrichment facility (10 CFR 20). The annual whole body (25 mrem or 0.25 mSv), organ (25 mrem or 0.25 mSv), and thyroid (75 mrem or 0.75 mSv) dose-equivalent limits established by EPA (40 CFR 190) apply to the general public who are at off-site locations at or beyond a plant's site boundary. Public exposure at off-site locations due to routine operations at GNF-A comply with the more restrictive EPA limits.

The NRC standards also limit occupational radiation exposures to a total effective dose equivalent (TEDE) of 50 mSv (5 rem), which includes external and internal exposure (10 CFR 20). The NRC standards also restrict the dose equivalent to the lens of the eye (0.15 Sv [15 rem]), skin (0.5 Sv [50 rem]), and extremities (0.5 Sv [50 rem]), and the committed dose equivalent (CDE) to any internal organ (0.5 Sv [50 rem]) (10 CFR 20).

### 3.11.6.2 Health Effects from Chemical Source Exposures

The most significant potential nonradiological exposure hazard at the Wilmington Site is HF. Uranium hexafluoride readily reacts with air, moisture, and other compounds to produce HF. Compounds including uranyl fluoride ($UO_2F_2$) and small amounts of uranium tetrafluoride ($UF_4$) may also be produced (ATSDR, 1999). HF is a colorless, highly corrosive gas or liquid with a sharp, penetrating odor. HF can cause severe eye and respiratory irritation, necrosis, and edema, and ingestion of HF can result in vomiting, diarrhea, and circulatory collapse. Tissue burns and destruction can occur with contact to HF, and in large doses, HF's effects on the heart and lungs can result in death (ATSDR, 2003).

EPA and OSHA have established exposure limits for HF. Recommendations regarding exposure to HF have also been established by the Agency for Toxic Substances and Disease Registry and the National Institute for Occupational Safety and Health. The American Conference of Governmental Industrial Hygienist also recommend exposure levels for HF. **Table 3.11-12** summarizes EPA and OSHA standards, as well as other federal and state exposure guidelines.

Other chemicals currently used at the FMO facility are used only in laboratory or cleaning agent quantities.

# Tables

**Table 3.11-1. Radioactive Gaseous Emissions Monitoring Data[a]**

| Year | No. of Vent Stacks | Total Air Volume Vented per Year ($10^{15}$ cc/yr) | Total Gross Alpha Activity (µCi) | Average Gross Alpha Concentration at Emission Points (x $10^{-12}$ µCi/cc) |
|---|---|---|---|---|
| 1995 | 30 | 2.38 | 115.5 | 0.049 |
| 1996 | 30 | 3.07 | 114.1 | 0.037 |
| 1997 | 32 | 3.43 | 197.0 | 0.057 |
| 1998 | 29 | 3.59 | 126.2 | 0.035 |
| 1999 | 27 | 3.56 | 43.0 | 0.012 |
| 2000 | 26 | 3.50 | 32.8 | 0.009 |
| 2001 | 26 | 3.54 | 23.2 | 0.007 |
| 2002 | 26 | 3.58 | 18.0 | 0.005 |
| 2003 | 26 | 3.53 | 16.3 | 0.005 |
| 2004 | 26 | 3.46 | 14.9 | 0.004 |
| 2005 | 26 | 3.24 | 22.2[b] | 0.007 |

Reference: GNF-A, 2007a.

[a] Summary for the years 1995–2005 from FMO vent stacks, Wilmington Site.

[b] HEPA filters were changed in 2005, resulting in slight increase in stack emissions.

**Table 3.11-2. Airborne Gross Alpha and Isotopic Concentrations: Northeast[a]**

| Year | Total Annual Site Uranium Emissions (grams/year) | Gross Alpha ($\times 10^{-15}$ µCi/cc) | | U-234 ($\times 10^{-15}$ µCi/cc) | | U-235 ($\times 10^{-15}$ µCi/cc) | | U-238 ($\times 10^{-15}$ µCi/cc) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Ave | Max | Ave | Max | Ave | Max | Ave | Max |
| 1995 | 21 | 2.16 | 5.50 | <0.02 | 0.08 | <0.01 | <0.02 | <0.01 | <0.02 |
| 1996 | 167 | <2.67 | 5.60 | <0.03 | <0.07 | <0.02 | <0.04 | <0.02 | <0.04 |
| 1997 | 290 | <2.32 | 16.00 | <0.09 | 0.22 | <0.01 | <0.03 | <0.03 | 0.06 |
| 1998 | 189 | 2.52 | 4.80 | <0.01 | 0.03 | <0.01 | <0.02 | <0.01 | <0.03 |
| 1999 | 62 | 3.46 | 9.10 | <0.03 | <0.07 | <0.02 | <0.05 | <0.02 | <0.06 |
| 2000 | 48 | 3.39 | 8.60 | <0.04 | 0.09 | <0.01 | <0.02 | <0.01 | <0.02 |
| 2001 | 33 | <2.64 | 6.70 | <0.03 | 0.22 | <0.01 | 0.06 | <0.02 | 0.09 |
| 2002 | 26 | 3.55 | 7.94 | <0.03 | 0.06 | <0.01 | <0.02 | <0.02 | 0.04 |
| 2003 | 23 | 2.94 | 10.30 | <0.02 | 0.04 | <0.01 | <0.01 | <0.02 | <0.03 |
| 2004 | 21 | 3.81 | 11.10 | <0.05 | 0.25 | <0.01 | <0.07 | <0.03 | <0.20 |
| 2005 | 32 | 4.08 | 13.80 | <0.03 | 0.06 | <0.01 | <0.02 | <0.02 | 0.04 |

Reference: GNF-A, 2007a.

Note: The minimum detection concentration (MDC) varies based on instrument calibration. The notation of "<" in the maximum column indicates that the sample was at or below the MDC. The notation of "<" in the average column indicates that at least one data point used to calculate the average by GE-Hitachi Nuclear Energy (GEH) was at or below the MDC.

[a] Ambient Air Northeast (AANE) monitoring location, northeast of FMO near sanitary lift station, Wilmington Site (see **Figure 3.11-1**).

**Table 3.11-3. Airborne Gross Alpha and Isotopic Concentrations: Southeast[a]**

| Year | Total Annual Site Uranium Emissions (grams/year) | Gross Alpha (x $10^{-15}$ µCi/cc) | | U-234 (x $10^{-15}$ µCi/cc) | | U-235 (x $10^{-15}$ µCi/cc) | | U-238 (x $10^{-15}$ µCi/cc) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Ave | Max | Ave | Max | Ave | Max | Ave | Max |
| 1995 | 21 | 2.27 | 5.30 | <0.05 | 0.37 | <0.01 | <0.02 | <0.01 | 0.05 |
| 1996 | 167 | 2.96 | 5.80 | <0.04 | 0.06 | <0.02 | <0.03 | <0.02 | <0.04 |
| 1997 | 290 | 2.92 | 5.90 | <0.05 | 0.13 | <0.01 | <0.03 | <0.02 | 0.04 |
| 1998 | 189 | <2.61 | 5.00 | <0.02 | 0.04 | <0.01 | <0.02 | <0.01 | <0.02 |
| 1999 | 62 | 3.51 | 8.70 | <0.03 | 0.04 | <0.02 | <0.04 | <0.02 | <0.04 |
| 2000 | 48 | 3.85 | 9.10 | <0.09 | 0.27 | <0.02 | 0.05 | <0.02 | 0.03 |
| 2001 | 33 | <2.93 | 7.50 | <0.04 | 0.25 | <0.02 | 0.11 | <0.02 | 0.04 |
| 2002 | 26 | <3.52 | 6.20 | <0.03 | 0.08 | <0.01 | <0.02 | <0.03 | 0.08 |
| 2003 | 23 | 3.19 | 7.54 | <0.03 | 0.05 | <0.01 | <0.02 | <0.02 | <0.04 |
| 2004 | 21 | 4.24 | 12.80 | <0.02 | 0.05 | <0.01 | <0.01 | <0.02 | <0.04 |
| 2005 | 32 | 4.19 | 13.00 | <0.02 | 0.03 | <0.01 | <0.02 | <0.02 | 0.03 |

Reference: GNF-A, 2007a.

