GLE Environmental Report

Section 4.4 – Water Resource Impacts

Revision 0

December 2008

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4.4 Water Resource Impacts

This section provides a description of the potential water resource impacts associated with the Proposed Action, including potential impacts to groundwater (**Section 4.4.1**), surface water (**Section 4.4.2**), flood plains (**Section 4.4.3**), wetlands (**Section 4.4.4**), and water use (**Section 4.4.5**).

4.4.1 Groundwater Impacts

This section focuses on groundwater quality impacts. Potential groundwater supply impacts are discussed in **Section 4.4.5**.

4.4.1.1 No Action Alternative

Groundwater conditions[1] would remain unchanged under the No Action Alternative; therefore, no impacts to groundwater quality would be anticipated.

4.4.1.2 Proposed Action

The Proposed GLE Facility would not discharge any effluents or other materials that are anticipated to impact groundwater quality. **Section 2.1.2** (*Proposed Action*), **Section 4.13** (*Waste Management Impacts)*, and **Chapter 5** (*Mitigation Measures*) of this Report describe aspects of the Proposed GLE Facility design, as well as hazardous material and waste-handling practices that would be implemented as part of the Proposed Action to limit the potential for accidental release of hazardous constituents and impact of groundwater quality.

4.4.1.2.1 GLE Facility Site Preparation and Construction

Due to increased traffic and equipment use during construction of the Proposed GLE Facility, incidental release of substances such as vehicle oil and grease would be possible. The potential release of these contaminants would be minimized by implementing BMPs and other procedures that contain and prevent releases and potential leaching to groundwater (see **Chapter 5** of this Report, *Mitigation Measures*). Sanitary waste will be managed using portable toilets. The water needed for GLE Facility site preparation and construction would be provided via tanker truck from off-site water sources, and it would be required that those sources be of potable quality; therefore, there would be no anticipated impact to groundwater quality during site preparation and construction.

4.4.1.2.2 Operation

The anticipated impacts to surface water quality from Proposed Action buildings, parking lots, the stormwater wet detention basin, UF_6 storage areas, administrative and other Facility-support buildings ancillary structures, and maintained landscaped areas of the Proposed GLE Facility are expected to be SMALL (see **Section 4.4.2**); therefore, any fraction of surface water that might infiltrate to groundwater would result in a SMALL impact on groundwater quality. As discussed in **Section 4.4.2**, stormwater runoff from the Proposed Action would drain to a stormwater wet detention basin before it would be discharged to receiving waters. This basin would be designed with a clay liner and installed according to standard engineering construction (NCDENR, 2007) and quality assurance practices to avert the infiltration of detained stormwater to the aquifer. Further, no more than trace levels of radiological constituents would be anticipated to be released from the Proposed GLE Facility to the stormwater wet detention basin considering the procedures that would be in place for managing and monitoring

[1] The current conditions that would remain unchanged include the continued improvement over time of on-site groundwater quality in response to the current remedial activities described in **Section 3.4.1.2.3** of this Report (*Wilmington Site Groundwater Remediation*).

stormwater from the UF_6 storage pad areas (see **Section 4.4.2.3.1.2** and **Section 4.13.2.2.1.4**, *Waste Management Operation Impacts* [*Stormwater Management*]). In addition, the potential for groundwater radiological impacts from any unanticipated releases of Proposed GLE Facility process water are anticipated to be SMALL considering the management and pre-treatment procedures described in **Section 4.13.2.2.1.1**, *Liquid Radwaste Management*, and **Section 4.13.2.2.1.2**, *Cooling Tower Blowdown Management*.

Process wastewater and sanitary wastewater from the Proposed GLE Facility would be treated at the Wilmington Site through the existing final process lagoon facility and sanitary waste treatment facility, respectively. The effluents from these facilities would be discharged through National Pollutant Discharge Elimination System (NPDES)–permitted outfalls to the effluent channel. In certain reaches of the effluent channel where the channel has incised through the semiconfining layer (see **Section 3.4.1.1.2.2** of this Report, *Wilmington Site Groundwater Impacts*) and Principal (Peedee) Aquifer water levels are suppressed from operation of Wilmington Site pumping wells, a small portion of the flow in the effluent channel may have the potential to infiltrate through the channel bed to the Principal Aquifer. The process wastewater effluent discharge (permitted NPDES Outfall 001) is at the Site dam (see **Figure 3.12-1**), which is downstream of the reach where there is greater potential for infiltration to groundwater. Although the sanitary wastewater effluent discharge (permitted NPDES Outfall 002) is upstream of this reach of the effluent channel (see **Figure 3.12-1**), no notable change in groundwater quality would be anticipated because the increase in flow is relatively small and the quality of the discharged water is expected to be the same or better, as compared to the current discharges (these discharges are further discussed in **Section 4.13**, *Waste Management Impacts*).

Additional water use associated with the Proposed Action (**Table 4.4-1**) would be provided by the existing Site groundwater supply well system. The additional pumping would lower groundwater levels to a small extent within the Peedee Aquifer in the Site vicinity (within approximately 1 to 2 miles [1.6 to 3.2 km]); the groundwater flow patterns would remain largely unchanged, although there would be a small shift in groundwater elevations (see **Figure 4.4-10**). As discussed in **Section 3.4.1.2.1** of this Report (*Regional Groundwater Impacts*), there are no known off-site groundwater quality issues within or just beyond the catchment area of the Wilmington Site pumping wells; therefore, the small change in groundwater elevations induced by the increased pumping of the Proposed Action is not anticipated to have any impact on off-site groundwater quality. This minimal groundwater-level lowering is further discussed in **Section 4.4.5**, along with the results of a numerical groundwater computer flow model established for the Site that was used to predict the degree of groundwater elevation lowering. **Appendix P**, *Numerical Modeling of Groundwater Flow and Contaminant*, provides documentation of the model development.

Residents in the subdivision north of the Site (Wooden Shoe subdivision) rely on groundwater obtained from individual wells (see **Figure 4.4-9**). Existing groundwater impacts at the Site are actively being contained and remediated to avoid the spread of impacted groundwater to these wells. **Section 3.4.1** of this Report (*Groundwater*) presents a discussion of the trough-of-depression (shown on **Figure 3.4-10**) that establishes the hydraulic on-site containment of existing impacted groundwater. The recovered water is treated and used as Wilmington Site process water. As discussed above, groundwater levels are not anticipated to change significantly in response to the increased pumping required for the Proposed Action; therefore, there is little anticipated change in the configuration of the on-site hydraulic trough-of-depression, and no anticipated significant impact on the effectiveness of the existing on-site pumping well system to protect off-site groundwater users from existing on-site impacted groundwater. Because the additional groundwater for the Proposed GLE Facility would be recovered from wells currently used to create the hydraulic trough of depression, the slight lowering of groundwater levels would slightly enhance the effectiveness of this containment system.

The numerical groundwater model for the Site includes a contaminant transport component that simulates the migration and removal of existing groundwater impacts over time from the current remedial groundwater containment, recovery, and treatment system (see **Section 3.4.1** of this Report, *Groundwater*). This transport model was used to evaluate potential impacts on the existing Site groundwater remedial measures from the additional water demand associated with the Proposed Action. These modeling results predict no significant changes in the capture zone or clean-up duration of the groundwater remedial measures as a result of the increased water demand of the Proposed Action. **Section 4.4.5** presents groundwater elevation results based on the modeling.

4.4.1.2.3 Decommissioning

As described in **Section 2.1.2.4** of this Report (*Site and Facility Information*), decontamination and decommissioning of the Proposed GLE Facility would involve the removal of the internal structures, utilities, and products from the building; however, the physical structure, associated foundations, access roads, and utility lines would likely remain intact.

The Decommissioning Plan to be prepared at the end of Facility life would include decontamination, dismantlement, and clean-up procedures; methodology and general decontamination and cleaning methods; and waste management protocol. These procedures, methods, and protocol would be designed to prevent impacts to groundwater quality; therefore, no significant adverse impacts to groundwater quality are anticipated during decommissioning. Sampling would also be integral to the decommissioning process to demonstrate that any residual impacts, as compared to the baseline sampling results (see **Chapter 5**, *Mitigation Measures*), meet NRC and EPA guidelines.

4.4.1.3 Cumulative Impacts

As described above, groundwater quality impacts are anticipated to be SMALL individually for the construction, operation, and decommissioning phases of the Proposed Action; therefore, cumulative groundwater quality impacts are anticipated to be SMALL when evaluating these three phases of the Proposed Action together.

Once constructed, stormwater from the ATC II complex and the Tooling Development Center (see **Section 2.3**, *Cumulative Effects*) would drain to stormwater wet detention basins before being discharged to receiving waters. As with the stormwater wet detention basin to be constructed for the Proposed Action, the basins for these other facilities would be designed with clay liners and installed according to standard engineering construction (NCDENR, 2007) and quality assurance practices to avert the infiltration of detained stormwater to the underlying Surficial Aquifer; therefore, cumulative stormwater runoff from these new Site facilities and the Proposed GLE Facility are anticipated to have SMALL cumulative impacts on groundwater quality.

Also described in **Section 2.3** is the planned reuse of the Wilmington Site's treated sanitary wastewater as make-up water in Wilmington Site cooling towers. Although this effluent re-use process became operational in April 2008, it is included in this cumulative impacts assessment because it postdates the 2006 baseline conditions presented in **Chapter 3** of this Report (*Description of the Affected Environment*). This effluent re-use process enables the switch away from discharge of treated sanitary wastewater to the effluent channel (via permitted NPDES Outfall 002). After industrial re-use, these waters would be treated through the existing Wilmington Site final process lagoon facility and the process wastewater effluent would be discharged to the effluent channel at the Site dam (via permitted NPDES Outfall 001). As discussed in **Section 4.4.1.2.2**, the process effluent discharge is downstream of the reach, where there is greater potential for infiltration to groundwater; however, the resultant quality of the discharged effluent is expected to be the same or better as compared to the current discharge. Therefore, only SMALL potential cumulative impacts on groundwater quality from effluent discharges are

anticipated when cumulatively assessing the Proposed Action with the planned Site expansion/modification projects described in **Section 2.3** (*Cumulative Effects*).

Table 4.4-2 shows projected Wilmington Site groundwater withdrawals, considering the Proposed Action along with the new facilities and systems described in **Section 2.3**. Once the Proposed GLE Facility, the ATC II complex, and the Tooling Development Center are operating, the volume of treated sanitary wastewater to be re-used as make-up water in Wilmington Site cooling towers is projected at approximately 62,300 gallons per day (gpd); 235,800 liters per day (lpd). Because the treated sanitary wastewater effluent has such low hardness, its addition to the Wilmington Site cooling towers increases efficiencies. Each gallon of re-use water introduced into a cooling tower offsets two gallons of process make-up water. Therefore, this effluent re-use process would reduce groundwater withdrawal for cumulative process-water requirements by approximately 124,600 gpd (471,700 lpd) (i.e., twice the projected cumulative sanitary wastewater treatment rate of 62,300 gpd [235,800 lpd]), resulting in a net projected cumulative decrease in process-water groundwater withdrawals of 44,600 gpd (168,800 lpd). Factoring in the projected increase in the amount of groundwater to be pumped from the separate potable supply wells to meet the cumulative potable water demand, there is a projected total (process and potable) net decrease in water demand of approximately 15,100 gpd (57,200 lpd). The Site numerical groundwater flow and contaminant transport model discussed previously and in **Section 4.4.5** was used to assess changes in groundwater elevation and remedial-system effectiveness associated with the cumulative groundwater demand. Only small changes in groundwater elevations are predicted, and the flow patterns remain largely unchanged. The changes are not anticipated to have any impact on off-site groundwater quality, the effectiveness of the existing on-site pumping well system, or the clean-up duration. **Section 4.4.5** provides further details about the projected cumulative water demand and the minimal anticipated impact on the groundwater levels.

4.4.1.4 Control of Impacts

Control and prevention of impacts to groundwater would be provided through several mechanisms. **Section 2.1.2** (*Proposed Action*), **Section 4.13** (*Waste Management Impacts*), and **Chapter 5** (*Mitigation Measures*) of this Report describe aspects of the Proposed GLE Facility design and hazardous material and waste-handling practices that would be implemented as part of the Proposed Action to limit the potential for accidental release of hazardous constituents and the impact on groundwater quality. The existing groundwater monitoring program at the Site would be supplemented with a focus on detecting any unforeseen impacts to groundwater quality associated with the Proposed Action (see **Chapter 6** of this Report, *Environmental Measurement and Monitoring Programs*). Although there would be only a small potential for indirect impacts to groundwater quality, stormwater and effluent sampling would be conducted as necessary by the existing and/or modified NPDES permits to protect surface water quality. In addition, site-wide groundwater levels would continue to be monitored routinely, and the groundwater monitoring-well and pumping-well networks would continue to be analyzed to confirm that the changes in groundwater levels associated with the Proposed Action are minimal. Thus, no adverse effect on off-site groundwater quality or the effectiveness of the existing on-site pumping well system is expected.

4.4.2 Surface Water Impacts

4.4.2.1 Methods for Assessing Potential Impacts

Field surveys were conducted September 4 through 7, 2007, to delineate the streams, wetlands, and other surface waters within the 265-acre (107-ha) GLE Study Area (**Figure 4.4-1**). Stream limits were marked in the field using flagging tape, and these flagged points were located by professional land surveyors. The top of the bank was considered the limits of the stream channel, and the centerline of the channel was used to assess the length of stream within the GLE Study Area. The USACE's *Stream Quality Assessment Worksheet* (USACE, 2003) was used to score the quality of each stream and the North Carolina

Department of Environmental and Natural Resources (NCDENR) Division of Water Quality (NC DWQ) Stream Identification Form (NCDENR, 2005) was used to classify the streams as ephemeral, intermittent, or perennial. Impacts to wetlands are discussed in **Section 4.4.4**. No ponds or impoundments are located within the GLE Study Area.

Existing sanitary and process wastewater effluent concentrations discharged from Wilmington Site operations were used to predict the wastewater concentrations discharged from the Proposed GLE Facility. Effluent concentrations for the Proposed Action are anticipated to be similar and additive in assessing the potential water quality impacts to receiving waters. Further details on wastewater-treatment and management practices for the Proposed Action that support the anticipated similarity between the effluent concentrations from existing Wilmington Site operations and those from the Proposed Action are presented in **Section 4.4.2.3.1.2** and **Section 4.13.2.2.1**, *Waste Management Impacts* (*Wastewaters*).

Changes in runoff volume were predicted using the Regional Nutrient Management (ReNuMa) model (Hong and Swaney, 2007). Average and extreme precipitation data, as well as land use information, were required to generate anticipated changes to stormwater quantity and quality received by the Wilmington Site surface waters. Additional information on the ReNuMa model and potential impacts to stormwater quantity are discussed in **Section 4.4.3.2.2**.

4.4.2.2 No Action Alternative

The No Action Alternative would not involve modifications to existing streams for road crossings, new construction, or improvements to the existing facility. Direct or indirect impacts to surface waters (i.e., quality, quantity, and physical characteristics) from the No Action Alternative are not expected; therefore, impacts would be SMALL.

4.4.2.3 Proposed Action

The Proposed GLE Facility and additional structures would be located in the North-Central Site Sector of the Wilmington Site. The buildings, parking lots, stormwater wet detention basin, UF_6 storage areas, and maintained landscaped areas of the Proposed GLE Facility would not require the modification, fill, or containment of existing surface waters. The proposed North Road portion of the GLE Study Area would have one new stream crossing (Unnamed Tributary #1 to Prince George Creek) and potentially alter a jurisdictional channel from construction and improvements to this road. The existing service road within the South Road portion of the GLE Study Area would be paved, and an existing stream crossing (Unnamed Tributary #1 to Northeast Cape Fear River) would be modified. **Figure 4.4-1** depicts the location of the Proposed GLE Facility and the surface waters of the Wilmington Site.

Process and sanitary wastewaters from the Proposed GLE Facility would be treated using the existing wastewater treatment systems and facilities, as described in **Section 3.12** of this Report (*Waste Management*). The pollutant loadings from the wastewater stream effluents are expected to remain well within the current NPDES-permitted levels. The Proposed Action would not require the consumptive use of any surface water (see **Section 4.4.5**).