Note: The minimum detection concentration (MDC) varies based on instrument calibration. The notation of "<" in the maximum column indicates that the sample was at or below the MDC. The notation of "<" in the average column indicates that at least one data point used to calculate the average by GE-Hitachi Nuclear Energy (GEH) was at or below the MDC.

[a] Ambient Air Southeast (AASE) monitoring location, southeast of FMO, Wilmington Site (see **Figure 3.11-1**).

**Table 3.11-4. Airborne Gross Alpha and Isotopic Concentrations: South[a]**

| Year | Total Annual Site Uranium Emissions (grams/year) | Gross Alpha ($\times 10^{-15}$ µCi/cc) | | U-234 ($\times 10^{-15}$ µCi/cc) | | U-235 ($\times 10^{-15}$ µCi/cc) | | U-238 ($\times 10^{-15}$ µCi/cc) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Ave | Max | Ave | Max | Ave | Max | Ave | Max |
| 1995 | 21 | 2.31 | 5.80 | <0.04 | 0.10 | <0.01 | <0.02 | <0.01 | 0.03 |
| 1996 | 167 | <2.88 | 6.30 | <0.05 | 0.11 | <0.02 | <0.10 | <0.02 | <0.07 |
| 1997 | 290 | <3.03 | 6.10 | <0.09 | 0.24 | <0.01 | <0.04 | <0.03 | 0.08 |
| 1998 | 189 | 2.65 | 5.10 | <0.02 | <0.04 | <0.01 | <0.02 | <0.01 | <0.03 |
| 1999 | 62 | 3.55 | 8.30 | <0.02 | 0.05 | <0.01 | <0.03 | <0.02 | <0.03 |
| 2000 | 48 | <3.65 | 11.00 | <0.08 | 0.36 | <0.02 | 0.13 | <0.02 | 0.10 |
| 2001 | 33 | 2.65 | 6.10 | <0.04 | 0.25 | <0.02 | 0.13 | <0.01 | 0.06 |
| 2002 | 26 | <3.55 | 6.77 | <0.02 | 0.05 | <0.00 | <0.01 | <0.02 | 0.04 |
| 2003 | 23 | <3.11 | 6.26 | <0.03 | 0.11 | <0.01 | <0.02 | <0.02 | <0.03 |
| 2004 | 21 | <3.96 | 9.07 | <0.06 | <0.43 | <0.02 | <0.13 | <0.04 | <0.33 |
| 2005 | 32 | 4.13 | 10.50 | <0.03 | 0.05 | <0.00 | <0.01 | <0.01 | 0.02 |

Reference: GNF-A, 2007a.

Note: The minimum detection concentration (MDC) varies based on instrument calibration. The notation of "<" in the maximum column indicates that the sample was at or below the MDC. The notation of "<" in the average column indicates that at least one data point used to calculate the average by GE-Hitachi Nuclear Energy (GEH) was at or below the MDC.

[a] Ambient Air South (AASS) monitoring location, south of FMO, Wilmington Site (see **Figure 3.11-1**).

**Table 3.11-5. Airborne Gross Alpha and Isotopic Concentrations: Southwest[a]**

| Year | Total Annual Site Uranium Emissions (grams/year) | Gross Alpha (x $10^{-15}$ µCi/cc) | | U-234 (x $10^{-15}$ µCi/cc) | | U-235 (x $10^{-15}$ µCi/cc) | | U-238 (x $10^{-15}$ µCi/cc) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Ave | Max | Ave | Max | Ave | Max | Ave | Max |
| 1995 | 21 | 2.24 | 4.00 | 0.05 | 0.08 | <0.01 | <0.02 | <0.01 | 0.02 |
| 1996 | 167 | 2.57 | 4.60 | <0.04 | 0.08 | <0.02 | <0.03 | <0.02 | <0.04 |
| 1997 | 290 | <2.90 | 6.03 | 0.09 | 0.26 | <0.01 | <0.02 | <0.03 | 0.09 |
| 1998 | 189 | 2.65 | 5.20 | <0.02 | <0.08 | <0.01 | <0.04 | <0.02 | <0.07 |
| 1999 | 62 | 3.48 | 9.80 | <0.03 | 0.12 | <0.01 | <0.02 | <0.02 | <0.04 |
| 2000 | 48 | 3.79 | 9.80 | <0.04 | 0.14 | <0.01 | 0.04 | <0.01 | 0.02 |
| 2001 | 33 | <2.71 | 7.30 | <0.02 | 0.05 | <0.01 | <0.01 | <0.01 | 0.03 |
| 2002 | 26 | <3.38 | 6.23 | <0.03 | 0.07 | <0.01 | <0.02 | <0.02 | 0.06 |
| 2003 | 23 | 3.08 | 6.00 | <0.02 | 0.06 | <0.01 | <0.03 | <0.02 | <0.03 |
| 2004 | 21 | 3.87 | 13.30 | <0.03 | <0.06 | <0.01 | <0.01 | <0.02 | <0.04 |
| 2005 | 32 | 4.46 | 12.20 | <0.02 | 0.05 | <0.01 | <0.02 | <0.01 | 0.02 |

Reference: GNF-A, 2007a.

Note: The minimum detection concentration (MDC) varies based on instrument calibration. The notation of "<" in the maximum column indicates that the sample was at or below the MDC. The notation of "<" in the average column indicates that at least one data point used to calculate the average by GE-Hitachi Nuclear Energy (GEH) was at or below the MDC.

[a] Ambient Air Southwest (AASW) monitoring location, southwest of FMO, Wilmington Site (see **Figure 3.11-1**).

**Table 3.11-6. Average Soil Uranium Concentrations (ppm): Sampling Locations on the Wilmington Site[a]**

| Year | Sampling Location ID Number | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 1A | 2 | 3 | 20 | 21 |
| 1995 | 1.53 | 7.34 | 1.63 | 0.46 | 9.55 | 3.21 |
| 1996 | 1.48 | 9.49 | 0.61 | 0.26 | 15.48 | 4.92 |
| 1997 | 0.66 | 2.66 | 0.85 | 0.50 | 16.10 | 3.97 |
| 1998 | 0.67 | 3.87 | 0.73 | 0.38 | - | - |
| 1999 | 0.24 | 1.66 | 1.28 | 0.54 | - | - |
| 2000 | <0.87 | 0.86 | 1.62 | 0.44 | - | - |
| 2001 | 0.73 | 1.73 | 0.87 | 0.56 | - | - |
| 2002 | 0.50 | 2.48 | 0.33 | 0.26 | - | - |
| 2003 | 2.53 | 8.06 | 20.46 | 0.30 | - | - |
| 2004 | 0.39 | 2.79 | 1.56 | 0.14 | - | - |
| 2005 | 3.99 | 1.72 | 0.31 | 0.16 | - | - |

Units = ppm.

Sample locations 20 and 21 discontinued in 1998 because the use of the storage pad was minimized at that time and the soil concentration at those locations had stabilized.

Reference: GNF-A, 2007a.

[a] See **Figure 3.11-3** for location of current (2005) soil sampling locations.