An assessment of the Proposed Action impacts on surface waters is provided below, and these impacts will be updated as revisions are made to the Proposed GLE Facility design. Methods and practices to avoid, minimize, and mitigate impacts to surfaces water are discussed in **Section 4.4.2.6** and **Section 5.4.2** (*Surface Waters [Water Resources]*) of this Report.

4.4.2.3.1 Impacts to Surface Water Quality (Receiving Waters)

4.4.2.3.1.1 Site Preparation and Construction

As detailed in **Section 3.4.2.10.1** (*Streams [Site-Specific Surface Water Characteristics]*), the current surface water flow direction at the location of Proposed GLE Facility is to the north-northwest. During construction, the location of the Proposed GLE Facility would be re-graded and the existing hydrology would be altered. Stormwater runoff from the Proposed GLE Facility would be routed to the stormwater wet detention basin, which would be created as a part of the Proposed Action. The assessments presented in this Report are based on the understanding that stormwater from the Proposed GLE Facility, including the main GLE operations building, would drain to the stormwater wet detention basin, and stormwater from the UF_6 storage pad areas would drain to a holding pond for monitoring before draining to the stormwater wet detention basin. Stormwater from the detention basin would discharge toward the effluent channel and, eventually, Unnamed Tributary #1 to Northeast Cape Fear River. **Figure 4.4-2** shows the Wilmington Site drainage with the Proposed Action. During construction, runoff from the Proposed GLE Facility would potentially be received by both Unnamed Tributary #1 to Northeast Cape Fear River and Unnamed Tributary #2 to Prince George Creek. Due to vegetation removal, grading, and other land-disturbing activities for the Proposed GLE Facility, increased sediment loadings to receiving streams could occur during the GLE Facility site preparation and construction phase. Impacts would be minimized with the implementation of required sediment and erosion control measures.

The proposed North access road would be constructed in the Eastern Site Sector to provide the Proposed GLE Facility with direct access to NC 133 (Castle Hayne Road). The road would require a stream crossing of Unnamed Tributary #1 to Prince George Creek and modifications to a jurisdictional channel (**Figure 4.4-1**). Impacts to the tributary could include increased sedimentation from land-disturbing activities, removal of bank vegetation, and stream bank and bed disturbance for construction of the crossing (e.g., concrete pipe, box culvert, bridge), as well as stream flow disruption for installation of the crossing structure. The proposed South access road currently exists along the southern edge of the Proposed GLE Facility boundary and joins with the existing Wilmington Site facilities. The road crosses Unnamed Tributary #1 to Northeast Cape Fear River. The Proposed Action would pave the existing gravel service road and improve the existing stream crossing. Impacts to this stream could include increased sedimentation and stream bank and bed disturbance from construction activities associated with these improvements. Impacts would be minimized with implementation of required sediment and erosion control measures.

During site preparation and construction, sediment would be the primary potential water pollutant due to the vegetation removal, grading, and road development required for the Proposed Action. Although North Carolina has no water quality standard for sediment or total suspended solids (TSS), excessive sediment loadings can affect transparency, organic content, and stream flow. Turbidity is a measure of water clarity or how much the material suspended in the water column decreases the passage of light. Suspended material includes soil particles (e.g., sand, silt, clay), organic matter, algae, and microscopic organisms. In North Carolina, the water quality standard for turbidity is 50 Nephelometric Turbidity Units. Higher turbidity decreases the amount of dissolved oxygen in the water by reducing the amount of light for photosynthesis and increasing the temperature of the water. Suspended materials, such as soil particles that erode during construction, can clog fish gills, lower growth rates, and smother fish eggs and aquatic insects (U.S. EPA, 1997). Increased sedimentation is a potential impact to the Northeast Cape Fear River and its tributaries on the Wilmington Site. Compliance with the North Carolina turbidity standard can be met when land management activities employ BMPs (15A NCAC 02B .0211), as would be implemented for the Proposed Action.

Increased traffic and equipment use during construction would increase the potential for accidental incidental release of oil, grease, or other contaminants from these construction vehicles. Releases would be avoided or minimized by regular maintenance and inspection of equipment and rapid response to clean-up spills that would contain and prevent contaminants from reaching soil, sediment, or water.

Construction of the Proposed Action would not cause water quality standards or limits to be exceeded; therefore, direct and indirect impacts to water quality are anticipated to be SMALL during the GLE Facility site preparation and construction of the Proposed GLE Facility and proposed North and South access roads due to the implementation of mitigation practices discussed in **Section 4.4.2.6** and **Section 5.4.2** (*Surface Waters [Water Resources]*) of this Report.

4.4.2.3.1.2 Operation

Process wastewater and sanitary wastewater from the Proposed GLE Facility would be treated through the existing Wilmington Site final process lagoon and sanitary wastewater treatment facilities. As discussed in **Section 4.13.2.2.1**, *Waste Management Impacts (Wastewaters)*, approximately 35,000 gpd (132,500 lpd) of treated process wastewater would be generated from the Proposed Action and discharged through a NPDES-permitted outfall (Outfall 001) to the effluent channel. Process wastewater is a combination of 5,000 gpd (18,900 lpd) of liquid radwaste generated from decontamination, cleaning, and laboratory activities and 30,000 gpd (113,600 lpd) of cooling tower blowdown that circulates in a closed-loop system that does not contact uranium materials. The liquid radwaste is pre-treated in the GLE liquid effluent treatment system to remove uranium to acceptable levels before it is transferred to the existing Wilmington Site final process lagoon wastewater treatment facility. Therefore, the quality of the GLE process wastewater effluent is anticipated to be similar to current process wastewater concentrations. According to the average 2006 process wastewater volumes discharged by Wilmington Site operations (see **Table 3.12-1**), process wastewater from the Proposed GLE Facility would increase the current volume by approximately 7%. Process wastewater quantity and quality would remain within NPDES-permitted levels. The impacts to surface water quality and quantity from a 7% increase in process wastewater effluent are anticipated to be SMALL. These impacts are further discussed in **Section 4.13**, *Waste Management Impacts.*

Treated sanitary wastewater effluent would discharge through the existing NPDES-permitted outfall (Outfall 002) to the effluent channel. The composition of the sanitary wastewater from the Proposed GLE Facility would be similar to that produced by the existing Wilmington Site operations (see **Table 3.12-3** for treated sanitary wastewater effluent characteristics). The Proposed GLE Facility would increase the current sanitary wastewater volume by 10,500 gpd (40,000 lpd). The Wilmington Site discharges would continue to be monitored for compliance with permitting requirements. Any impacts to the Northeast Cape Fear River or to Unnamed Tributary #1 to Northeast Cape Fear River from the addition of the proposed sanitary wastewater effluent discharge would be SMALL. These impacts are further discussed in **Section 4.13**, *Waste Management Impacts*.

In compliance with State and local regulations, stormwater runoff from the Proposed GLE Facility would drain to a stormwater wet detention basin (previously described in **Section 4.4.2.3.1.1**) before discharging to receiving waters. **Figure 4.4-2** indicates the changes in drainage area and surface water runoff from the Proposed Action. An area representing approximately 9% of the Wilmington Site that currently drains north to Unnamed Tributary #2 to Prince George Creek would be graded to drain southeast toward the stormwater wet detention basin and, ultimately, Unnamed Tributary #1 to Northeast Cape Fear River (**Table 4.4-3**). The stormwater wet detention basin would serve to regulate stormwater quality and quantity from the Proposed GLE Facility. In addition, a holding pond would be placed near the UF_6 storage pads to collect the stormwater runoff from these pads. This holding pond would be monitored, and the data would be evaluated by GLE personnel to ensure that no unanticipated radiological discharge

occurs to the stormwater wet detention basin. Should unanticipated radioactivity be detected in the holding pond, radiological material would be allowed to settle and/or precipitate. The liquid then would be pumped from the holding pond and, if necessary, routed to the GLE liquid effluent treatment system. Surveys then would be conducted on the contained solids to identify contaminated portions to be disposed as LLRW. Given these BMPs and that the holding pond would be designed with concrete and/or synthetic liners so as not to leak, no more than trace levels of radiological contamination would be anticipated to be released from the UF_6 storage pads area stormwater holding pond.

Stormwater runoff quality from the Proposed GLE Facility is anticipated to be similar to the quality of runoff from the existing Wilmington Site facilities in that it would consist of runoff from buildings, parking lots, and storage facilities. Stormwater quality from stormwater discharge outlet (SDO) 9 (see **Figure 3.4-22**) would likely be similar to the runoff from the Proposed GLE Facility (see **Table 3.4-11**); however, runoff from outfall SDO 9 is not routed through a detention basin prior to being discharged to receiving waters. The planned stormwater wet detention basin would help improve stormwater quality from the Proposed GLE Facility by removing up to 85% of the TSS, 25% of the total nitrogen, and 40% of the total phosphorus (NCDENR, 2007). Therefore, stormwater discharge to receiving streams from the Proposed GLE Facility should have better water quality than has been reported for SDO 9.

Once the North Road portion of the GLE Study Area has been constructed, sediment loads would be expected to decrease, and runoff characteristics would be similar to other paved roads on the Site. Small amounts of oil and grease, metals, and other constituents associated with vehicular activity would be expected to be carried in runoff from the access roads; however, BMPs, such as the use of grass swales, would help reduce peak flow and trap sediment. Paving of the proposed South access road should reduce fugitive dust and sediment available to travel to surface waters.

Vegetation maintenance practices would be similar to existing maintenance practices on Operation Areas of the Wilmington Site. Chemical herbicides would only be used in site-specific locations and would not be used directly along streams, ditches, or the stormwater wet detention basin, decreasing the potential for the entry of herbicides into receiving waters. In addition, the implementation of BMPs and other practices to contain and prevent the release of herbicides would minimize impacts (see **Chapter 5** of this Report, *Mitigation Measures*).

Application for a modified stormwater permit would likely be required for the Proposed Action. The existing Wilmington Site Stormwater Pollution Prevention Plan and BMPs would be expanded to include the Proposed Action, and permitting requirements regulated by the NPDES stormwater permit would continue to be met. Therefore, no degradation of water quality would be expected in the downstream receiving waters, Unnamed Tributary #2 to Prince George Creek, Unnamed Tributary #1 to the Northeast Cape Fear River, and the Northeast Cape Fear River. In summary, impacts to the quality of receiving waters from operation of the Proposed GLE Facility would be expected to be SMALL.

4.4.2.3.1.3 Decommissioning

As described in **Section 2.1.2.4** of this Report (*Site and Facility Information [Proposed Action]*), decontamination and decommissioning of the Proposed GLE Facility would involve removal of internal structures, utilities, and products from the building; however, the physical structure, associated foundations, access roads, and utility lines would likely remain intact. Landscape areas and maintained lawn areas established at the completion of the construction phase could be impacted during the decommissioning process for staging of equipment or temporary storage of materials. Erosion-control BMPs similar to those required during the construction phase would be used to mitigate potential impacts during the decommissioning phase (see **Chapter 5** of this Report, *Mitigation Measures*).

Sanitary and process wastewater effluent discharges would gradually decrease over the decommissioning phase as the processes and number of personnel in the Proposed GLE Facility decreases. Transportation-related activities associated with the Proposed GLE Facility would also gradually decrease, further reducing any minimal impacts to the effluent channel and downstream receiving waters. Stormwater would continue to be routed from the Proposed GLE Facility to the stormwater wet detention basin during and after the decommissioning phase; therefore, no additional impacts would occur. The overall impact to surface water quality from the decommissioning phase would be SMALL.

4.4.2.3.2 Impacts to Surface Waters (Physical)

The Proposed GLE Facility could directly impact up to 454 linear ft (66 m) of stream channel, comprising 0.50 acres (0.20 ha) from physical modifications for road crossings (**Table 4.4-4**). The proposed North access road would cross Unnamed Tributary #1 to Prince George Creek (see **Figure 4.4-1**), totaling approximately 175 linear ft (53 m) of potential stream impacts. This stream segment within the GLE Study Area was evaluated during field surveys and received a USACE water quality assessment score of 43 (with 100 representing the highest-quality stream [USACE, 2003]) and was ranked as an intermittent stream based on the NC DWQ Stream Identification Form (NCDENR, 2005). The low-flow condition of the stream due to drought conditions at the time of the assessment may have lowered these scores. During field surveys, a jurisdictional channel was delineated within the North Road portion of the GLE Study Area (see **Figure 4.4-1**). This channel was classified as jurisdictional by the USACE because it provides a hydrological connection of Wetland WC to waters of the United States (i.e., Unnamed Tributary #1 to Prince George Creek; see **Section 3.4.4** of this Report, *Wetlands*, for more information). The proposed North access road, depending on final design, could also impact approximately 62 linear ft (19 m) of this channel. The proposed South access road would cross Unnamed Tributary #1 to Northeast Cape Fear River (see **Figure 4.4-1**); 217 linear ft (66 m) of this stream is within the 200-ft (61-m) wide South Road portion of the GLE Study Area. This stream segment within the GLE Study Area was evaluated during field surveys, received a USACE water quality assessment score of 66 (with 100 representing the highest-quality stream [USACE, 2003]), and was ranked as a perennial stream based on the NC DWQ Stream Identification Form (NCDENR, 2005). The low-flow condition of the stream due to drought conditions at the time of the assessment may have lowered these scores.

The Proposed GLE Facility, including buildings, parking lots, the stormwater wet detention basin, UF_6 storage areas, and maintained landscaped areas, would not require the diversion, fill, or containment of existing surface waters. The Proposed Action would not impact the Northeast Cape Fear River or its shoreline. No new intake or NPDES outfalls on the Northeast Cape Fear River are proposed. No direct impacts to existing surface waters would be expected.

4.4.2.3.2.1 Site Preparation and Construction

The proposed North access road would intersect Unnamed Tributary #1 to Prince George Creek (see **Figure 4.4-1**). To minimize impacts to this stream channel during the GLE Facility site preparation and construction of the proposed North access road, the stream crossing would be perpendicular to Unnamed Tributary #1 to Prince George Creek. A maximum of 175 linear ft (53 m) of this stream would be impacted (**Table 4.4-4**). Construction of the crossing would have a temporary impact on the bank stability and stream capacity; however, precautions would be taken to minimize the intensity and duration of impacts. The hydrological connectivity provided by the approximately 62 linear ft (19 m) of jurisdictional channel to Wetland WC would be maintained during construction of the proposed North access road. The Proposed Action would modify the existing stream crossing of Unnamed Tributary #1 to Northeast Cape Fear River (approximately 50 linear ft [15 m]) for the proposed South access road. It is anticipated that physical impacts to the streambed and banks would be less than the entire 217 linear ft (66 m) of stream channel identified within the South Road portion of the GLE Study Area (**Table 4.4-4**) because most of

the impacts would occur only to the existing piped section. Temporary construction impacts can not be determined until final site design is complete; however, anticipated impacts to Unnamed Tributary #1 to Prince George Creek, the jurisdictional channel, and Unnamed Tributary #1 to Northeast Cape Fear River during construction of the stream crossing would be SMALL due to the implementation of mitigation practices and BMPs. Refer to **Chapter 5** of this Report (*Mitigation Measures*) for more information on mitigation practices. Applicable permits (Clean Water Act [CWA] Section 404 permit and 401 water quality certification) can not be obtained until final site design is complete and mitigation measures for impacts are approved. (See **Section 3.4.2.9** of this Report, *Federal and State Regulations [Surface Waters],*for more information on State and federal regulations applicable to surface waters.) No direct impacts would occur to any other streams on the Wilmington Site because no other construction activities or modifications from the Proposed Action are planned for these streams.

4.4.2.3.2.2 Operation

Permanent impacts to Unnamed Tributary #1 to Prince George Creek, the jurisdictional channel, and Unnamed Tributary #1 to Northeast Cape Fear River would be determined after final site design is complete and the structure for the stream crossing is selected (i.e., pipe, culvert, or bridge). These permanent impacts from the operation of the proposed North and South access roads would be smaller than the areas temporarily disturbed during construction. Once construction of the crossings is complete, the disturbed banks would be stabilized, and the stream channel would adjust to the modifications. Maintenance would likely be required to clear the culverts or bridges from debris after storms and to ensure new stream banks are stable. Impacts to surface waters would be SMALL from the operation of the Proposed Action.