**Table 3.11-7. Average Soil Uranium Concentrations (ppm): Sampling Locations in the Vicinity of the Wilmington Site[a]**

| Year | Sampling Location ID Number | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 11 | 12 | 13 | 15 | 16 | 17 | 18 |
| 1995 | 0.26 | 0.58 | 0.19 | 0.45 | 0.27 | 0.43 | 0.83 | 0.27 | 0.37 | 0.13 | 0.47 | 0.25 |
| 1996 | 0.36 | 0.33 | 0.21 | 0.83 | 0.34 | 0.38 | 0.48 | 0.20 | 0.41 | 0.15 | 0.34 | 0.34 |
| 1997 | 0.41 | 0.42 | 0.16 | 0.77 | 0.65 | 0.68 | 0.41 | 0.18 | 0.81 | 0.26 | 0.56 | 0.22 |
| 1998 | 0.38 | 0.29 | 0.17 | 0.75 | - | - | - | - | - | - | - | - |
| 1999 | 0.32 | 0.23 | 0.13 | 0.94 | - | 0.79 | - | - | - | - | - | - |
| 2000 | 0.31 | 0.07 | 0.14 | 0.49 | - | 1.46 | - | - | - | - | - | - |
| 2001 | 0.63 | 0.29 | 0.35 | - | - | 0.42 | - | - | - | - | - | - |
| 2002 | 0.40 | 0.15 | 0.27 | - | - | 0.71 | - | - | - | - | - | - |
| 2003 | 0.20 | 0.38 | 0.36 | - | - | 0.39 | - | - | - | - | - | - |
| 2004 | 0.29 | 0.41 | 0.53 | - | - | 1.66 | - | - | - | - | - | - |
| 2005 | 0.24 | - | 0.48 | - | - | 0.39 | - | - | - | - | - | - |

Units = ppm.

Sample locations 8, 12, 13, 15, 16, 17, and 18 discontinued in 1998; sample location 7 discontinued in 2001; and sample location 5 discontinued in 2005. Sampling locations are chosen based on a number of factors (e.g., facility operations, historical values at the location); as concentrations stabilize or as operations change, sampling locations are removed or added.

Reference: GNF-A, 2007a.

[a] See **Figure 3.11-3** for location of current (2005) soil sampling locations.

**Table 3.11-8. Fluoride Emissions Monitoring Data Summary for Years 1995–2005: Wilmington Site FMO Building**

| Year | Total Annual Fluoride Emissions (grams/yr) | Total Air Volume Vented Per Year ($10^{15}$ cc/yr) | Average Fluoride Concentration (µg/m$^3$) |
|---|---|---|---|
| 1995 | 2,083 | 0.26 | 0.80 |
| 1996 | 1,642 | 1.45 | 0.11 |
| 1997 | 2,350 | 1.60 | 0.15 |
| 1998 | 3,042 | 1.66 | 0.18 |
| 1999 | 3,296 | 1.59 | 0.21 |
| 2000 | 2,388 | 1.56 | 0.15 |
| 2001 | 1,813 | 1.55 | 0.12 |
| 2002 | 1,383 | 1.54 | 0.09 |
| 2003 | 1,466 | 1.58 | 0.09 |
| 2004 | 2,292 | 1.40 | 0.16 |
| 2005 | 1,505 | 1.32 | 0.11 |

Reference: GNF-A, 2007a.

**Table 3.11-9. Annual Radiation Dose to Nearest Resident [a]**

| Year | Committed Effective Dose Equivalent (mrems) |
|---|---|
| 1995 | 0.060 |
| 1996 | 0.200 |
| 1997 | 0.400 |
| 1998 | 0.200 |
| 1999 | 0.064 |
| 2000 | 0.056 |
| 2001 | 0.039 |
| 2002 | 0.027 |
| 2003 | 0.029 |
| 2004 | 0.031 |
| 2005 | 0.033 |

Reference: GNF-A, 2007a.

[a] Calculated using EPA's COMPLY code for nearest known residence (current as of 2006), which is located 426 and 1260 feet (130 to 384 meters) south of the FMO building stacks.

**Table 3.11-10. Recordable Accidents at GNF-A Facility**

| Year | Recordable Accidents | Recordable Injury and Illness Rates[a] | Total Number of Lost Time Accidents | Total Number of First Aids |
|---|---|---|---|---|
| 2000 | 22 | 1.64 | 11 | 165 |
| 2001 | 7 | 0.65 | 5 | 115 |
| 2002 | 11 | 1.04 | 0 | 96 |
| 2003 | 8 | 0.81 | 1 | 87 |
| 2004 | 3 | 0.46 | 2 | 79 |
| 2005 | 4 | 0.63 | 0 | 91 |
| 2006 | 9 | 1.01 | 4 | 93 |

[a] Recordable Injury and Illness Rate – Total number of injuries and illnesses divided by the number of hours worked by employees x 200,000 hours worked.

**Table 3.11-11. Public and Occupational Radiation Exposure Limits**

| Exposure Group | Annual Dose Equivalent Limit | Reference |
|---|---|---|
| Worker | 50 mSv (5 rem) TEDE<br>0.5 Sv (50 rem) CDE to any organ<br>0.15 Sv (15 rem) lens of eye<br>0.5 Sv (50 rem) skin<br>0.5 Sv (50 rem) extremity | NRC (10 CFR 20) |
| General Public | 1 mSv (100 mrem) TEDE<br>0.02 mSv (2 mrem) in any 1 hour period | NRC (10 CFR 20) |
| | 0.25 mSv (25 mrem) whole body<br>0.25 mSv (25 mrem) any organ<br>0.75 mSv (75 mrem) thyroid | EPA (40 CFR 190) |

CDE = committed dose equivalent.
TEDE = total effective dose equivalent.

**3.11-12. Hydrogen Fluoride Regulations and Guidelines**

| Agency | Description | Limit or Guideline |
|---|---|---|
| ACGIH | STEL (ceiling) | 3.0 ppm |
| NIOSH | REL (TWA) | 2.5 $mg/m^3$ |
| NIOSH | IDLH | 30 ppm |
| OSHA | PEL (8-hour TWA) | 2.0 $mg/m^3$ |
| EPA | Accidental release prevention toxic endpoint | 0.0160 mg/L |
| EPA | Accidental release prevention threshold quantity | 1,000 lbs |
| OSHA | Highly hazardous chemicals threshold quantity | 1,000 lbs |
| EPA | Superfund – reportable quantity | 5,000 lbs |

Reference: ATSDR, 2003.
ACGIH = American Conference of Governmental Industrial Hygienists.
IDLH = immediately dangerous to life and health.
EPA = U.S. Environmental Protection Agency.
NIOSH = National Institute for Occupational Safety and Health.
OSHA = Occupational Safety and Health Administration.
PEL = permissible exposure limit.
REL = recommended exposure limit.
STEL = short term exposure limit.
TWA = time-weighted average.

# Figures

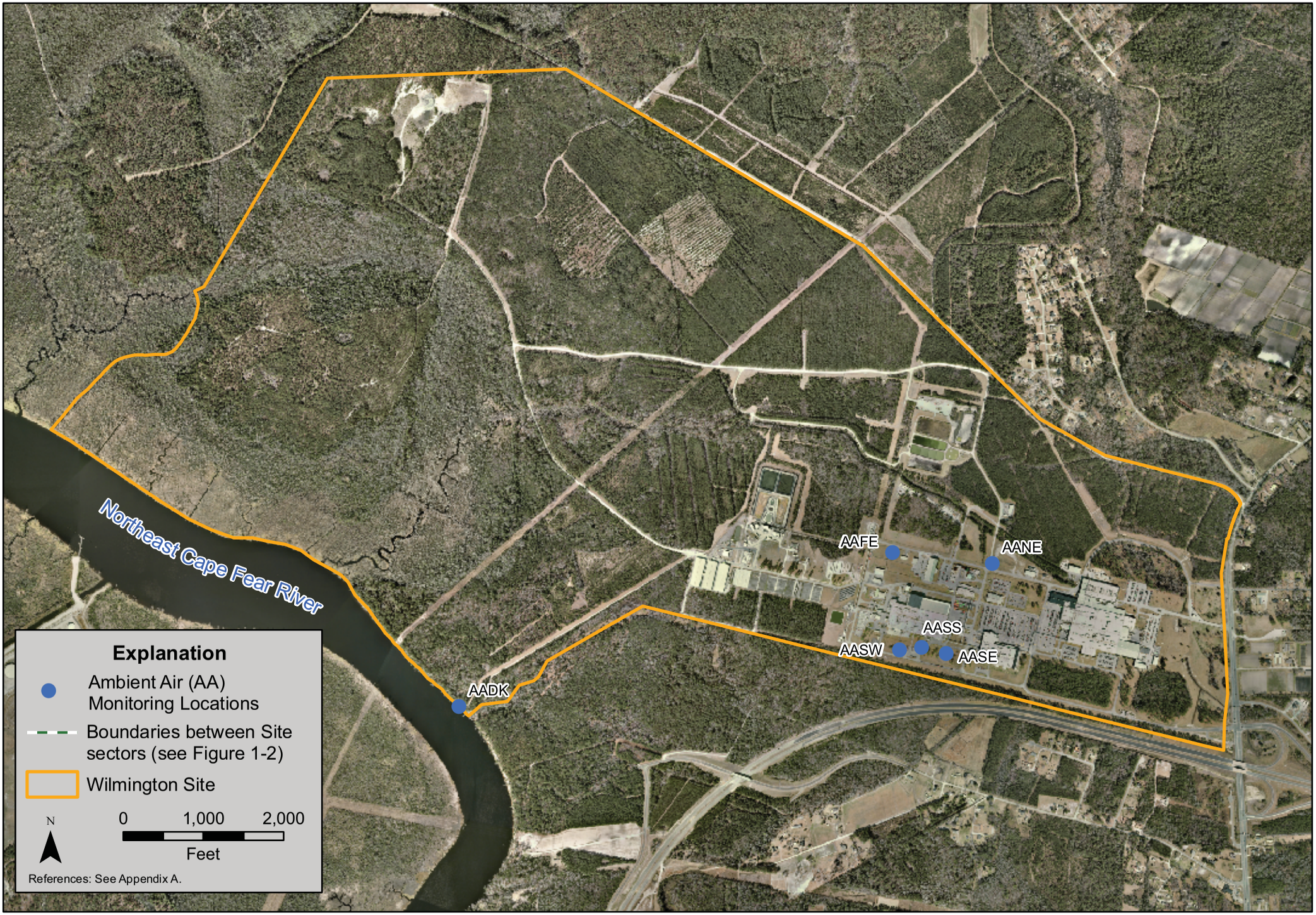


**Figure 3.11-1. On-site ambient air monitoring locations for gross alpha and uranium isotopes.**

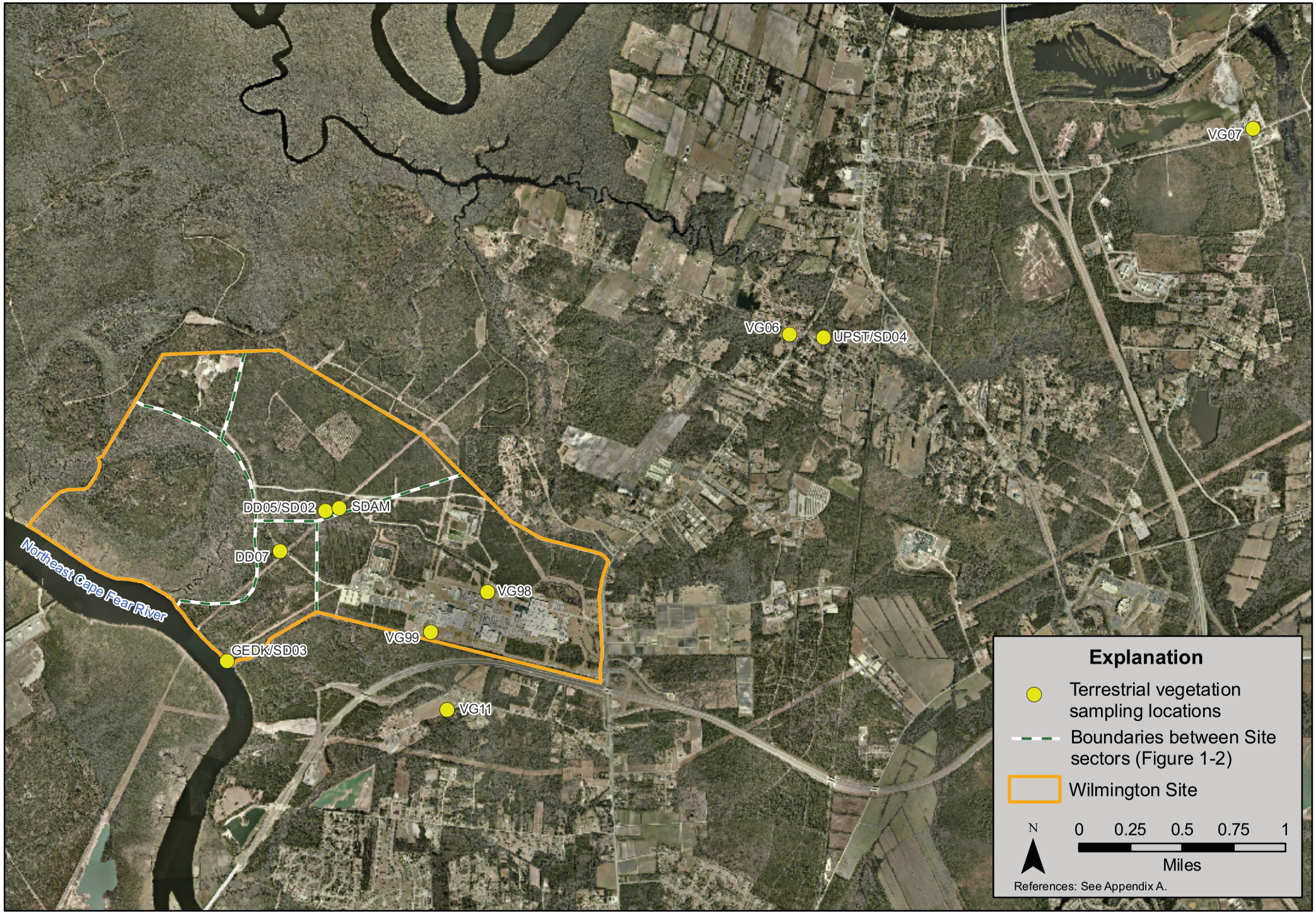


**Figure 3.11-2. Terrestrial vegetation sampling locations for gross alpha on and in the vicinity of the Wilmington Site.**