4.4.2.3.2.3 Decommissioning

Decommissioning of the Proposed Action would not impact surface waters by the placement of fill or dredged material into waters of the United States; therefore, physical impacts to stream channels from the decommissioning phase would be SMALL.

4.4.2.4 Impacts to Surface Water Quantity

The increase in surface water runoff from converting the area of the Proposed GLE Facility from forested and herbaceous land to an industrial area (high- and low-density development) is described in **Section 4.4.3.2.2**. Watershed modeling indicates that surface water runoff from the operational Facility would increase by approximately 36% for a year with normal rainfall, when compared to existing conditions. This increased surface water runoff would be mitigated by the stormwater wet detention basin that would be designed to detain the stormwater from a 25-year storm event and reduce peak flow volumes. Therefore, the impact on receiving waters due to increased surface water runoff would be SMALL. This topic is discussed further in **Section 4.4.3.2.2.**

No surface water withdrawals would occur during the construction, operation, or decommissioning of the Proposed GLE Facility. Groundwater is the source of all water used for the Proposed Action (see **Section 4.4.5** for more information on water use). Exclusive of the effluent re-use process assessed in **Section 4.4.2.5**, sanitary and process wastewater effluents would be discharged from existing NPDES outfalls during operations, resulting in a 7% increase in the volume discharged to the effluent channel (and, subsequently, Unnamed Tributary #1 to Northeast Cape Fear River). The resultant increase in surface water flow of 45,500 gpd (172,200 lpd) would be negligible in comparison to the flow of the Northeast Cape Fear River. Unnamed Tributary #1 to Northeast Cape Fear River would likely develop some temporary unstable areas while the channel adjusts to the increased flow, such as eroding banks and incision of the streambed. Impacts from the increased wastewater discharge to surface waters would be SMALL. For more information on wastewater discharges, refer to **Section 4.13**, *Waste Management Impacts*.

The Northeast Cape Fear River and Prince George Creek are used for commercial and recreational fishing; however, no impact to fish stocks in quantity or quality would be expected during construction, operation, or decommissioning of the Proposed GLE Facility (see **Section 4.5**, *Ecological Resources Impacts*, for more information). The Northeast Cape Fear River is a navigable river with boating and industrial transport uses. Impacts to navigation, industrial transport, or secondary recreation incurred during construction, operation, or decommissioning of the Proposed GLE Facility would be SMALL.

4.4.2.5 Cumulative Impacts to Surface Waters

As discussed in **Section 2.3** of this Report (*Cumulative Effects*), other planned projects on the Wilmington Site include construction of the ATC II complex in the southeastern portion of the Eastern Site Sector and the Tooling Development Center in the southwestern portion of the Eastern Site Sector. During construction of the ATC II complex, increased sediment loadings to Unnamed Tributary #1 to Prince George Creek may occur; however, construction of the complex would not occur at the same time as the Proposed Action. Runoff from the construction and operation of the Tooling Development Center would drain toward Unnamed Tributary #1 to Northeast Cape Fear River; however impacts would be minimal because the Center will be located significantly upland from the stream and any runoff would be discharged through existing forest land, which provides natural sediment attenuation. During operation, stormwater from the ATC II complex and the Tooling Development Center would be routed to stormwater wet detention basins to reduce peak flows and to improve water quality before draining to receiving waters. Direct and indirect cumulative impacts to surface water quality from construction and operation of these facilities would be SMALL.

The cumulative treated wastewater effluents from the Proposed Action, the ATC II complex, and the Tooling Development Center would be discharged to the effluent channel. The resultant quality of the discharged effluents is expected to be the same or better as compared to the current discharge, and the discharge flows are estimated to remain well below the existing NPDES permit limitations (these discharges are further discussed in **Section 4.13**, *Waste Management Impacts*). The industrial re-use of treated sanitary wastewater effluent as make-up water in Wilmington Site cooling towers became operational in April 2008, but is included in this cumulative impacts assessment because it postdates the 2006 baseline conditions presented in **Chapter 3** of this Report (*Description of the Affected Environment*). Once the Proposed GLE Facility, the ATC II complex, and the Tooling Development Center are operating, approximately 62,300 gpd (235,800 lpd) of sanitary wastewater effluent generated by the wastewater treatment facility would be used for process operations. Because the treated sanitary wastewater effluent has such low hardness, its addition to the Wilmington Site cooling towers increases efficiencies and would reduce groundwater withdrawal for process-water requirements by approximately 124,600 gpd (471,700 lpd) (i.e., twice the projected cumulative sanitary wastewater treatment rate of 62,300 gpd [235,800 lpd]) and would reduce the amount of process water to be treated in the final process lagoons and discharged to waters the effluent channel by approximately 62,300 gpd (235,800 lpd). Considering that approximately 62,300 gpd [235,800 lpd]) of treated sanitary wastewater effluent also would be switched away from discharging to the effluent channel, this effluent re-use process would result in a total net reduction of approximately 124,600 gpd (471,700 lpd) of wastewater effluents discharged to the effluent channel, or a decrease of only approximately 1% (see **Table 4.13-5**). Therefore, surface water quality cumulative impacts from the projected changes in effluent discharges are anticipated to be SMALL.

Construction of the ATC II complex and the Tooling Development Center would not require the diversion, fill, or containment of existing surface waters; therefore, direct cumulative impacts to the amount of surface waters on the Site would be SMALL.

A continuing-care retirement community, the River Bluffs subdivision, is planned for development adjacent to the southern boundary of the South-Central Site Sector. The River Bluffs development would convert approximately 240 acres (97 ha) of forested land to residential and recreational land uses. During construction, the potential for increased sediment loadings to the Northeast Cape Fear River could occur. Depending on the timing of development, the potential for cumulative sediment impacts to the Northeast Cape Fear River could occur. During operations, surface water runoff quality and quantity could be potentially altered due to the development. Additional information on the construction plans, NPDES requirements, and stormwater management practices of the River Bluffs development would be required to assess the cumulative impact anticipated.

The off-site industrial development proposed by the Carolinas Cement Company (see **Section 2.3**, *Cumulative Effects*) would be located approximately 20 river miles (32 km) upstream of the Wilmington Site boundary. The proposed site is bordered on the north by the Northeast Cape Fear River and on the east by Island Creek (USACE, 2008). Review of jurisdictional stream delineations is complete, but the results would not be available until the final verification is issued by the USACE; therefore, impacts to surface waters are not known (USACE, 2008). The operation of the quarry and manufacturing facility would likely impact surface water quality (U.S. FWS, 2008). Both the STORET Station B958000 (Northeast Cape Fear River at US 117 at Castle Hayne, NC) and GE-Hitachi Nuclear Energy (GEH) monitoring station UPST (Northeast Cape Fear River near Castle Hayne, NC) would be downstream of the proposed Carolinas Cement Company development; therefore, any changes to surface water quality could be distinguished from potential impacts from the Wilmington Site.

4.4.2.6 Control of Impacts to Surface Waters

Because the Wilmington Site is subject to Federal Phase II Stormwater Management requirements (40 CFR 122, *EPA Administered Permit Programs: The National Pollutant Discharge Elimination System*), the stormwater management plan for the GLE Facility site would be designed to meet the requirements outlined in North Carolina Senate Bill 1566 for high-density projects.

The Proposed Action would utilize stormwater treatment devices, including stormwater wet detention basins, as described in the NCDENR *Stormwater Best Management Practices Manual* (NCDENR, 2007). BMPs would be designed and constructed in accordance with the procedures and guidelines listed within the manual to effectively treat stormwater runoff and reduce the resulting TSS loading rate. Sediment- and erosion-control devices would be designed to meet applicable design guidelines listed in the current version of the *North Carolina Erosion and Sediment Control Planning and Design Manual* (Smolen et al., 2006).

The location of the Proposed GLE Facility was chosen to avoid impacts to surface waters. The proposed South access road already intersects Unnamed Tributary #1 to Northeast Cape Fear River. In an effort to reduce the impacts to surface waters, this existing gravel road only will be paved, and the location of the existing stream crossing will be modified in its current location. Potential impacts from modifications would be controlled with measures and practices discussed in **Chapter 5** of this Report (*Mitigation Measures*).

The proposed North access road between NC 133 (Castle Hayne Road) and the Proposed GLE Facility would be constructed because no existing road is available for direct transport from the highway to the Proposed GLE Facility. To minimize impacts to Unnamed Tributary #1 to Prince George Creek, the proposed crossing would be perpendicular to the stream. Impacts from the Proposed Action to the jurisdictional channel would be controlled, maintaining the hydrological connectivity provided by this channel to Wetland WC (see **Figure 4.4-6**). Other proposed practices and measures to control the impacts to water quality and/or quantity are included in **Chapter 5** of this Report (*Mitigation Measures*).

4.4.3 Impacts to Floodplains

This section describes potential impacts associated with the No Action Alternative and the Proposed Action on the floodplains of the Northeast Cape Fear River, and primarily addresses floodwaters produced by the 100- or 500-year magnitude storms. Further description of the stormwater runoff quality and quantity from smaller storms from the Proposed Action is discussed in **Section 4.4.2**. The majority of the Western Site Sector (described in **Section 1.2**, *Purpose and Need for the Proposed Action*, and shown in **Figure 1.2-4**) of the Wilmington Site lies within the 100- and 500-year floodplains. The Main portion and the North Road portion of the GLE Study Area are located outside of these flood boundaries (**Section 3.4.3** of this Report, *Floodplains*). The corridor outlined for the proposed South access road passes along the edge of the 500-year floodplain boundary, which coincides with the boundary of the Western Site Sector and crosses the floodplain boundary at the crossing of Unnamed Tributary #1 to Northeast Cape Fear River. According to the *2006 Flood Insurance Survey* for New Hanover County, "[t]he dominant flooding source in Wilmington is storm surge generated in the Atlantic Ocean by hurricanes and other severe windstorms that are propagated up Hewletts Creek and the Cape Fear River and into its tributaries. Effects of these tides are felt at the New Hanover-Pender County line, approximately 56 miles from the mouth of the Cape Fear River." Several creeks within the Cape Fear River Basin, including Prince George Creek, are prone to flooding during heavy rainfalls and storm surges. However, due to the estuarine nature of the Northeast Cape Fear River, the stage of the river experiences negligible effects from such tributary and creek overflows (FEMA and State of North Carolina, 2006). Direct and indirect effects of tsunamis at the Wilmington Site were not assessed due to the distance of the Site from the ocean and the elevation of the Site msl (**Section 4.3.2.2.2**, *Operations [Proposed Action, Geological Impacts]*).

4.4.3.1 No Action Alternative

The No Action Alternative would not involve any grading or other modification of the terrain on the Wilmington Site, nor would it affect stormwater runoff quantity and quality; therefore, SMALL impacts to the floodplains are expected for this alternative.

4.4.3.2 Proposed Action

Impact to the floodplain boundary from the upgrade of the crossing of the existing service road within the South Road portion of the GLE Study Area over Unnamed Tributary #1 to Northeast Cape Fear River would be SMALL. No other direct modifications to the boundaries of the floodplains are expected under the Proposed Action because other construction, operation, and expected decommissioning activities would occur outside of the floodplain boundaries. The behavior of floodwaters due to any Wilmington Site changes and the potential effect that these waters may have on the Site and surrounding surface waters are evaluated below.

4.4.3.2.1 Construction

Construction activities that may alter the behavior of floodwaters include the grading of the GLE Facility site to shift a portion of the drainage direction within the North-Central Site Sector in the GLE Study Area from the north to the south and the conversion of land use from undeveloped forest and herbaceous cover to developed, impervious surfaces. Grading would be performed to route stormwater from the newly constructed Facility to a stormwater wet detention basin located east of the 100-acre (40-ha) Proposed GLE Facility. Stormwater from this detention basin would discharge toward Unnamed Tributary #1 to Northeast Cape Fear River (see **Section 4.4.2.3** and **Figure 4.4-2**). The impacts on floodwater behavior due to this construction activity and the conversion of land use would be fully experienced only upon completion of construction when new drainage patterns are complete and new impervious areas are created. As such, the impacts on floodwaters are discussed with regards to operation of the Proposed GLE Facility, **Section 4.4.3.2.2**.

Grading of the 100-acre (40-ha) Proposed GLE Facility site in the interior of the North-Central Site Sector should not result in a change in the floodplain boundaries. The current slope gradient of the Main portion of the GLE Study Area (containing the 100 acres [40 ha] proposed to be graded for construction of the Proposed GLE Facility) generally lies around 0 to 2%. The minimum elevation within the GLE Study Area where the grading would occur is approximately 11 ft (3.4 m) above the 500-year coastal stillwater flood elevation. (Coastal stillwater elevations factor in potential impacts from storm surge, including tidal and wind setup effects. See **Section 3.4.3** of this Report, *Floodplains,* for more information.) Minor changes in gradation of portions of the GLE Study Area to reverse a 2% slope gradient from the north to the south would not lower the minimum elevation on the site enough to convert the newly graded areas to floodplains or to encroach on the existing floodplain—two actions that would increase the flood impacts. Therefore, grading of the site would result in SMALL impacts. The proposed South access road, which is adjacent to the 500-year floodplain boundary, currently lies 7 to 16 ft (2.1 to 4.9 m) above the 500-year coastal stillwater flood elevation. Modifications to the stream crossing for the proposed South access road would occur within the floodplain, but floodwaters would not be impeded during the construction process. The new crossing would have the same or greater flow capacity than that of the existing crossing; therefore, no rise to the 100-year or 500-year floodwaters would be anticipated. Modifications from this stream crossing would have SMALL impacts to the floodplain.

4.4.3.2.2 Operation

Upon completion of construction, the 100-acre [40 ha] Proposed GLE Facility would have an altered land use and a different drainage pattern. As discussed in **Sections 4.4.2**, surface runoff from the Proposed GLE Facility would drain to a stormwater wet detention basin in the southeast corner of the Main portion of the GLE Study Area, draining toward the effluent channel instead of toward Unnamed Tributary #2 to Prince George Creek. As discussed previously, Prince George Creek is subject to overflow during heavy storm events; removal of some of the runoff from the GLE Study Area to the creek should mitigate this overflow issue. To determine the change in runoff quantity during large/peak storm events (100- or 500-year storms) due to development of the Proposed GLE Facility, land area estimations for Facility and road construction were made based on the 100-acre (40-ha) outline of the Proposed GLE Facility and the 1996 landcover data available for the Wilmington Site. Consideration was given that not all 100 acres (40 ha) have been allocated for development to impervious areas within the GLE Study Area. Additionally, the corridors outlined for the roadway study areas are approximately 200-ft (61-m) wide. For the proposed North access road, it was assumed that the entire 200-ft (61-m) wide corridor would be cleared of forested vegetation, but only a 30-ft (48-m) wide roadway would be paved. The remaining area would be drainage swales, utility easements, and maintained herbaceous cover. For the South access road, it was assumed that only the 30-ft (48-m) wide roadway would be paved, with no modification to the existing forested vegetation surrounding the roadway. Using these assumptions, an estimate of approximately 112 acres (45 ha) of land conversion from forested and herbaceous areas to developed areas was obtained for the GLE Study Area (**Table 4.4-5**). Approximately 63 acres (25.5 ha) would be developed (based on areal estimates of preliminary building and roadway plans) for primary structures within the 100-acre (40-ha) GLE Facility site, with approximately an additional 36 acres (14.5 ha) for paving of the proposed North and South access road portions of the GLE Study Area. To the east of the 100-acre (40-ha) Proposed GLE Facility and within the Main portion of the GLE Study Area, an additional 8 acres (3.2 ha) of forested areas would be converted to open water for the stormwater wet detention basin and an additional 5 acres (2 ha) of forested areas would be converted to impervious area for additional structures. In addition, the Proposed Action would result in conversion of approximately 37 acres (15 ha) from the original vegetation cover to managed herbaceous lands within the 100-acre (40-ha) GLE Facility site.