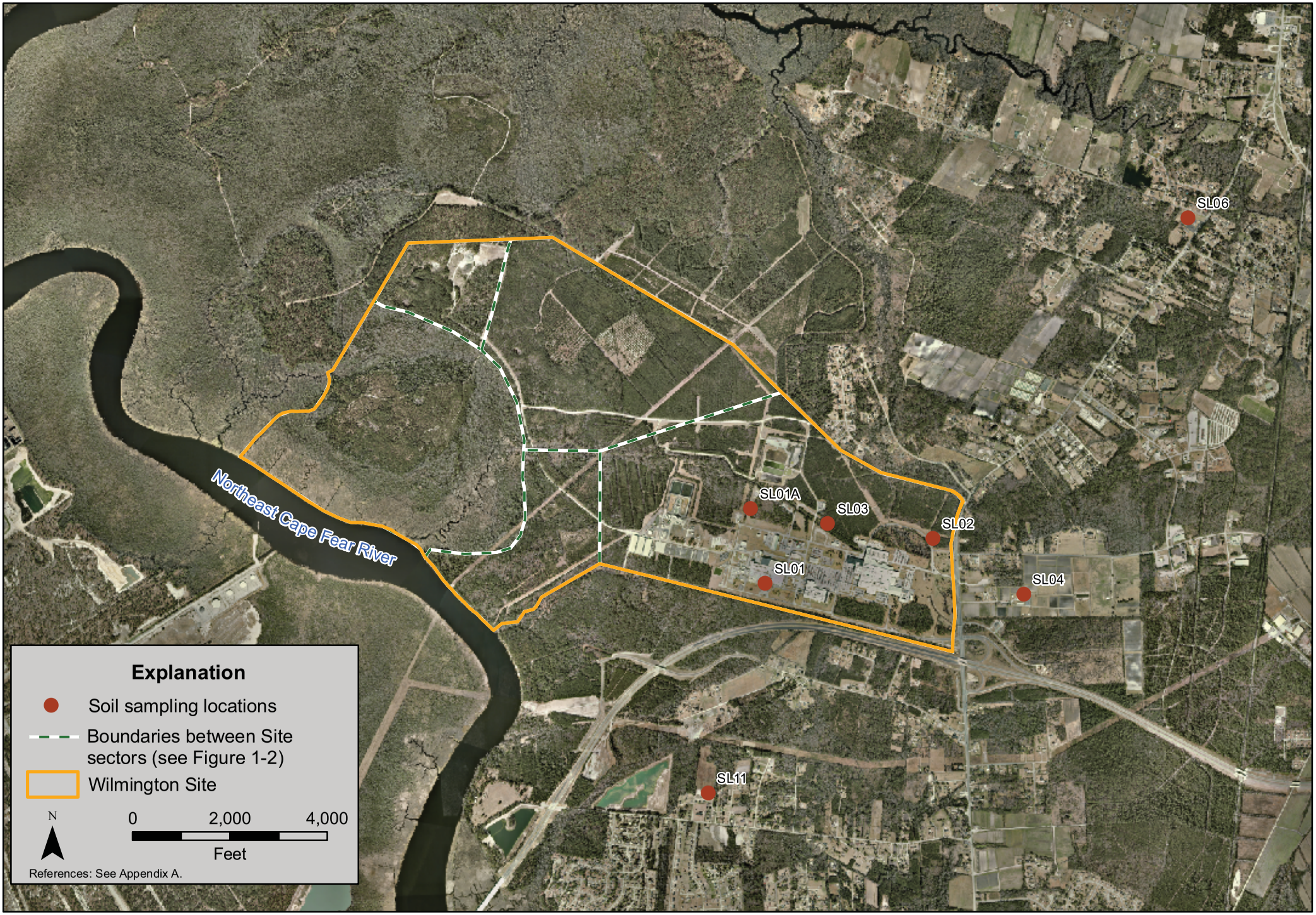


**Figure 3.11-3. Current (2005) soil sampling locations for uranium on and in the vicinity of the Wilmington Site.**

# GLE Environmental Report

# Section 3.12 – Waste Management

## Revision 0

## December 2008

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## 3.12 Waste Management

This section describes the generation, management, and disposal of various wastes from current operations at the Wilmington Site. EPA's solid waste management and disposal regulatory programs implemented under Resource Conservation and Recovery Act (RCRA) Subtitle C (*Hazardous Wastes*) and Subtitle D (*Nonhazardous Wastes*) regulate many liquids and semi-solids that are stored and managed in containers (e.g., drums, tanks) as solid wastes. The hazardous liquid wastes, used oil, and other liquid wastes currently generated at the Wilmington Site and shipped off-site for final treatment, disposal, or recycling/reuse are addressed in **Section 3.12.3**.

### 3.12.1 Gaseous Wastestreams

Gaseous wastes generated at the Wilmington Site occur in the form of air emissions released to the atmosphere from the current manufacturing operations. Sources, quantities, and control of nonradioactive gaseous air emissions from the current operations at the Wilmington Site are described in **Section 3.6.3.5**, *Wilmington Site Existing Air Emission Sources and Controls*. Sources, quantities, and control of gaseous radionuclides from the current operations at the Wilmington Site are described in **Section 3.11.2**, *Current Sources and Levels of Exposure to Radioactive Materials*.

### 3.12.2 Wastewaters

Liquid wastes generated at the Wilmington Site include process wastewater effluents from the current manufacturing operations, and sanitary wastewater from the existing building restrooms, cafeteria, and other sanitary facilities. **Table 3.12-1** summarizes the wastewater streams generated by current operations at the Wilmington Site.

Process wastewaters from existing Site operations are routed for treatment to the existing Site final process lagoon facility, and sanitary wastewaters are routed to the existing Site sanitary wastewater treatment facility. **Figure 3.12-1** shows the locations of these wastewater treatment facilities and their associated effluent discharge points. Effluents from the final process lagoon facility and sanitary wastewater treatment facility are monitored at the locations identified on **Figure 3.12-1** as Outfall 001 and Outfall 002, respectively. The effluent from the final process lagoon facility then drains to the effluent channel (Discharge Location 001 on **Figure 3.12-1**), which also receives stormwater and groundwater discharge. The effluent channel then drains to Unnamed Tributary #1 to Northeast Cape Fear River. Additional information on Site surface waters and drainage is discussed in **Section 3.4.2.1.1**, *Streams*. During the timeframe that the baseline set of data presented in this chapter to describe the affected environment were generated (i.e., through 2006), the treated effluent from the sanitary wastewater treatment facility also drained to the effluent channel (Discharge Location 002 on **Figure 3.12-1**). More recent changes to the treatment and handling of sanitary wastewater effluent are discussed in **Section 3.12.2.2**.

#### 3.12.2.1 Process Wastewater

A common process wastewater drain system is used for the various current manufacturing operations at the Wilmington Site. This is a dedicated system for collection of treated process wastewater, non-treated process wastewater, filter backwash water, and non-contact cooling water from the combined GNF-A FMO facility, GNF-A FCO facility, GE AE operations, and GE SCO facility. The GE/GNF-A facility is permitted to discharge up to 1.8 million gpd (6,813,741 lpd)) of treated process wastewater under the current NPDES discharge permit (NPDES permit number NC0001228). The 2006 average daily discharge from the final process lagoon facility to the effluent channel was 476,200 gpd (1,802,613 lpd) (see **Table 3.12-1**).

Since the process wastewater drain system was installed, changes to manufacturing processes and waste management practices for GNF-A and AE facility operations have eliminated most of the process wastewater streams discharged into the drain system. These pollution-prevention initiatives include the following:

- Replacement of the GNF-A FMO facility's ammonium diuranate (ADU) process with a Dry Conversion Process (DCP) for direct conversion of $UF_6$ to $UO_2$, which eliminated ammonia and fluoride wastewater streams being discharged to the drain system
- Placement of the GNF-A facility's uranium-recovery unit in standby status, which eliminated the nitrate wastewater stream being discharged to the drain system
- Shipment of the etch-acid solution waste generated by the GNF-A FCO facility to an off-site disposal facility, which eliminated use of the on-site waste treatment nitrate basins
- Elimination of waste streams from GE AE/SCO facility operations
- Replacement of the GNF-A FMO facility's radioactive wastewater (radwaste) treatment system with an improved system.

In the DCP used by the GNF-A FMO facility, $UF_6$ is reacted with steam and hydrogen, resulting in the formation of $UO_2$ and aqueous HF. This process generates no liquid waste stream other than a small quantity of uranium-contaminated dilute aqueous HF stream (typically 1% to 2% HF). A more concentrated aqueous HF stream (<50% HF) also is produced as a co-product of the conversion process. Under a condition of GNF-A's NRC license, this concentrated HF product can be transferred to any commercial chemical company or supplier without either company possessing an NRC or Agreement State license for special nuclear material, provided that the concentration of uranium does not exceed 3 ppm by weight of the liquid and the enrichment is less than or equal to 5 weight percent $^{235}U$. The HF product is sold to companies for industrial and commercial uses in such a manner that the minute quantity of uranium does not enter into any food, beverage, cosmetic, drug, or other commodity designated for ingestion or inhalation by, or application to, people such that the uranium concentration in these items would exceed that which naturally exists.