To estimate the increase in floodwaters that might result from these land use changes on the GLE Facility site, a hydrologic model was used to estimate the magnitude of runoff expected from the site during a peak storm event. For this analysis, data from the 1999 Hurricane Floyd storm were used. Hurricane

Floyd produced 13.4 inches (34.0 cm) of rain in a single day (September 15, 1999), according to data collected at the Wilmington International Airport, which is located approximately 4 miles (6.4 km) southeast of the Wilmington Site. This magnitude of rain in a 24-hour period is greater than the 100-year storm (10 inches [25.4 cm] in a 24-hour period), according to the Depth-Duration-Frequency table provided in the *Storm Water Design Manual for New Hanover County* (New Hanover County, 2000; magnitudes for a 500-year storm were not provided in this guidance). Additionally, U.S. Geological Survey (USGS) stream gages recorded flooding that was "likely greater than the 100 years and very possibly greater than 500 years" in magnitude (FEMA and State of North Carolina, 2006). During this storm event, the GLE Study Area and the existing developed areas of the Wilmington Site were not observed by on-site personnel to have flooded.

The hydrologic model chosen to analyze the changes in runoff, and hence floodwaters, due to development of the GLE Study Area was the ReNuMa, which utilizes the Generalized Watershed Loading Function (GWLF) hydrology functions to drive the model (Haith et al., 1996; Hong and Swaney, 2007). GWLF is a widely used model for flow and nutrient load estimation (Haith and Shoemaker, 1987; Dodd and Tippett, 1994; Lee et al., 2000). ReNuMa is available with a Microsoft Excel interface with a Visual Basic for Applications (VBA) backend that simplifies use and quality control and assurance of the results of the model output. The version of GWLF incorporated into ReNuMa relies on the Soil Conservation Service's *Technical Release 55* (USDA, 1986) and the Universal Soil Loss Equation (USLE) to determine discharge, runoff, and erosion rates from each land use type. For these calculations, a Curve Number and USLE factors (as explained for erosion rates in **Section 3.4.2.10.3** of this Report, *Erosion Characteristics and Sediment Transport [Site-Specific Surface Water Characteristics]*) are assigned to each intersection of land use and soil type (see **Table 4.4-5**). These methods are consistent with those suggested for peak discharge calculation by the *New Hanover County Storm Water Design Manual*. The model produces daily runoff, groundwater flows, and sediment erosion, which it then sums to monthly and annual output. ReNuMa also records output by land use type, allowing for direct comparisons between simulations when the area of each land use type changes within a study area. ReNuMa was run using the original land use areas and the modified land use that would result from the Proposed Action to determine the increase in floodwaters due to development of the Proposed GLE Facility.

Table 4.4-6 presents the results from ReNuMa in terms of the change in annual runoff totals and volume for 1998, a year with slightly above average precipitation, and 1999, the year during which Hurricane Floyd occurred (i.e., a peak storm event). In that year, the annual precipitation total (72.1 inches; 183 cm) was 26% above the average of 57.1 inches (145 cm). These annual runoff volumes and the peak daily runoff total and volume during Hurricane Floyd on September 15, 1999, (also presented in **Table 4.4-6**) are used to examine the potential effects of the Proposed Action. Using the daily runoff estimations from the model, the increase in runoff on September 15, 1999—the day of record precipitation during Hurricane Floyd—would have amounted to 0.6 inches (1.5 cm), or a 10% increase for the 1621-acre (656-ha) Wilmington Site due to development of the Proposed GLE Facility. Across the entire year of 1999, the increase of runoff due to development of the Proposed GLE Facility would have totaled 1.8 inches (4.5 cm)—a 15% increase over current conditions. For 1998, a year without a record storm event, the increase in runoff due to development of the Proposed GLE Facility would have been 1.6 inches (4.0 cm) —a 35% increase over current conditions. These results reveal less of an impact from the Proposed Action during peak storm events and years with such events than during years with only minor storm events. The increased runoff during minor storm events, as reflected in the 1998 results, would be mitigated by the proposed stormwater wet detention basin (**Section 4.4.2.3**). The runoff from the impervious sections of the proposed North access road of the GLE Study Area would be minor compared to the increased runoff from the Proposed GLE Facility based on the size of impervious area; this increase in runoff should easily be absorbed by the surrounding lands. Additionally, because no flooding was observed across the developed portions of the Wilmington Site or the GLE Study Area during the actual

occurrence of Hurricane Floyd—a storm with a magnitude approximating that of the 500-year storm event (FEMA and State of North Carolina, 2006)—the minor 10% increase in peak daily precipitation and runoff from a storm of this magnitude would be a SMALL impact. Therefore, not only would the floodplain not be impacted by topographic changes, but any increase in floodwaters due to runoff from the Proposed GLE Facility during storm events would be SMALL and likely mitigated by the natural buffering capacity of the Swamp Forest of the Western Site Sector on the border of the Northeast Cape Fear River system. Refer to **Chapter 5**, *Mitigation Measures*, for further details on mitigation measures.

4.4.3.2.3 Decommissioning

There would be no additional anticipated impacts to the floodplains or floodwaters of the Wilmington Site due to decommissioning activities because there would be no change in grading or impervious areas on the site; therefore, impacts would be SMALL.

4.4.3.3 Cumulative Impacts to Floodplains

There are two additional projects planned for the Wilmington Site, as described in **Section 2.3**, *Cumulative Effects*, both of which will include construction outside of the floodplain boundaries. The ATC II complex will be located near the south gate entrance in the Eastern Site Sector. Drainage from this new facility is planned to flow to Unnamed Tributary #1 to Prince George Creek (see **Figure 3.4-19**). The Tooling Development Center will be located in the western end of the Eastern Site Sector to the west of the existing facility and north of the South Road portion of the GLE Study Area. Drainage from the Center is planned to flow toward Unnamed Tributary #1 to Northeast Cape Fear River (see **Figure 4.4-2**). Runoff from both of these projects would flow to stormwater wet detention basins that would attenuate peak runoff volumes. As with the Proposed Action, there are no anticipated impacts to the floodplain boundaries due to these future developments; however, SMALL impacts may occur due to increase in magnitudes of floodwaters from site runoff as more vegetated land is converted to impervious surfaces. Similar to the SMALL impacts due to development of the GLE Study Area, it is expected that the natural buffering capacity of the Swamp Forest of the Western Site Sector along the border of the Northeast Cape Fear River would absorb and mitigate these indirect impacts (refer to **Chapter 5**, *Mitigation Measures*).

The River Bluffs retirement community development (discussed in **Section 2.3** of this Report, *Cumulative Effects)* is planned for the parcel south of the South-Central Site Sector and south of the western portion of the Eastern Site Sector. At least some of the drainage from the River Bluffs development is understood to be planned to drain to the adjacent existing wetlands along the South-Central Site Sector property line. Drainage from neither the Proposed Action nor the other additional projects planned for the Wilmington Site (as described in **Section 2.3**, *Cumulative Effects*) would drain to these wetlands; therefore, all the cumulative impacts to the floodplains of the Northeast Cape Fear River and its tributaries discussed above are expected to be SMALL.

The off-site industrial development proposed by the Carolinas Cement Company (see **Section 2.3**, *Cumulative Effects*) would be located approximately 20 river miles (32 km) upstream of the Wilmington Site boundary. The proposed site is bordered on the north by the Northeast Cape Fear River and on the east by Island Creek (USACE, 2008). The proposed quarrying action would impact approximately 493 acres (200 ha) of wetlands (USACE, 2008), which include the alluvial floodplain habitat (U.S. FWS, 2008). Anticipated impacts to the floodplain from the proposed off-site industrial development are unknown. However, due to its distance upstream from the Wilmington Site and because the Proposed Action would have only minor impacts on the floodplain on the Wilmington Site, cumulative impacts from these projects would be SMALL.

4.4.3.4 Control of Impacts to Floodplains

Because there are no topographic changes that would modify the floodplains, and the change in floodwaters due to development is anticipated to be SMALL, there is no need to institute structural (e.g., levees, dams) or non-structural (e.g., land use management, policies, practices) flood protection measures. The upgrade of the existing stream crossing for the proposed South access road would be designed and constructed following the procedures required by the New Hanover County Flood Damage Prevention Ordinance discussed in **Section 1.4.3.2** of this Report (*New Hanover County Engineering Department [Applicable Regulatory Requirements, Permits, and Required Consultations]*). The new stream crossing would be designed to meet or exceed current flow capacity. The stormwater wet detention basin intended for use during smaller storm events (less than the 25-year storm event) were previously discussed in **Section 4.4.2**. **Chapter 5**, *Mitigation Measures*, discusses a variety of mitigation measures (e.g., stormwater detention ponds) that would be used to minimize related impacts from the Proposed Action.

4.4.4 Wetland Impacts

4.4.4.1 Methods for Determining Impacts

Field surveys were conducted during September 4 through 7, 2007, to delineate wetlands within the 265-acre (107-ha) GLE Study Area. Wetlands were delineated using the USACE's 3-parameter approach (i.e., vegetation, hydrology, and soils), as explained in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987) and the *Jurisdictional Determination Form Instruction Guidebook* (USACE, 2007). The wetland boundary points were marked in the field using flagging tape. These flagged points were located by professional land surveyors, and the area for each wetland was calculated. A representative from the USACE field verified these wetlands on October 18, 2007. Wetlands (and streams) were plotted on a Wilmington Site parcel map and certified by the professional land surveyor for the jurisdictional determination. This jurisdictional determination was issued by the USACE on January 22, 2008, and will be valid for 5 years from that date (see **Appendix B**, *Regulatory Correspondence*).

The quality of each wetland was rated using the *Guidance for Rating the Values of Wetlands in North Carolina* (NCDENR, 1995). The wetland quality ratings were submitted to the USACE as part of the jurisdictional determination. This rating system is designed to evaluate the value of wetlands as perceived by humans. This system rates the wetland on the following six values: water storage, bank/shoreline stabilization, pollutant removal, wildlife habitat, aquatic life value, and recreation education. The range of the score is 0 to 100, with 100 representing the highest-value wetland and 0 the lowest-value wetland.

4.4.4.2 No Action Alternative

The No Action Alternative would not involve new road crossings, new construction, or improvements to the Wilmington Site; therefore, direct or indirect impacts to wetlands from the No Action Alternative would be SMALL.

4.4.4.3 Proposed Action

The 265-acre (107-ha) GLE Study Area for the Proposed Action was evaluated for the presence of wetlands. No wetlands were found within the 209-acre (85-ha) Main portion of the GLE Study Area. The 56 acres (22 ha) associated with the proposed access roads may impact three jurisdictional wetlands and two isolated wetlands (**Figure 4.4-3** and **Table 4.4-7**) and are discussed below. Names for plants species in this section of the Report are consistent with *Flora of the Carolinas, Virginia, Georgia and Surrounding Areas* (Weakley, 2007).

As shown on **Figure 4.4-3**, the proposed North access road would cross Unnamed Tributary #1 to Prince George Creek and Wetland WD. Also within this 200-ft (61-m) wide corridor, there is one jurisdictional wetland (Wetland WC), one jurisdictional channel, and two isolated wetlands (Wetlands WA and WB). Depending upon final design, the proposed North access road could impact portions of these wetlands and channel. The proposed South access road crosses Unnamed Tributary #1 to Northeast Cape Fear River and Wetland WE. Wetland WE also parallels this road. Since the Proposed Action would pave the existing gravel service road, there would be no impacts to the Swamp Forest portion of Wetland WE that parallels this road. The Proposed Action would also modify the existing stream crossing of Unnamed Tributary #1 to Northeast Cape Fear River along the proposed South access road. The riparian portion of Wetland WE abuts this stream. As described in **Section 3.4.4.2** of this Report (*Federal and State Regulations [Wetlands]*), final impacts to the wetlands and mitigation measures would be determined once final design is complete and before the 404 permit and 401 Water Quality Certification could be obtained.

Wetlands WA and WB are isolated wetlands and would not require a 404 permit; however, impacts to these wetlands would require an Isolated Wetland Permit from the NC DWQ. Wetland WA is approximately 0.06 acres (0.02 ha) and is located along an existing gravel road east of the Proposed GLE Facility (**Figure 4.4-4**). This wetland is dominated by weatherby (*Eleocharis fallax*) and narrowleaf cattail (*Typha angustifolia*), but also contains sweet gum (*Liquidambar styraciflua*), black willow (*Salix nigra*), and dotted smartweed (*Polygonum punctatum*). Wetland WA has a NC DWQ wetland rating score of 6 (with 100 representing the highest-value wetland). Precipitation and surface runoff are the sources of water for this wetland. Wetland WB is approximately 0.13 acres (0.05 ha) and is located along an existing gravel road east of the Proposed GLE Facility (**Figure 4.4-5**). This wetland is dominated by beaked panic grass (*Panicum anceps*) and sugarcane plumegrass (*Saccharum giganteum*) and also contains loblolly pine (*Pinus taeda*), warty panicgrass (*Panicum verrucosum*), stinking camphorweed (*Pluchea foetida*), coinleaf (*Centella erecta*), and yelloweyed grass (*Xyris* sp.). Wetland WB also has a NC DWQ wetland rating score of 6. Precipitation and surface water runoff are the sources of water for this wetland. Both of these wetlands have disturbed sandy soils with no connection to surface waters.

Wetland WC is a headwater wetland that is connected through a jurisdictional channel flowing into Unnamed Tributary #1 to Prince George Creek (**Figure 4.4-6**). Approximately 0.22 acres (0.09 ha) of this wetland occur within the GLE Study Area. Vegetation in Wetlands WC is dominated by canopy species swamp tupelo/gum (*Nyssa biflora*) and swamp titi (*Cyrilla racemiflora*). Sweetbay (*Magnolia virginiana*), laurel greenbrier (*Smilax laurifolia*), roundleaf greenbrier (*Smilax rotundifolia*) and switch cane (*Arundinaria tecta*) are also present. This wetland occurs within the Swamp Forest biotic community (see **Section 3.5** of this Report, *Ecological Resources*). Due to wildlife habitat and the potential for pollutant removal, this wetland has a NC DWQ wetland rating score of 20. It is supported in organic soil to a depth of 16 inches (41 cm). No surface or shallow subsurface water (within 16 inches [41 cm]) was present at the time of the field surveys; however, the following hydrologic signs were present: drainage patterns, buttressed trees, exposed roots, and water-strained leaves.

Wetland WD is a riparian wetland that abuts Unnamed Tributary #1 to Prince George Creek. Approximately 0.20 acres (0.08 ha) of this wetland is located within the GLE Study Area (**Figure 4.4-7**). This wetland continues along the western side of this unnamed tributary north of the GLE Study Area. Wetland WD is located within the Alluvial Forest biotic community identified in **Section 3.5** of this Report (*Ecological Resources*) and is dominated by red maple (*Acer rubrum*) in the canopy. Loblolly pine is also scattered throughout the canopy. Muscadine (*Vitis rotundifolia*), switch grass, shallow sedge (*Carex lurida*), and Japanese stilt grass (*Microstegium vimineum*) are present in the vine and understory layers, respectively. Wetland WD has an NC DWQ wetland rating score of 58, reflecting its bank stabilization and pollutant-removal functions, as well as wildlife and aquatic life habitat. This wetland

provides storage of flood water from the unnamed tributary. The soils of this wetland are organic-covered silt grains with sand inclusions to a depth of 16 inches (41 cm).

Wetland WE is part riparian wetland and part Swamp Forest wetland and is located along the proposed South access road (**Figure 4.4-8**). A total of 0.39 acres (0.16 ha) of this wetland occurs within the GLE Study Area. The riparian part of this wetland abuts Unnamed Tributary #1 to Northeast Cape Fear River. The canopy of the riparian portion of this wetland is dominated by swamp gum and red maple, whereas the groundcover is dominated by Japanese stilt grass, shallow sedge, lizard's tail (*Saururus cernuus*), and false-nettle (*Boehmeria cylindrica*). The soils are a mixture of silt and sand. This portion of the wetland has a NC DWQ score of 60 because it provides good bank stabilization to the tributary, helps to remove potential pollutants from floodwaters, and provides good wildlife habitat. The Swamp Forest portion of this wetland is located within the Western Site Sector and parallels the proposed South access road. Within the GLE Study Area, this wetland is dominated by tulip tree (*Liriodendron tulipifera*), American holly (*Ilex opaca*), and red maple. This wetland also contains loblolly pine, swamp bay (*Persea palustris*), switch cane, Virginia creeper (*Parthenocissus quinquefolia*), cinnamon fern (*Osmunda cinnamomea*), and poison ivy (*Toxicodendron radicans*). Water was present 14 inches (35 cm) below the surface in coarse sandy soils. The existing road is located approximately 75 ft (23 m) away from this wetland boundary. The Swamp Forest portion of Wetland WE has a NC DWQ score of 67 due to excellent wildlife habitat, good pollutant-removal capabilities, and good aquatic life habitat.