The dilute aqueous HF waste stream from the DCP is mixed with lime (calcium hydroxide) to form calcium fluoride ($CaF_2$). This material is dewatered, and the dewatered solids are collected and included with the other wastes shipped to the Energy*Solutions* disposal facility in Clive, UT (discussed in **Section 3.12.3.4**). The liquid effluent from the dewatering unit is pH adjusted and combined with the FMO-treated radwaste in the aeration basin and final process lagoons. Before the treated wastewater is discharged to the effluent channel, the water is tested at various sample points. If the pH needs to be further adjusted, the water is retained until the proper pH levels are obtained.

The GNF-A FCO facility generates a used sodium hydroxide (NaOH) solution waste and a spent etch-solution waste that are not discharged to the on-site wastewater drain system, but are instead collected in tanks for further off-site treatment. These liquid process streams are further discussed in **Sections 3.12.3.2 and 3.12.3.3**, respectively.

As required by the NPDES permit issued by NC DWQ, GNF-A monitors effluent quality for compliance with permit limitations set for various analytes. Process wastewater effluent is monitored for these analytes at Outfall 001, which is a location along the discharge pipe that drains from the final process lagoon facility to the effluent channel slightly upstream of the Site dam. Although effluent flow is monitored continuously to estimate total daily flow, other effluent characteristics are monitored weekly, monthly, or quarterly in composite or grab samples as specified by the permit. In addition, monitoring results are reported monthly to the NC DWQ. The permit limitations, monitoring requirements, and a

summary of the monthly Discharge Monitoring Reports (DMRs) for the 2002 through 2006 calendar years are provided in **Table 3.12-2**.

#### 3.12.2.2 Sanitary Wastewater

Liquid wastes originating in bathrooms, the cafeteria, and other sanitary facilities are collected and routed through the sanitary waste sewer system to an on-site, activated sludge-aeration treatment plant. The treatment of the sanitary wastes at this plant is designed to achieve the biochemical oxygen demand (BOD) reductions typical of similar systems.

Under the current NPDES discharge permit (NPDES permit number NC0001228), up to 75,000 gpd (283,906 lpd) of sanitary wastewater effluent can be discharged from the Wilmington Site. The 2006 average daily discharge from the sanitary wastewater treatment facility to the effluent channel was 33,000 gpd (124,919 lpd) (see **Table 3.12-1**). Sanitary wastewater must also meet similar monitoring requirements and effluent limitations as described above for the process wastewater effluent. The sanitary wastewater effluent is monitored at Outfall 002, which is a location along the discharge pipe that drains from the sanitary wastewater treatment facility to the effluent channel just south of the treatment facility. The permit limitations, monitoring requirements, and a summary of the monthly DMRs for the 2002 through 2006 calendar years are provided in **Table 3.12-3**.

During the timeframe that the baseline set of data presented in this chapter to describe the affected environment were generated (i.e., through 2006), the treated effluent from the sanitary wastewater treatment facility drained to the effluent channel per the NPDES discharge permit discussed above. However, as presented in **Section 2.3** of this Report, *Cumulative Effects*, 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 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.

### 3.12.3 Solid Wastes

Solid wastes generated at the Wilmington Site from the current manufacturing operations vary in form and type. These wastes include packaging and construction materials, worn-out tools and equipment, spent process chemicals, used oils, and uranium sludges. The current Wilmington Site waste management program is both comprehensive and flexible, allowing the Site to tailor waste management techniques to specific solid-waste types. The waste management practices currently used at the Site include waste elimination, waste-volume reduction achieved by source separation of recyclable or recoverable materials, waste compaction, and on-site waste incineration.

Four types of solid waste are generated at the Wilmington Site by the current operations: municipal solid waste (MSW), nonhazardous industrial wastes, hazardous wastes, and low-level radioactive wastes (LLRW). High-level radioactive wastes or mixed wastes (a type of waste that contains both hazardous and radioactive source, special nuclear, or by-product material, as defined by the Atomic Energy Act) are not generated at the Wilmington Site. **Table 3.12-4** describes the composition and quantities of solid and liquid wastes generated by current operations at the Wilmington Site and shipped off-site for final treatment, disposal, or reuse. The treatment and disposal facilities listed in **Table 3.12-4** have adequate capacity to continue accepting solid-waste materials generated at the Wilmington Site for the foreseeable future. GEH is not aware of closure or other plans by the facility owners and operators that would impede the future acceptance of the appropriate waste materials generated by operations at the Wilmington Site.

### 3.12.3.1 Municipal Solid Wastes

In 2006, a total of approximately 990 tons (898 metric tons [mt]) of MSW was generated at the Wilmington Site from both the GNF-A and GE AE/SCO facility operations. A commercial refuse service regularly collects and disposes this waste off-site at the New Hanover County municipal landfill. This RCRA-permitted Subtitle D landfill is located on US 421, approximately 4.5 driving miles (7.2 km) southwest of the Wilmington Site. This landfill has a current permitted capacity of 4.2 million tons (3.8 million mt) and an estimated closure year of 2016. The county is currently permitting a new 115-acre (47-ha) area which will extend the capacity and lifetime of the landfill.

### 3.12.3.2 Nonhazardous Industrial Wastes

Industrial waste that is neither an RCRA MSW nor an RCRA hazardous waste under federal or State laws is regulated under RCRA Subtitle D as nonhazardous wastes. Nonhazardous industrial wastes generated by current manufacturing operations at the Wilmington Site that are not accepted by the local New Hanover county municipal landfill are collected and stored on-site before being periodically shipped via Heritage Environmental Services to approved treatment and disposal facilities. Depending on the composition of the nonhazardous waste, these materials are either shipped directly to the Heritage Environmental Services facility in Indianapolis, IN, for treatment and burial, or routed through Heritage Environmental Services to be reused, reclaimed, or treated at other GE-approved facilities.

The GNF-A FCO facility generates a used NaOH solution that is recycled. In 2006, the quantity of reused NaOH was 77 tons (70 mt) of the total 107 tons (97 mt) of nonhazardous industrial waste listed in **Table 3.12-4** shipped to Heritage Environmental Services from the GNF-A operation. Similarly, the 1,755 tons (1,592 mt) of used oils listed in **Table 3.12-4** shipped to the FCC Environmental Treatment Facility in Concord, NC, is recycled.

### 3.12.3.3 Hazardous Wastes

Hazardous wastes generated by the existing Wilmington Site facilities are predominately spent etch-acid solutions generated by GNF-A FCO activities. Minor additional hazardous wastes from the GNF-A and GE AE facility operations typically include used paints, spent solvents, and X-ray wastes. The hazardous wastes generated at the Wilmington Site are collected, packaged in DOT-approved shipping containers, and stored temporarily on-site. At least once every 90 calendar days, the containers are shipped to the Heritage Environmental Services RCRA-permitted Subtitle C treatment, storage, and disposal facility in Indianapolis, IN.

### 3.12.3.4 Low-Level Radioactive Wastes

Another classification of solid waste that is generated by GNF-A operations is LLRW. Industrial or commercial waste that has been contaminated by radioactive material falls into this classification. At the Wilmington Site, the low-level contaminated material generated by GNF-A operations is segregated between combustible and noncombustible materials. No LLRW is generated by the GE AE/SCO operations.

Used, noncombustible, uranium-contaminated preventative and corrective maintenance items (e.g., air-cleaning system filters, pumps, motors, valves, metal containers, process piping segments, various filtrates, DCP $CaF_2$ solids) are shipped off-site for disposal. These materials are collected and packaged in DOT/NRC–approved shipping containers, which then are stored temporarily on-site. When a full truck load is collected, the containers are shipped to the LLRW disposal facility operated by Energy*Solutions* (formerly Envirocare) in Clive, UT.