4.4.4.3.1 Impacts to Wetlands

4.4.4.3.1.1 Site Preparation and Construction

All necessary federal and State permits would be obtained before any land-disturbing activities for preparation or construction of the GLE Facility site could begin for any portion of the Proposed Action. In order to obtain necessary permits, a detailed construction design would be used to determine the type and extent of direct impacts to wetlands during the construction phase of the project. USACE and NC DWQ would determine if mitigation would be required for these impacts. Indirect impacts, such as increased stormwater runoff, decreased groundwater recharge, and disconnected hydrologic conductivity (Wright et al., 2006), are not assessed during the permit process, but are considered in this Report.

Impacts to wetlands may be greatest during preparation and construction of the GLE Facility site due to the removal of vegetation, temporary storage of construction materials, and potential sediment runoff. All temporary impacts would be mitigated, and the wetlands would be restored to pre-existing conditions through the planting of vegetation and removal of excess sediment. Both temporary and permanent impacts would be identified in the permit application. Permanent impacts are discussed in **Section 4.4.4.3.1.2**. **Section 4.4.4.5** discusses the methods that could be used to avoid and minimize these impacts. Since all direct and indirect impacts would be minimized to the greatest extent possible, and the site preparation and land-disturbing activities would be conducted using all required BMPs, the impacts to wetlands during Site preparation and construction would be SMALL.

4.4.4.3.1.2 Operation

The maximum area of jurisdictional wetlands that would be directly impacted by the Proposed Action would be 0.42 acres (0.17 ha) from Wetlands WC and WD. No direct impacts would be anticipated to occur to Wetland WE; however, final impacts would be determined before applicable permits would be obtained. The maximum area of isolated wetlands that would be directly impacted would be 0.19 acres (0.07 ha) for WA and WB. The total possible amount of wetlands directly impacted would be approximately 0.1% of the current wetlands that occur on the Wilmington Site (based on the estimate of 459.9 acres [186 ha] of wetlands currently on the Site that have not been ditched or partially drained from the National Wetlands Inventory [NWI] data; see **Section 3.4.4.1** of this Report, *Description [Wetlands]*).

Therefore, direct impact to wetlands on the Wilmington Site by the Proposed Action would be SMALL. **Section 4.4.4.5** and **Chapter 5** (*Mitigation Measures*) discuss the methods that could be used to avoid and minimize these impacts. Impacts to Unnamed Tributary #1 to Prince George Creek and the jurisdictional channel associated with Wetland WC, as well as impacts to Unnamed Tributary #1 to Northeast Cape Fear River, are discussed in **Section 4.4.2**.

Indirect impacts would occur to wetlands directly impacted on the Wilmington Site or wetlands that would receive runoff from the Proposed Action both on and off of the Site. The Proposed Action would decrease stormwater runoff to the wetland associated with Unnamed Tributary #2 to Prince George Creek, located northwest of the Proposed GLE Facility on an adjacent property (see **Figure 3.4**), and would increase runoff to wetlands associated with Unnamed Tributary #1 to Northeast Cape Fear River. The decrease in runoff would reduce the surface water from overland flow and shallow groundwater recharge to the wetland system northwest of the Proposed GLE Facility; however, tidal freshwater from the Northeast Cape Fear River controls the hydrology of this wetland. Increased runoff could decrease water quality and increase water quantity to the wetlands associated with Unnamed Tributary #1 to Northeast Cape Fear River, thereby altering the species composition or decreasing their ability to function. The proposed North access road would likely bi-sect Wetland WD, thereby interrupting the hydrologic connectivity of that riparian wetland. This disruption could create wetter conditions upstream of the crossing and drier conditions downstream. Finally, the Proposed GLE Facility could cause a decrease in the local groundwater recharge that the surrounding wetlands areas depend on as a source of water. Indirect impacts to wetlands on and surrounding the Wilmington Site could be mitigated by the methods described in **Chapter 5** of this Report (*Mitigation Measures*), such as bridging Wetland WD and directing runoff away from wetlands area. Therefore, indirect impacts to wetlands would be SMALL.

4.4.4.3.1.3 Decommissioning

As described in **Section 2.1.2.4** of this Report (*Site and Facility Information*), the decommissioning and decontamination of the Proposed GLE Facility are not anticipated to involve additional land-disturbing activities. All activities associated with this phase would occur within the areas disturbed for operations of the Facility. Decommissioning of the Proposed GLE Facility would not further impact wetlands along the North Road portion of the Wilmington Site. Runoff from the Facility would be similar in quality to runoff during the operations phase, and the stormwater wet detention basin would still be in place. Therefore, no additional indirect impacts to wetlands receiving runoff would be anticipated from the decommissioning of the Proposed GLE Facility. Direct and indirect impacts to wetlands from the decommissioning process would be SMALL.

4.4.4.4 Cumulative Impacts to Wetlands

As discussed in **Section 3.4.4** of this Report (*Water Resources*), approximately 298.4 acres (120.9 ha) of previous wetland habitat have been drained on the Wilmington Site (U.S. FWS, 1990). Efforts would be made to minimize additional hydrological impacts to the existing wetlands on the Site.

There are no known direct impacts to wetlands on the Wilmington Site from the planned construction of the ATC II complex near the south entrance and the Tooling Development Center in the western portion of the Eastern Site Sector. Indirect cumulative impacts could occur to incoming water quality to Wetland WD along the Unnamed Tributary #1 to Prince George Creek from construction of the ATC II complex. However, as required by state regulations, runoff from the ATC II complex would be routed to a stormwater wet detention basin before it would be discharged to the tributary, thereby minimizing the potential for water quality and quantity impacts. The Tooling Development Center would not directly or indirectly impact any wetlands on the Site. Cumulative loss of wetlands is not expected from these projects and the Proposed Action; therefore, the cumulative impacts to wetlands are expected to be SMALL.

Indirect impacts may occur to a wetland area located along the South-Central Site Sector property line from increased runoff and decreased buffer from the adjacent planned River Bluff retirement community development. This development would be required to mitigate direct wetland impacts and to have stormwater BMPs to treat the quality of the runoff and control the quantity of runoff from the development; however, the project appears to decrease the vegetated buffer and would likely impact the quality of the wetland that occurs on the Site property boundary. This wetland would not be impacted by the Proposed Action; however, the project could decrease the quality of a wetland on the Wilmington Site, thereby having a combined effect on the quality of wetlands on the Site.

The off-site industrial development proposed by the Carolinas Cement Company (see **Section 2.3**, *Cumulative Impacts*) would be located approximately 20 river miles (32 km) upstream of the Wilmington Site boundary. The proposed site is bordered on the north by the Northeast Cape Fear River and on the east by Island Creek (USACE, 2008). The proposed quarrying action would impact approximately 493 acres (200 ha) of wetlands, including approximately 214 acres (87 ha) of wetlands located within Coastal Area Management Act (CAMA) jurisdictional areas (USACE, 2008). Field reviews have been conducted by USACE and NCDENR to verify wetland delineations, but final verification of these wetlands is still pending (USACE, 2008). Although the nature of the impacts to these wetlands is not known, it is likely that most are associated with the alluvial floodplains of the Northeast Cape Fear River and Island Creek. The potential for loss of wetlands from this proposed off-site industrial development is significant, which emphasizes the importance that the Proposed Action has been designed to avoid or minimize impacts to wetlands.

4.4.4.5 Control of Impacts to Wetlands

In compliance with the National Environmental Policy Act (NEPA), implementation of the Proposed Action would strive first to avoid wetland impacts, then to minimize wetland impacts, and finally to mitigate any remaining impacts. Avoidance of impacts to wetlands was a criterion used in the initial site-selection process for the Proposed GLE Facility. Efforts were made to locate the Facility in a non-wetlands area. In addition, the existing road would be used when possible to eliminate new impacts to wetlands. The North Road portion of the GLE Study Area would cross Wetlands WC and WD in a perpendicular manner to minimize wetland impacts. Modifications to Wetland WE within the South Road portion of the GLE Study Area are not anticipated and would be avoided to the maximum extent practicable. During the design phase, wetlands impacts would be further minimized using engineered features or BMPs, such as reducing cut/fill slopes, avoiding the temporary storage of materials in wetlands during construction, and maintaining the hydrological connectivity of the wetlands. In compliance with permit requirements, remaining wetland impacts would be mitigated as required, either through on-site or off-site mitigation, purchase of mitigation credits, or payment in North Carolina Ecosystem Enhancement Program. Additional mitigation options are discussed in **Chapter 5** of this Report (*Mitigation Measures*).

4.4.5 Water Use

This section describes potential water use impacts associated with the No Action Alternative, the Proposed Action, and cumulative impacts. This section mainly focuses on groundwater supply impacts because groundwater wells are the source of water for both the Wilmington Site and its surrounding current water users. As discussed in **Section 4.4.2**, surface water is not used as a drinking water supply in the Northeast Cape Fear River Sub-basin, and no surface water impacts are expected. Potential groundwater quality impacts are discussed in **Section 4.4.1**.

4.4.5.1 No Action Alternative

Groundwater use conditions would remain unchanged under the No Action Alternative; therefore, the SMALL impacts to groundwater caused by the Proposed Action would be avoided, and current activities

at the Wilmington Site would continue with their same level of impact. Current activities are described in **Section 3.4.5** of this Report (*Water Use*).

4.4.5.2 Proposed Action

The Proposed Action would require additional groundwater withdrawals for process and potable water. This additional groundwater would be supplied from currently unused capacity associated with the existing groundwater pumping-well system at the Site (see **Section 3.4.1** of this Report, *Groundwater*). As discussed below, no significant water use impacts are anticipated from these relatively small additional groundwater withdrawals.

As discussed in **Section 4.4.2**, surface water is not used as a drinking water supply in the Northeast Cape Fear River Sub-basin, and the Proposed Action does not include any surface water intakes. The Northeast Cape Fear River and Prince George Creek are used for commercial and recreational fishing; however, no impacts to fish stocks in quantity or quality would be expected during construction, operation, or decommissioning of the Proposed GLE Facility (see **Section 4.5**, *Ecological Resources Impacts*, for more information). The Northeast Cape Fear River is a navigable river with boating and industrial transport uses. No impacts to navigation, industrial transport, or secondary recreation would be incurred during Proposed GLE Facility construction, operation, or decommissioning. Thus, no significant impacts to surface water uses are anticipated, and the remainder of this section focuses on potential groundwater supply impacts.

4.4.5.2.1 Site Preparation and Construction

Activities requiring water during construction of the Proposed GLE Facility may include dust suppression and equipment cleaning. The water needed during construction would be provided via tanker truck from off-site potable water sources. No water would be used from the Proposed GLE Facility process or potable water systems. Construction of excavations may require temporary dewatering of the shallow groundwater; however, significant impacts on the groundwater resource would not be anticipated because 1) the Surficial Aquifer is not directly used as a groundwater resource at the Wilmington Site, and 2) water levels in the Surficial Aquifer respond directly to rainfall and any temporary lowering should recover within a fairly short time to pre-construction levels; therefore, no adverse water use impacts are expected during construction.

4.4.5.2.2 Operation

The estimated process water and potable water requirements for operation of the Proposed GLE Facility are 75,000 gpd (283,900 lpd), and 11,000 gpd (41,600 lpd), respectively (see **Table 4.4-1**). As discussed below, the results of computer modeling indicate that the impacts to the groundwater system from operation of the Proposed GLE Facility are expected to be minimal. **Appendix P** provides documentation of the model development. Although water levels would decline slightly in the vicinity of the Site (within a lateral distance of approximately 1 to 2 miles [1.6 to 3.2 km] from the Wilmington Site), no adverse impacts to groundwater resources are anticipated.

As described in **Section 3.4.5** of this Report (*Water Use*), the Peedee Aquifer should have sufficient capacity to provide water for the Proposed Action with no significant impacts on the regional groundwater system. The local groundwater system (within approximately 1 to 2 miles [1.6 to 3.2 km] of the Site) was analyzed using a numerical groundwater flow model developed for the Site to assess existing groundwater impacts and ongoing remediation efforts at the Site (RTI, 2002). The baseline pumping rates for this analysis were from November 2007 (Site process- and potable-well pumping rates of 578,880 and 77,760 gpd [2,191,111 and 294,353 lpd], respectively). The groundwater recovery rates in the model were increased to satisfy the projected Proposed GLE Facility demand for selected existing wells with available, unused capacity.

Modeling results in **Figure 4.4-9** show the simulated groundwater elevations[2] associated with the increased pumping required to satisfy the projected Proposed GLE Facility water demand. **Figure 4.4-10** provides the relative lowering of groundwater elevations. As indicated on **Figure 4.4-10**, the piezometric surface decreases by an approximate range of 0 to 8 ft (0 to 2.4 m). The maximum decreases are in the vicinity of the pumping wells with increased pumping rates.

Residents in the Wooden Shoe subdivision north of the Wilmington Site rely on groundwater for their water supply, which is derived from individual private wells on approximately 1-acre (.40-ha) lots. **Figure 4.4-10** shows that groundwater levels within the Wooden Shoe subdivision would decrease approximately between 1.5 and 3.5 ft (0.5 to 1.1 m). This decrease is relatively small compared to typical historical and seasonal groundwater-level variations in the area (approximately 5 to 10 ft [1.5 to 3 m], as shown in **Figure 3.4-11**). In addition, available registration records for wells installed in the Wooden Shoe subdivision indicate that the wells have an average depth of approximately 62 ft (19 m) below ground surface (bgs) (RTI, 2008). Using the computer model, the maximum estimated depth to the groundwater level from the ground surface within Wooden Shoe is approximately 29 ft (8 m). Thus, on average, the wells would maintain about 33 ft (10 m) of water column. The decreases in groundwater levels at the public supply wells discussed in **Section 3.4.5.1** of this Report (*Regional Water Use*) that are located between 2 and 3 miles (3.2 and 4.8 km) from the GLE Study Area are estimated to be no greater than about 1 ft (0.3 m).

Due to former manufacturing processes that were more water intensive, Site water use during the 1990s significantly exceeded current water use. Available Wilmington Site sanitary and wastewater treatment effluent data show this general change in water demand. Specifically, the average process wastewater effluent discharge from 1992 through 1997 was 31% greater than the average discharge from 2002 through 2007. The average sanitary wastewater effluent discharge (from potable water use) from 1992 through 1997 was 24% greater than the average discharge from 2002 through 2007. No off-site water-supply issues are known to have been reported during the 1992 through 1997 period as a result of on-site groundwater withdrawals. Operation of the Proposed GLE Facility is projected to increase the current total water demand (656,640 gpd [2,485,652 lpd]) by approximately 13% (86,000 gpd [325,500 lpd]). This assessment indicates that the existing Wilmington Site groundwater pumping-well system was able to provide volumes of water in the past that were significantly greater than the projected demand of the Proposed GLE Facility without significant adverse impacts.

The above analyses indicate that the risk for significant adverse impacts on neighboring residential wells or vicinity public supply wells, as well as the groundwater supply from the relatively small projected increase in groundwater withdrawals required to meet the operational water demands of the Proposed GLE Facility, is SMALL.

4.4.5.2.3 Decommissioning

As described in **Section 2.1.2.4** of this Report (*Site and Facility Information*), decommissioning of the Proposed GLE Facility would involve the removal of the internal structures, utilities, and products from the building; however, the physical structure, associated foundations, access roads, and utility lines would likely remain intact. Activities during Proposed GLE Facility decommissioning are expected to require similar or lower quantities of potable and process water than the amount needed during operation; therefore, water use impacts during decommissioning are anticipated to be SMALL.

[2] The simulated groundwater elevations in **Figure 4.4-**19 are generally lower than the measured water levels in **Figure 3.4-10** because the simulation was based on lower seasonal recharge conditions than the measured data. Measured water levels in **Figure 3.4-10** (from February, 2007) were relatively higher than the typical average conditions at the Site represented in the base simulation. See **Appendix P** for additional model documentation.

4.4.5.3 Cumulative Impacts

As described above, no significant water use impacts are anticipated individually for the construction, operation, and decommissioning phases of the Proposed Action. In addition, no significant cumulative water use impacts are anticipated when evaluating these three phases of the Proposed Action together.

Other planned projects on the Wilmington Site are discussed in **Section 2.3** of this Report (*Cumulative Effects*) and include construction of the ATC II complex and the Tooling Development Center and the industrial re-use of the sanitary wastewater treatment facility effluent as process water. **Table 4.4-1** shows projected Wilmington Site groundwater withdrawals, considering the Proposed Action along with the new facilities and systems described in **Section 2.3**.

The potable water needs are projected to be 7,500 and 11,000 gpd (28,390 and 41,649 lpd) for the ATC II complex and Tooling Development Center, respectively. The projected process water need for the Tooling Development Center is 5,000 gpd (18,927 lpd), whereas the ATC II complex would not require process water. Once the Proposed GLE Facility, ATC II complex, and Tooling Development Center are operating, the volume of treated sanitary wastewater to be reused as make-up water in Wilmington Site cooling towers is projected at approximately 62,300 gpd (235,800 lpd). Because the treated sanitary wastewater effluent has such low hardness, its addition to the Wilmington Site cooling towers increases efficiencies. Each gallon of re-use water introduced into a cooling tower offsets two gallons of process make-up water. Therefore, this effluent re-use process would reduce groundwater withdrawal for cumulative process-water requirements by approximately 124,600 gpd (471,700 lpd) (i.e., twice the projected cumulative sanitary wastewater treatment rate of 62,300 gpd [235,800 lpd]), resulting in a net projected cumulative decrease in process-water groundwater withdrawals of 44,600 gpd (168,800 lpd). Factoring in the projected increase in the amount of groundwater to be pumped from the separate potable supply wells to meet the cumulative potable water demand, there is a projected total (process and potable) net decrease in water demand of approximately 15,100 gpd (57,200 lpd), as shown in **Table 4.4-2**.

The cumulative impacts on the local groundwater system (within approximately 1 to 2 miles [1.6 to 3.2 km] of the Site) were analyzed using the numerical groundwater flow model for the Site (RTI, 2002). The baseline pumping rates for this analysis were from November 2007 (Site process- and potable-well pumping rates of 578,880 and 77,760 gpd [2,191,299 and 294,353 lpd], respectively). The groundwater pumping rates in the model were adjusted as described above to satisfy the projected groundwater withdrawals needed to meet the future Wilmington Site water needs, including both the Proposed Action and the other new facilities and effluent re-use process (a 44,600-gpd [168,800-lpd] decrease in process water use and a 29,500-gpd [111,699-lpd] increase in potable water use). Increased groundwater withdrawals to meet the projected potable water demand were provided in the model from potable water wells with available, unused capacity. The potable-water wells are located east of the Wilmington Site on property owned by GE on the east side of NC 133 (Castle Hayne Road).

Modeling results in **Figure 4.4-11** show the simulated groundwater elevations associated with pumping rates adjusted to match the projected cumulative Wilmington Site water demands discussed above. **Figure 4.4-12** shows the relative changes of groundwater elevations; under this groundwater pumping scenario, groundwater elevations are projected to decrease as much as approximately 5 ft (1.5 m) in the vicinity of the potable water wells and increase as much as approximately 3 ft (0.9 m) in the vicinity of the process water wells. The maximum changes are in the vicinity of the potable pumping wells with increased pumping rates. As previously indicated, residents in the Wooden Shoe subdivision north of the Wilmington Site rely on groundwater for their water supply. Predicted groundwater levels within Wooden Shoe change by a range from an approximate 0.5-ft (0.2-m) decrease to an approximate 1.5-ft (0.5-m) rise. This change is relatively small compared with the typical historical and seasonal groundwater level variation in the area (approximately 5 to10 ft [1.5 to 3 m], as shown in **Figure 3.4-11**). Using the

computer model, the maximum estimated depth to the groundwater level from the ground surface within Wooden Shoe is approximately 22 ft (6.7 m) bgs. Given an average well depth of 62 ft (19 m) bgs, the wells would maintain, on average, about 40 ft (12.2 m) of water column. The changes in groundwater levels at the public supply wells (discussed in **Section 3.4.5.1** of this Report, *Regional Water Use*) located between 2 and 3 miles (3.2 and 4.8 km) from the GLE Study Area are estimated to be no greater than about 0.5 ft (0.2 m).

The cumulative water needs of the Proposed Action, ATC II complex, and Tooling Development Center would be more than offset by the groundwater withdrawal savings resulting from the re-use of sanitary wastewater treatment facility effluent as make-up water in Wilmington Site cooling towers. The cumulative projected Site water demand would decrease by approximately 2% relative to the current water use (compared to a total water usage increase of 13% from the Proposed Action alone).

It is possible that some new residential wells could be installed north or east of the Wilmington Site; however, the modeling results discussed above are not likely to be noticeably affected by such potential small incremental increases in residential groundwater withdrawals. Although a new residential development, the River Bluffs retirement community, is planned for a parcel adjacent to the Wilmington Site (south of the Southwestern Site Sector and south of the southeastern portion on the Eastern Site Sector), it is understood that these residences would receive water from the New Hanover County water-supply system (New Hanover County, 2008). No new large industrial or municipal water-supply wells are known to be planned close enough to the Wilmington Site to notably alter the modeling projections presented above.

The above analyses indicates a SMALL risk for adverse cumulative impacts on neighboring residential wells or vicinity public supply wells and the groundwater supply due to the relatively small projected change (i.e., 2% decrease) in groundwater withdrawals required to meet the projected cumulative water demands of the Proposed GLE Facility and the new facilities and systems described in **Section 2.3**, *Cumulative Effects*. The projected small rise in groundwater elevations across most of the Wooden Shoe subdivision north of the Wilmington Site is anticipated to represent a potential SMALL beneficial impact.

4.4.5.4 Control of Impacts

Control and prevention of impacts to water resources would be provided through several mechanisms. The existing Wilmington Site groundwater pumping system would supply water needed for the Proposed Action, and this system would continue to be closely maintained and monitored for proper operation and minimal impact to the water resource. Pumping rates and pump run times are monitored routinely so that the system is operating as designed. In addition, groundwater levels throughout the Site are measured and analyzed to understand the influence of groundwater withdrawals on groundwater elevations and flow patterns. These activities would continue with a focus on confirming that changes in groundwater levels associated with the Proposed Action are as small as predicted, thus confirming minimal impacts to nearby groundwater users and the long-term sustainability of the groundwater resource.

Tables

Table 4.4-1. Wilmington Site Groundwater Withdrawal Projections: Proposed Action

Proposed/Planned Facility or System	Projected Groundwater Withdrawals (gallons per day)		
	Potable Water	**Process Water**	**Total**
Existing Wilmington Site Withdrawals	77,760	578,880	656,640
Proposed GLE Facility	11,000	75,000	86,000
Total Projected Groundwater Withdrawals	88,760	653,880	742,640
Additional Withdrawal as Compared to Existing Withdrawals	11,000	75,000	86,000

Table 4.4-2. Wilmington Site Groundwater Withdrawal Projections: Cumulative Impacts

Proposed/Planned Facility or System	Projected Groundwater Withdrawals (gallons per day)		
	Potable Water	**Process Water**	**Total**
Existing Wilmington Site withdrawals	77,760	578,880	656,640
Proposed GLE Facility	11,000	75,000	86,000
GEH Advanced Technology Center II complex	7,500	0	7,500
Tooling Development Center	11,000	5,000	16,000
Industrial Re-Use of Treated Sanitary Wastewater Effluent as Process Water[a]	-	-124,600	-124,600
Total Projected Groundwater Withdrawals	107,260	534,280	641,540
Additional Withdrawal as Compared to Existing Withdrawals	29,500	-44,600	-15,100

[a] Based on existing sanitary wastewater discharge of 33,300 gallons per day (gpd; 126,054 liters per day [lpd]; see **Section 3.12**); projected sanitary wastewater discharges from the Proposed GLE Facility, the ATC II complex, and the Tooling Development Center of 10,500, 7,500, and 11,000 gpd, respectively (39,747, 28,391, and 41,640 lpd, respectively); and re-use of this effluent in cooling towers twice due to its high quality.

Table 4.4-3. Drainage Area Impacts and Relative Percent Impacts

Waterbody	Current Drainage Area (Percent of Wilmington Site)	Proposed Drainage Area (Percent of Wilmington Site)
Unnamed Tributary #1 to Northeast Cape Fear River	42	51
Unnamed Tributary #2 to Northeast Cape Fear River	11	11
Unnamed Tributary #1 to Prince George Creek	12	12
Unnamed Tributary #2 to Prince George Creek	20	11
Effluent Channel[a,b]	N/A	N/A
Miscellaneous tributaries to Northeast Cape Fear River[c]	11	11
Other[d]	4	4

N/A = Not Applicable.

[a] An effluent channel is a discernable confined and discrete conveyance, which is used for transporting treated wastewater to a receiving stream. (15A NCAC 02B .0202[23]).

[b] The drainage area for the effluent channel is included with Unnamed Tributary #1 to Northeast Cape Fear River.

[c] Tributaries are visible on aerial photo in **Figure 4.4.2-1**.

[d] Portions of the Wilmington Site drain through a series of ditches and swales and are not associated with a specific waterbody on the Site.

Table 4.4-4. Streams and Channels Potentially Impacted by the Proposed Action within the GLE Study Area

Stream or Channel	Area within Study Area[a]		Length within Study Area[a]		USACE[b] Quality Assessment Score	NCDWQ[c] Stream Identification (Points)
	Acres	Heactares	Feet	Meters		
Unnamed Tributary #1 to Northeast Cape Fear River	0.29	0.12	217	66	66	Perennial
Unnamed Tributary #1 to Prince George Creek	0.2	0.08	175	53	43	Intermittent
Jurisdictional channel[d]	0.009	0.004	62	19	None[d]	None[d]
Total[e]	0.499	0.204	454	138	N/A	N/A

N/A = Not Applicable.

NCDWQ = North Carolina Division of Water Quality.

USACE = United States Army Corps of Engineers.

[a] The length of streams and channels within the full with of the road portions of the GLE Study Area are used to calculate potential impacts to surface waters until final stream/channel crossings are designed.

[b] USACE (2003).

[c] NCDENR (2005).

[d] USACE classified channel as a jurisdictional tributary providing hydrologic connectivity for Wetland WC to a traditional navigable water. This classification does not require a USACE Assessment score and NCDWQ Stream Identification.

[e] Maximum anticipated impact; final impacts will be revised once final stream/channel crossings are designed and before permit applications are submitted.

Table 4.4-5. Modeling Parameters and Land Use Area Changes for Input to ReNuMa[a] and GWLF[b] for Runoff Estimates

Land Cover[c]	Curve Number[d]	USLE Parameter[e]	Initial Land Area (acres)	Assumed Change (acres)[g]	Altered Land Area (acres)
Managed Herbaceous Cover	70	0.0002	228	+15.5	243.5
Unmanaged Herbaceous Cover-Upland	70	0.0003	61	-	61
Deciduous Shrubland	60	0	2	-	2
Bottomland Forest / Hardwood Swamps	80	0.00005	79	-0.2	78.8
Needleleaf Deciduous	75	0.0002	32	-	32
Southern Yellow Pine	40	0.0002	734	-117	617
Mixed Hardwoods/Conifers	30	0.0002	223	-10	213
Oak/Gum/Cypress	50	0.000002	145	-	145
Water Bodies	90	0	3	+8	11
Unconsolidated Sediment	80	0	2	-	2
High Intensity	90	0	108	+61.3	169
Low Intensity	85	0	4	+42.4	46
Totals	-	-	1621	+/- 127.2	1621

[a]Regional Nutrient Mangement Model.

[b]Generalized Watershed Loading Function.

[c]Determined using 1996 land cover data from the State of North Carolina.

[d]Determined using area-weighted soil type contributions to each land use type and tables provided by the USDA NRCS TR-55 guidance.

[e]The USLE parameter input to ReNuMa/GWLF is the product of K (soil erodibility factor), LS (topographic factor), C (cover and management factor), P (supporting practice factor) and the rainfall erosivity. These values were determined from the USDA NRCS TR-55 guidance.

[f]Determined using 1996 landcover data for North Carolina (NC GIA, 1998).

[g]Determined using prelimnary design plans and maps of land cover, soil types, and GLE Study Area boundaries; may be revised on final engineering design.

Table 4.4-6. Change in Runoff Volumes from the Proposed GLE Facility as Predicted by ReNuMa[a] and GWLF[b]

Parameter	1998			1999		
	Undeveloped[c]	Developed[d]	Change[e]	Undeveloped[c]	Developed[d]	Change[e]
Annual Values						
Precipitation Total (inches)	64.2		-	72.0		-
Runoff Totals (inches)	4.5	6.1	1.6	11.4	13.2	1.8
Runoff Volume (10^6 ft^3)	27	36	9.4	67	78	11
Hurrican Floyd Storm Peak						
Daily Precipitation (inches)	-		-	13.4		-
Daily Runoff Total (inches)	-	-	-	6.0	6.5	0.6
Daily Runoff Volume (10^6 ft^3)	-	-	-	35	38	3.5

[a] Regional Nutrient Mangement Model.

[b] Generalized Watershed Loading Function.

[c] Undeveloped refers to the land at the Wilmington Site in its current state, i.e., prior to development of the GLE Study Area.

[d] Developed refers to the Wilmington Site after development within the GLE Study Area.

[e] Change is the difference in runoff values between the undeveloped and developed land conditions.

Table 4.4-7. Wetlands within the GLE Study Area

Wetland ID	Area within the GLE Study		Type	NCDWQ Score[a]
	Acres	Heactares		
WA	0.06	0.02	Isolated	6
WB	0.13	0.05	Isolated	6
WC	0.22	0.09	Headwater	20
WD	0.20	0.08	Riparian	58
WE	0.39	0.16	Riparian/Swamp Forest	60/67

[a] This rating system is designed to evaluate the value of wetlands as perceived by humans and was developed by NCDENR (1995). The score for each wetland was based on field observations in September 2007.

Figures

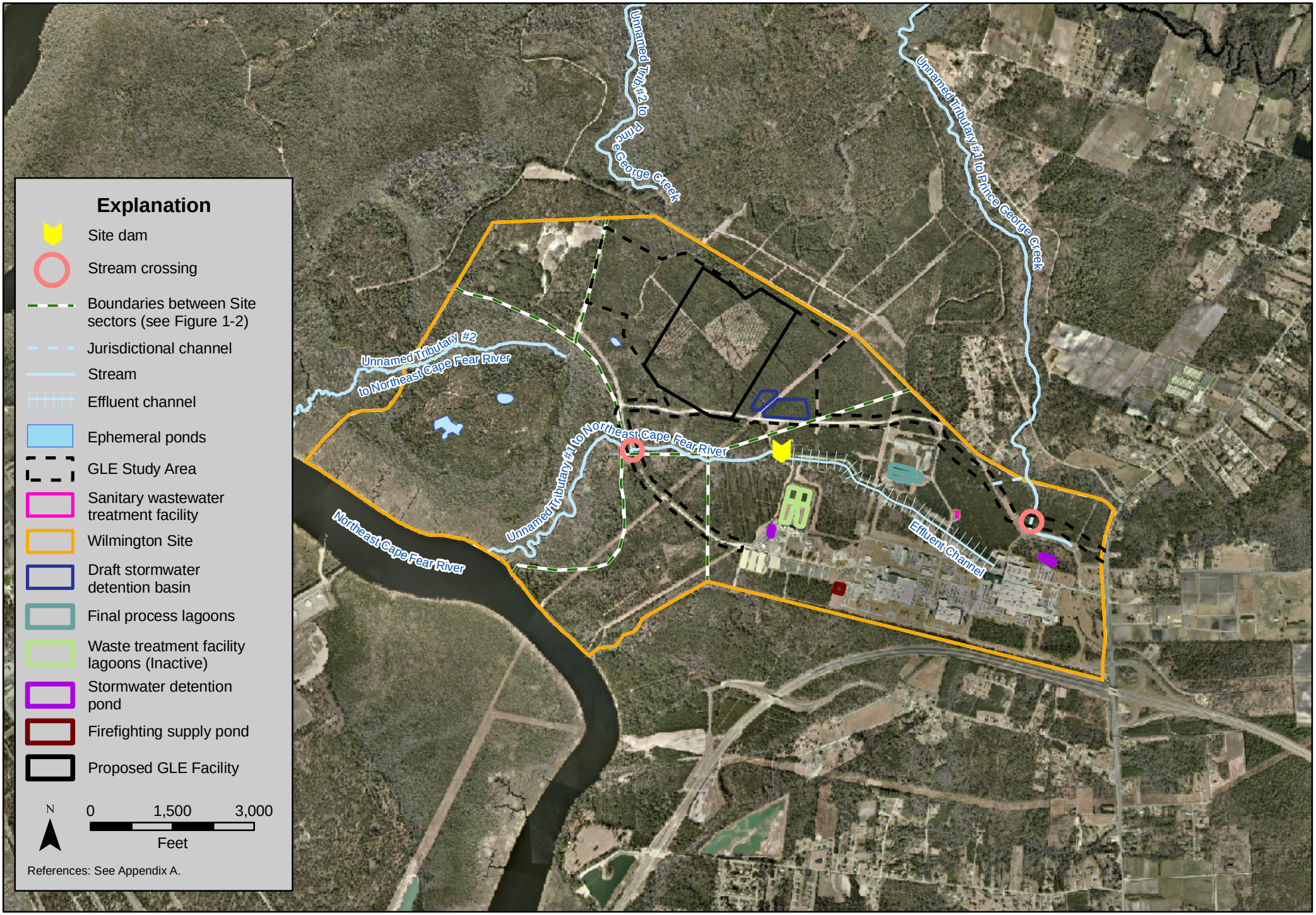

Figure 4.4-1. Wilmington Site surface water features, the GLE Study Area, and the Proposed GLE Facility.