Used combustible, uranium-contaminated maintenance items are incinerated in an on-site natural-gas-fired, multiple-chamber waste incinerator. Approximately 367,000 lbs (166,468 kg) of LLRW are burned in the incinerator per year. The waste incinerator is permitted by the NC DAQ to burn up to 1,200 lb (544 kg) per hour of Type 0 Waste (see **Section 3.6.3.5.1**, *Wilmington Site Existing Air Quality Permits*). Although the GNF-A's air quality permit for the waste incinerator allows the burning of used oil, no used oil generated at the Wilmington Site is fed to the incinerator. The incinerator air-emission control system is described in **Table 3.6-23**. The incinerator ash is shipped to the Energy*Solutions* LLRW disposal facility in Clive, UT.

# Tables

**Table 3.12-1. Wastewater Streams Generated by Current Operations at the Wilmington Site and Treated On-site**

| Wastewater Stream | Generation Frequency | NPDES Limit [a] | 2006 Average Daily Flow Rate | Wastewater Treatment |
|---|---|---|---|---|
| Process wastewater | Continuous | 1,800,000 gpd (6,813,741 lpd) | 476,200 gpd (1,802,613 lpd) | pH adjustment, settling, aeration |
| Sanitary waste effluent | Continuous | 75,000 gpd (283,906 lpd) | 33,300 gpd (124,919 lpd) | Dual-train, extended, activated sludge-aeration wastewater treatment facility with chlorination/dechlorination[b] |

[a] NPDES = National Pollutant Discharge Elimination System.

The Wilmington Site sanitary wastewater treatment facility has recently been upgraded to a single-train, extended aeration activated sludge wastewater treatment facility with membrane ultrafiltration and ultraviolet (UV) filtration (operational March 2008).

**Table 3.12-2. Summary of NPDES Outfall 001 Treated Process Wastewater Effluent Monitoring Results (2002–2006)**

| Permit Limitation | | | | Outfall 001 (Treated Process Wastewater Effluent) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Characteristic | Daily Maximum Limit | Monthly Average Mean Limit | Units | # Samples | Minimum (of daily values) | Mean [a] (of daily values) | Maximum (of daily values) | # Months | Maximum of monthly means |
| Biological oxygen demand (5 days) | NL | NL | mg/L | 260 | ND | 6.81 | 41.0 | 60 | 18.0 |
| Cadmium | 15 | NL | µg/L | 172 | ND | 1.19 | 10.0 | 60 | 10.0 |
| Chromium | 4.49 | 2.41 | lbs/day | 151 | ND | 0.26 | 0.41 | 60 | 0.29 |
| Copper | 5.34 | 2.86 | lbs/day | 151 | ND | 0.16 | 0.26 | 60 | 0.21 |
| Cyanide | 22 | NL | µg/L | 60 | ND | 2.54 | 5.0 | 60 | 5.0 |
| Dissolved oxygen | NL | NL | mg/L | 261 | 3.17 | 7.65 | 13.6 | 60 | 10.9 |
| Flow | NL | 1.8 | MGD | 2659 | 0.12 | 0.50 | 5.34 | 60 | 0.78 |
| Fluoride | 45 | 23 | lbs/day | 153 | 3.58 | 8.05 | 27.2 | 60 | 19.9 |
| Lead | 34 | NL | µg/L | 68 | ND | ND [b] | 3.0 | 60 | ND [b] |
| Nickel | 6.79 | 3.63 | lbs/day | 151 | ND | 0.16 | 0.21 | 60 | 0.21 |
| Nitrogen, total as N [c] | 183 | 86 | lbs/day | 267 | ND | 14.1 | 71.0 | 60 | 52.5 |
| Oil and grease | 118.4 | 57.7 | lbs/day | 261 | ND | 7.84 | 36.1 | 60 | 36.1 |
| pH [d] | 6.0/9.0 NL[d] | NL | SU | 1255 | 6.20 | 7.2847 [e] | 8.85 | 60 | 6.81/8.0516 [e, f] |
| Phosphorus, total as P | NL | NL | mg/L | 40 | 0.025 | 0.33 | 1.3 | 39 | 1.3 |
| Silver | 0.68 | 0.33 | lbs/day | 151 | ND | 0.009 | 0.011 | 60 | 0.01 |
| Solids, Total Suspended (TSS) | 390 | 178 | lbs/day | 708 | ND | 59.1 | 188 | 60 | 125.6 |
| Temperature, water | NL | NL | deg C | 1253 | 5.75 | 21.1 | 33.2 | 60 | 29.9 |
| Trichloroethylene | NL | NL | µg/L | 60 | ND | 1.66 | 6.98 | 60 | 6.98 |
| Zinc | 4.12 | 2.05 | lbs/day | 151 | ND | 0.11 | 0.47 | 60 | 0.47 |

Reference: GEH environmental database.

ND = The analyte was not detected or not detected above the reported practical quantitation limit.

NL = The analyte not listed with a permit limitation.

[a] Non-detect results were included in the mean calculations as half of the laboratory-reported practical quantitation limit (PQL) for radiological, inorganic and physical constituents, and as one-fifth the laboratory-reported PQL for organic constituents.

[b] All lead results were non-detect except one sample collected in March 2005, which had a reported concentration of 3.0 µg/L.

[c] Total Nitrogen (as N) = $NO_2 + NO_3 + NH_3$.

[d] The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.

[e] Mean pH values were calculated by converting the pH measurements to their corresponding hydrogen-ion concentration ($H^+_c$), performing the statistical calculation on those concentrations, and converting the statistical result back to pH per the equation, $pH = -\log_{10}(H^+_c)$.

[f] Minimum of monthly means/maximum of monthly means.

**Table 3.12-3. Summary of NPDES Outfall 002 Treated Sanitary Wastewater Effluent Monitoring Results and Requirements (2002–2006)**

| Permit Limitation | | | | Outfall 002 (Treated Sanitary Wastewater Effluent) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Characteristic | Daily Maximum Limit | Monthly Average Mean Limit | Units | # Samples | Minimum (of daily values) | Mean [a] (of daily values) | Maximum (of daily values) | # Months | Maximum of monthly means |
| Biological oxygen demand (5 days) | 45 | 30 | mg/L | 518 | ND | 3.63 | 21 | 60 | 12.5 |
| Chlorine, total residual | 28 | NL | µg/L | 525 | ND | 10.2 | 24 | 60 | 15 |
| Dissolved oxygen [b] | NL [b] | NL | mg/L | 1708 | 5.0 | 7.14 | 15.6 | 60 | 9.85 |
| Fecal coliform | 400 | 200 | cfu/100 mL | 263 | ND | 14.7 | 300 | 60 | 91.4 |
| Flow | NL | 0.075 | MGD | 1826 | 0.001 | 0.025 | 0.077 | 60 | 0.036 |
| Phosphorus, total | NL | NL | mg/L | 20 | 1.0 | 5.35 | 9.31 | 20 | 9.31 |
| Nitrogen, total as N [c] | NL | NL | mg/L | 20 | 0.53 | 29.7 | 52.1 | 20 | 52.1 |
| Nitrogen, ammonia as N | NL | NL | mg/L | 343 | ND | 0.91 | 34 | 60 | 13.8 |
| pH [d] | 6.0/9.0 [d]NL | NL | SU | 281 | 5.87 | 6.764 [e] | 7.56 | 60 | 6.24/7.356 [e] |
| Solids, Total Suspended (TSS) | 45 | 30 | mg/L | 518 | ND | 3.46 | 45 | 60 | 20.7 |
| Temperature, water | NL | NL | deg C | 1799 | 3 | 20.1 | 33 | 60 | 27.4 |

Reference: GEH environmental database.

ND = The analyte was not detected or not detected above the reported practical quantitation limit.

NL = The analyte not listed with a permit limitation.

[a] Non-detect results were included in the mean calculations as half of the laboratory-reported practical quantitation limit.

[b] The daily average dissolved oxygen effluent concentration shall not be less than 5.0 mg/L.

[c] Total Nitrogen (as N) = $NO_2 + NO_3 + TKN$.