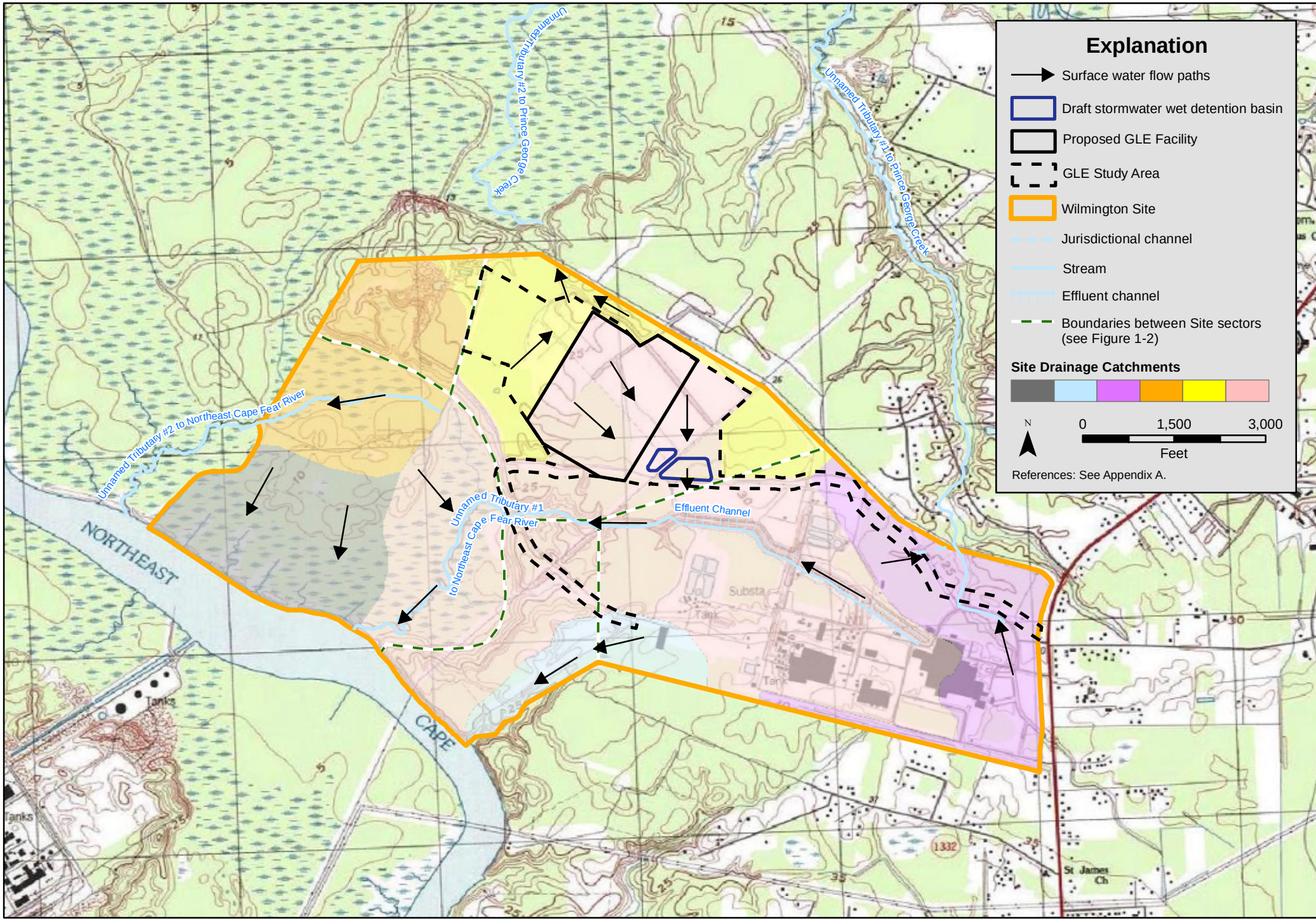

Figure 4.4-2. Wilmington Site drainage with Proposed Action.

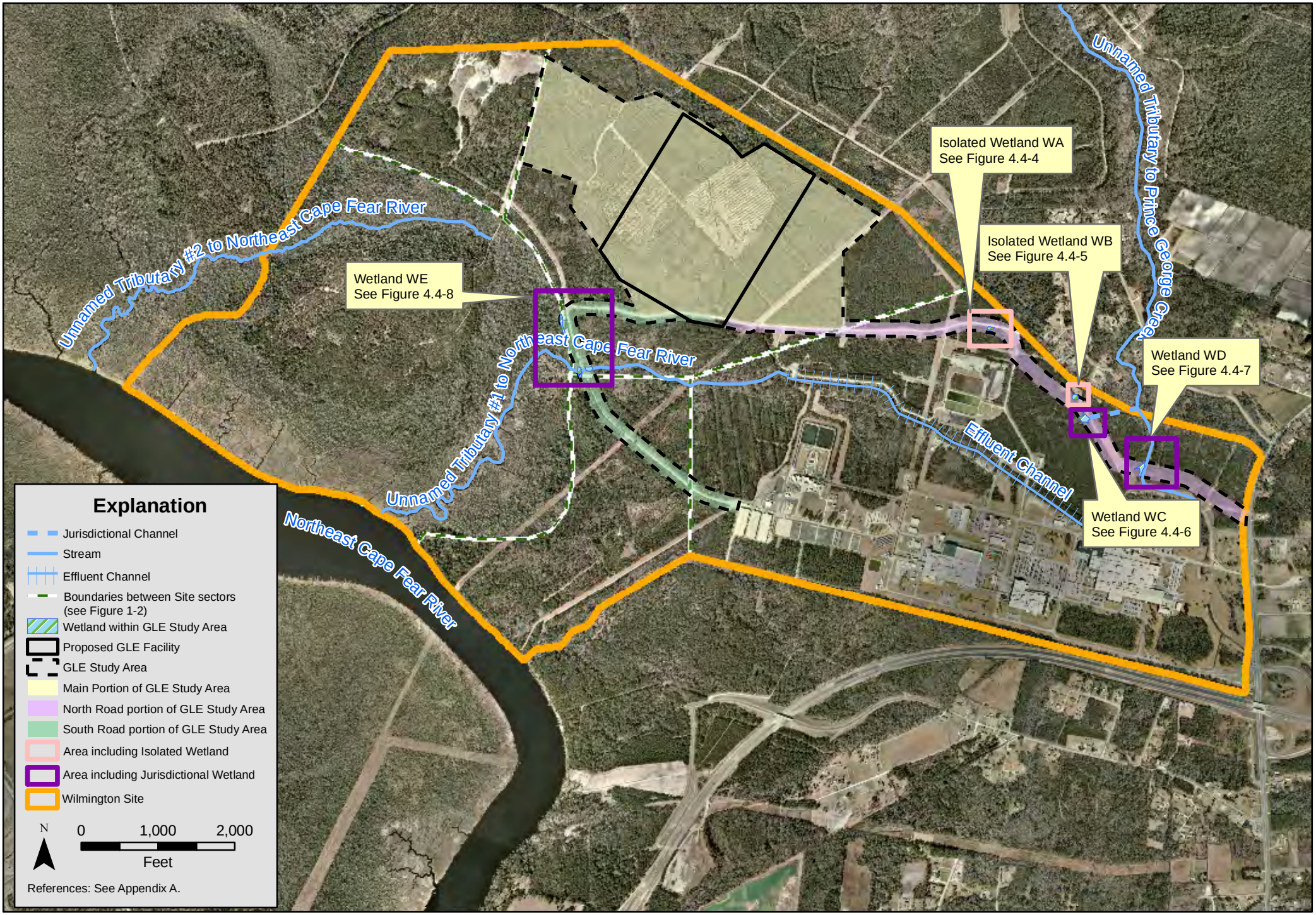

Figure 4.4-3. Wetlands within the GLE Study Area.

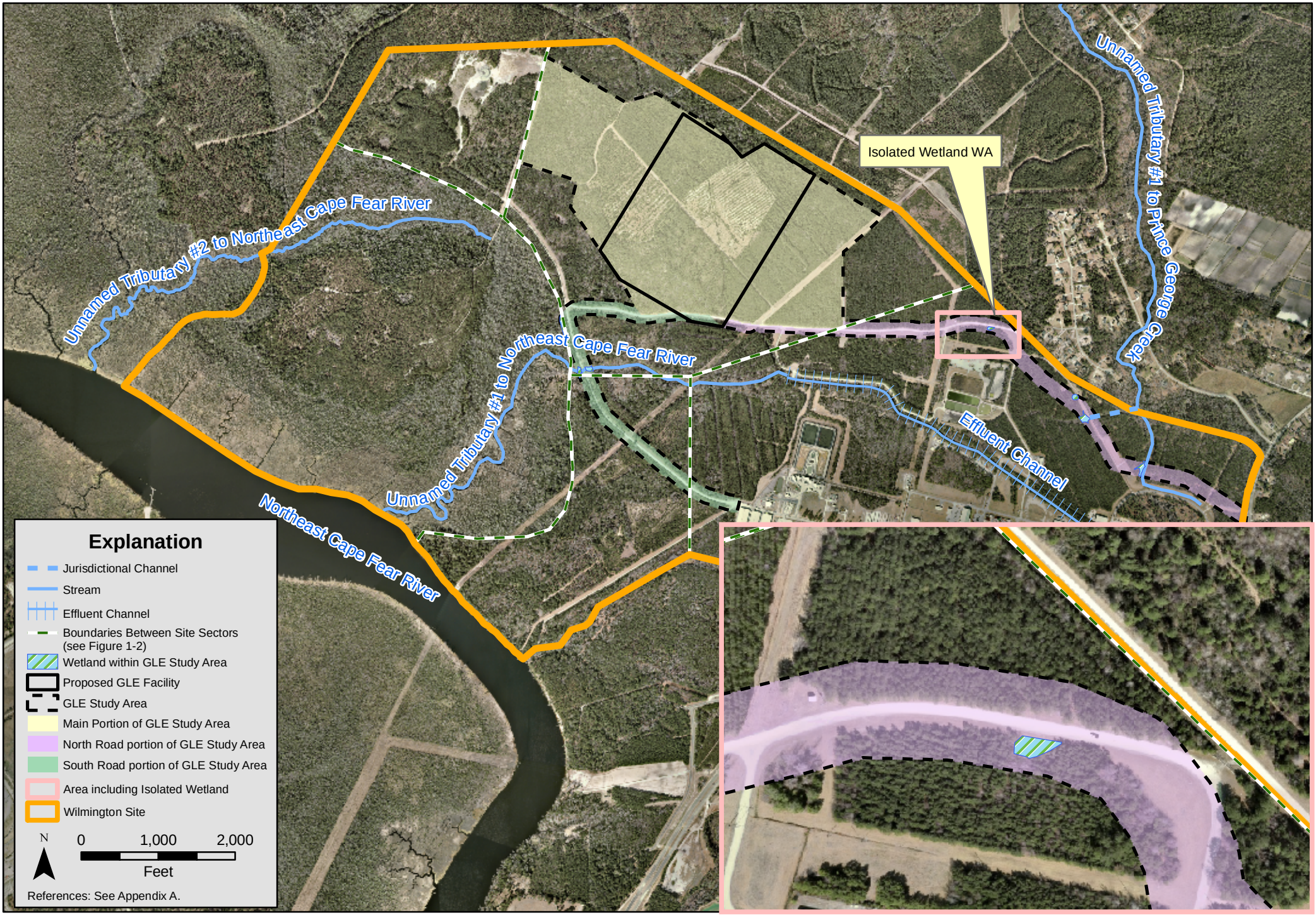

Figure 4.4-4. Isolated Wetland WA.

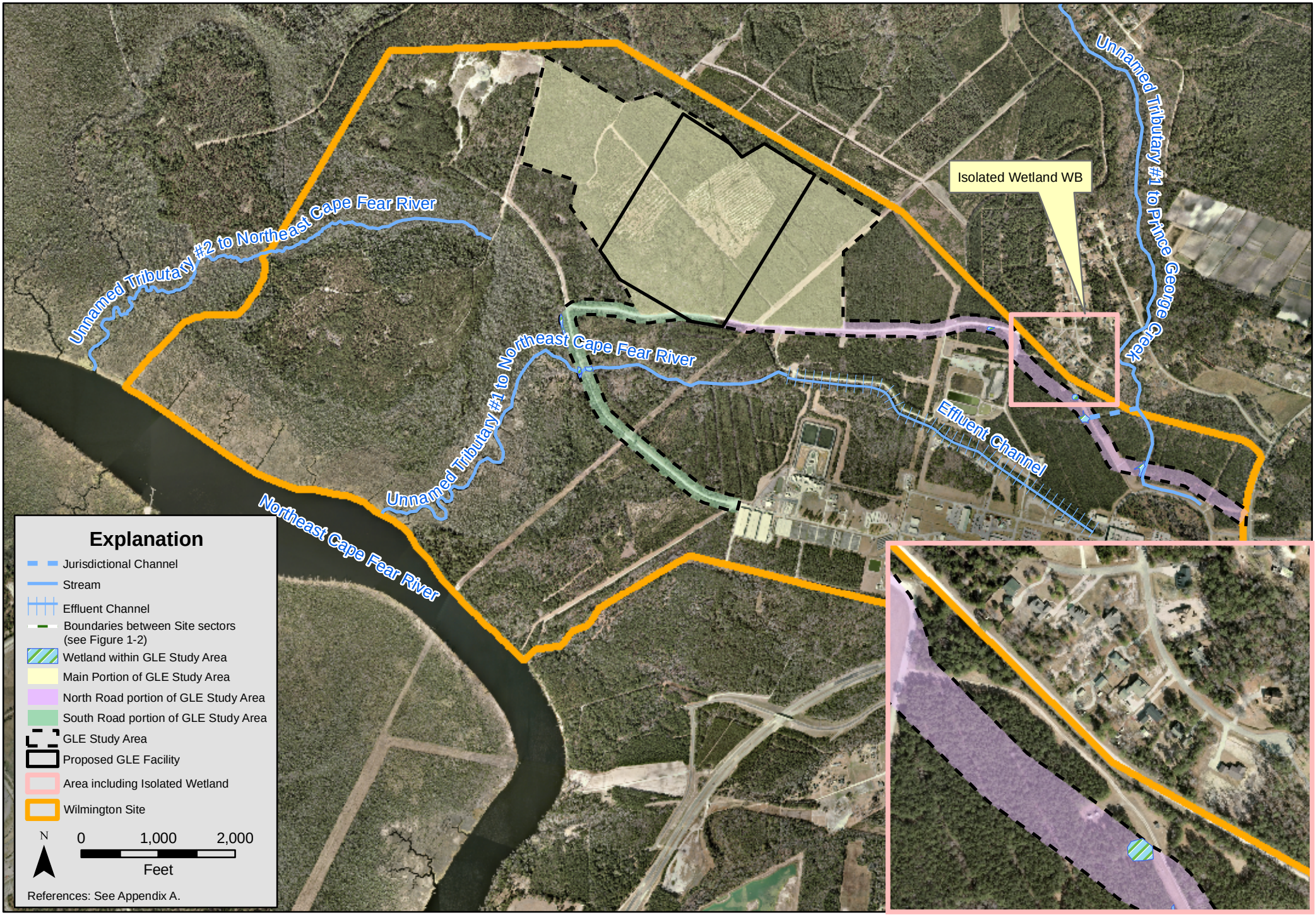

Figure 4.4-5. Isolated Wetland WB.