[d] The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.

[e] Mean pH values were calculated by converting the pH measurements to their corresponding hydrogen-ion concentration ($H^+_c$), performing the statistical calculation on those concentrations, and converting the statistical result back to pH per the equation, $pH = -\log_{10}(H^+_c)$.

[f] Minimum of monthly means/maximum of monthly means.

**Table 3.12-4. Solid and Liquid Wastes Generated by Current Operations at the Wilmington Site and Shipped Off-site for Final Treatment, Disposal, or Reuse**

| Waste Type | Waste Generation Source (Wilmington Site) | Waste Composition | Annual[a] Quantity Generated | Offsite Treatment or Disposal Facility (Type and Location) |
|---|---|---|---|---|
| Municipal solid waste | GNF-A operations and GE Aircraft Engines/ Services Components Operations (AE/SCO) | ▪ Refuse and other nonhazardous solid wastes accepted at landfill | 990 tons (898 mt) | New Hanover County Landfill Wilmington, NC |
| Nonhazardous industrial wastes | GNF-A operations | ▪ Used NaOH solution[b]<br>▪ Clean-room sludge<br>▪ Spent coolant<br>▪ Used tube reducer<br>▪ Nonhazardous caustic<br>▪ Filter medium | 107 tons (97 mt) | Heritage Environmental Services RCRA Permitted TSDF[c] Indianapolis, IN, or other facilities depending on the composition of the waste[d] |
| | GE AE/SCO | ▪ Pre-rinse emulsifier<br>▪ Spill-cleanup adsorbent media<br>▪ Mixed dry batteries<br>▪ Metal chips<br>▪ Process tank and drain cleanout sludges | 40 tons (36 mt) | |
| | GNF-A and GE AE/SCO | ▪ Used oils[e] | 1,755 tons (1,592 mt) | FCC Environmental Treatment Facility Concord, NC |
| Hazardous waste | GNF-A and GE AE/SCO | ▪ $HF/HNO_3$ waste[f]<br>▪ Minor quantities of waste paints and solvents and X-ray wastes | 2,175 tons[g] (1,973 mt) | Heritage Environmental Services RCRA Permitted TSDF[c] Indianapolis, IN |
| Low–level radioactive Waste (LLRW) | GNF-A operations | ▪ Metal parts, filters, and other noncombustible wastes<br>▪ Dewatered $CaF_2$[h] solids<br>▪ Waste incinerator ash | 208 tons (188 mt) | EnergySolutions LLRW Disposal Facility Clive, UT |

[a] Annual waste quantity records for existing Wilmington Site facilities operations for the year 2006, with the exception of LLRW. The value for LLRW is an estimate of annual waste quantity for 2008 and future years to reflect the current LLRW management practices used by the GNF-A operations, which reduce the quantity of LLRW shipped to Energy*Solutions* from the historical levels for the years 2006 and earlier.

[b] Used NaOH solution manifested to Heritage Environmental Services is recycled and reused. In 2006, the quantity of recycled/reused NaOH was 77 tons of the total 107 tons of non-hazardous industrial waste manifested to Heritage Environmental Services from the GNF-A operation.

[c] TSDF = Treatment, storage, and disposal facility permitted under RCRA Subtitle C requirements to manage hazardous wastes. Also accepts nonhazardous wastes for treatment and recycling/reuse.

[d] Depending on the composition of the nonhazardous waste, these materials are either shipped direct to the Heritage Environmental Services facility in Indianapolis, IN, for treatment and burial and or routed through Heritage Environmental Services for reuse, reclaim, or treatment at other GE-approved facilities.

[e] Used oils manifested to FCC Environmental are recycled and reused.

[f] $HF/HNO_3$ waste = hydrofluoric acid (HF) and nitric acid ($HNO_3$) wastes.

[g] Hazardous waste predominately generated by GNF-A operation with a small quantity from the GE AE operation.

[h] Calcium fluoride ($CaF_2$).

# Figures

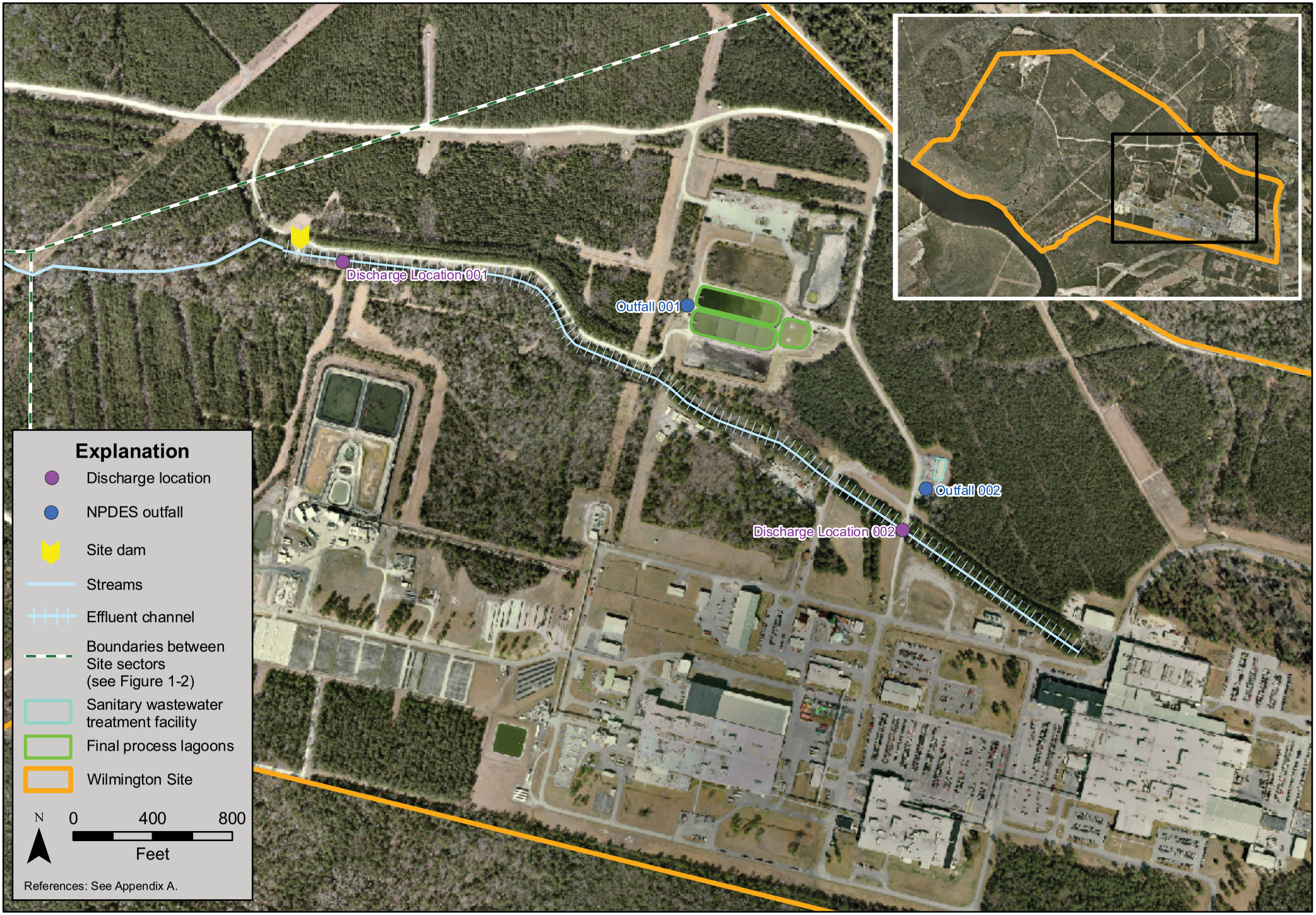


**Figure 3.12-1. Existing wastewater treatment facilities and discharge points at the Wilmington Site.**