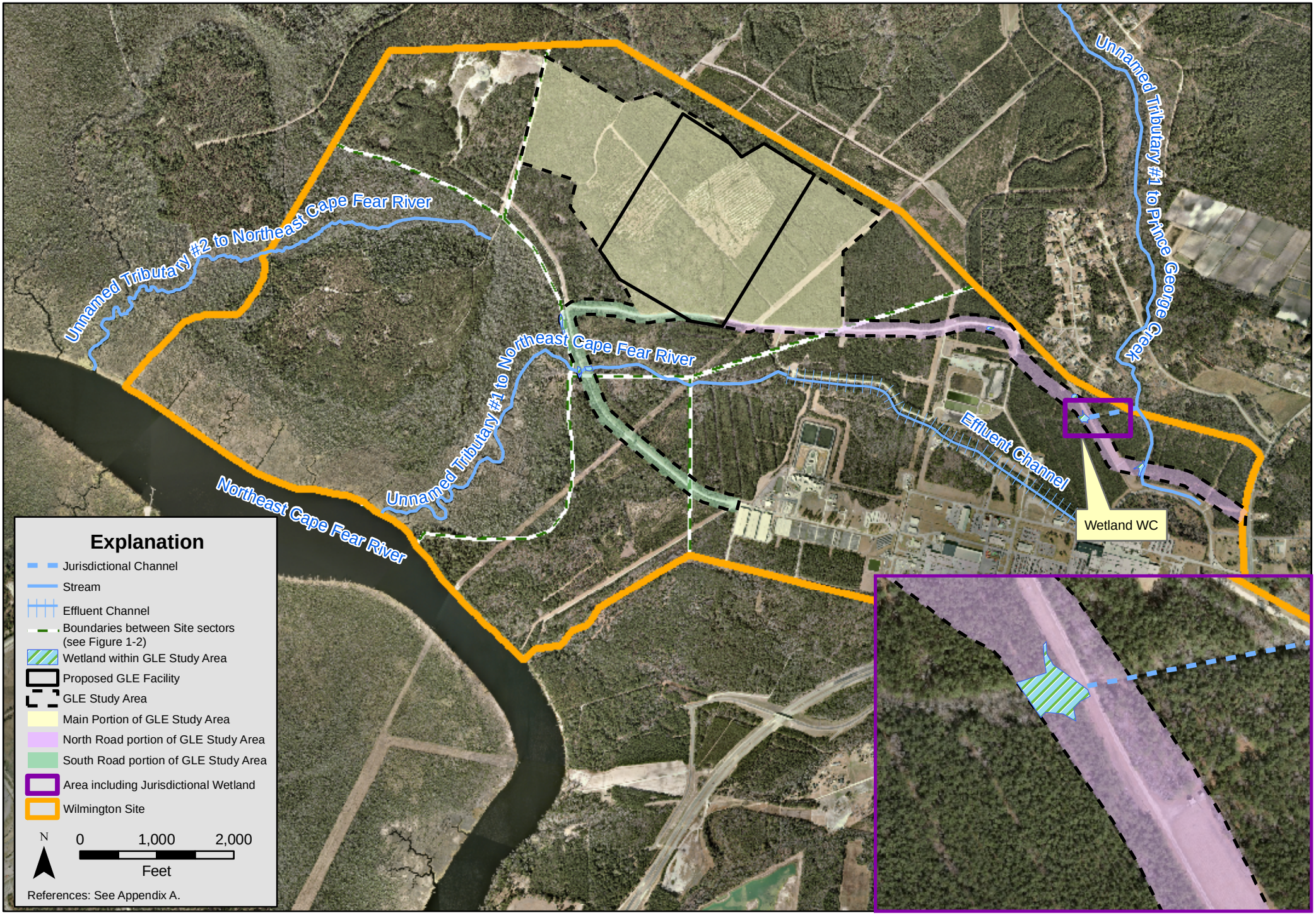

Figure 4.4-6. Wetland WC.

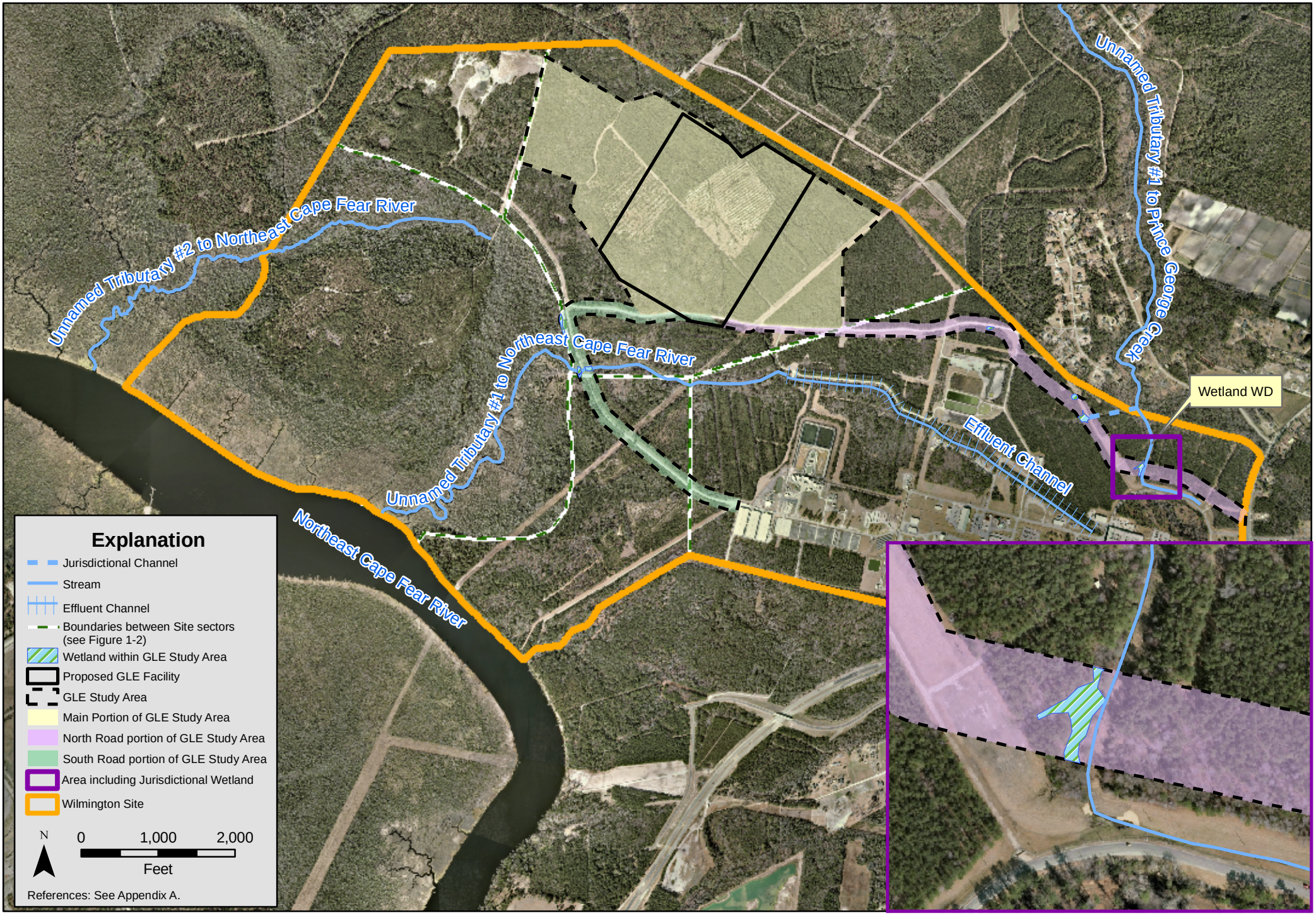

Figure 4.4-7. Wetland WD.

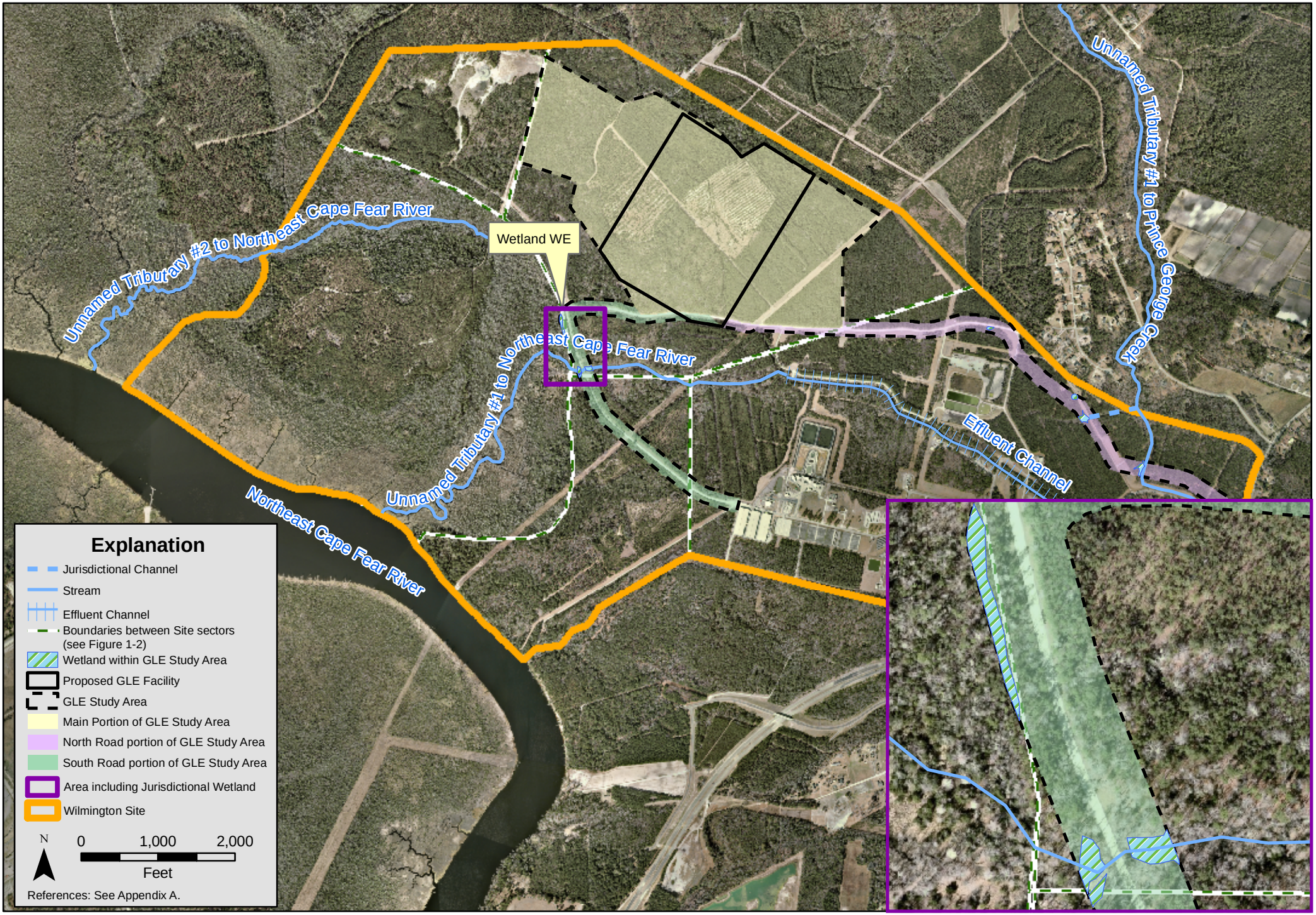

Figure 4.4-8. Wetlands WE.

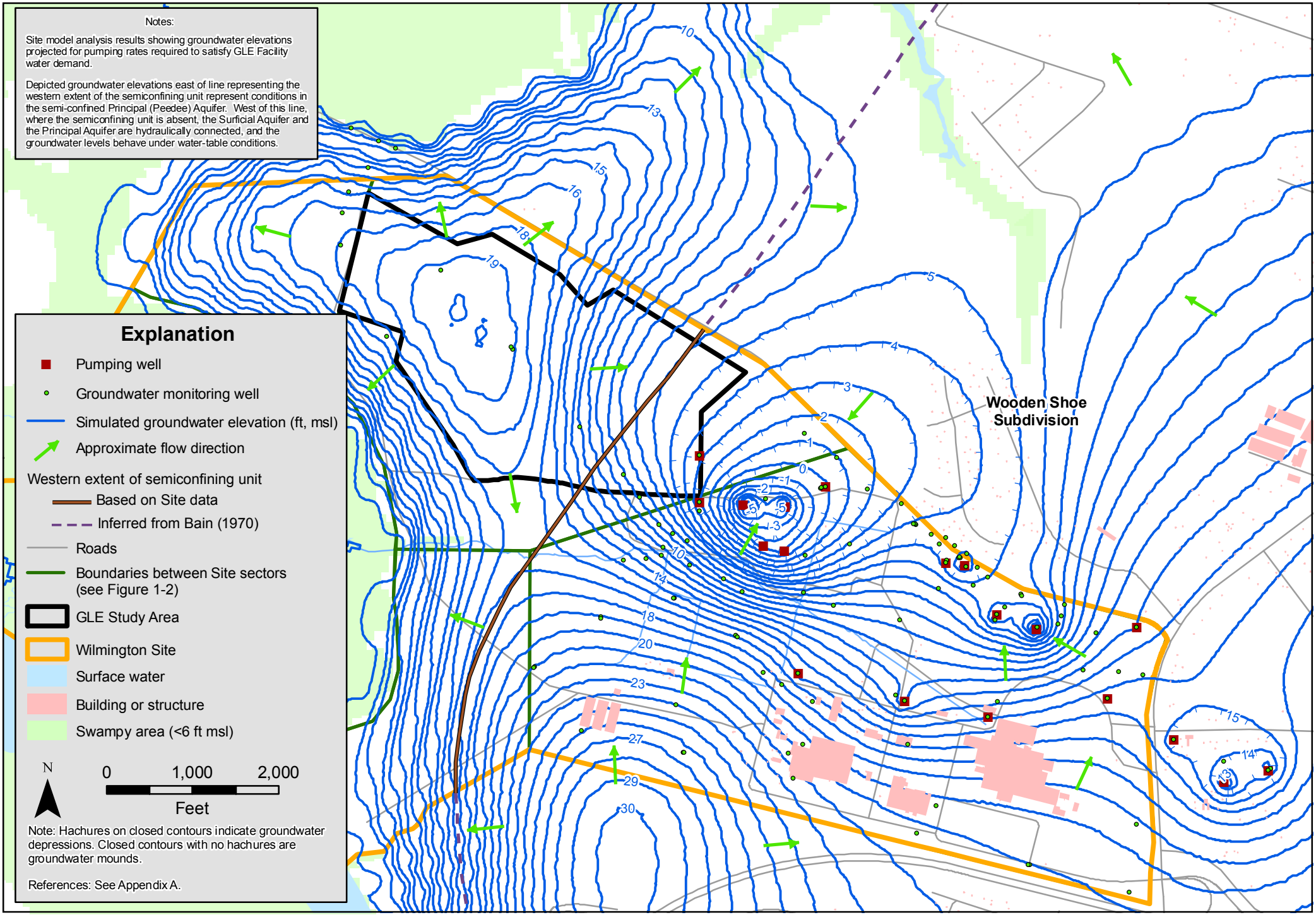

Figure 4.4-9. Simulated groundwater elevations from Proposed GLE Facility water demand.

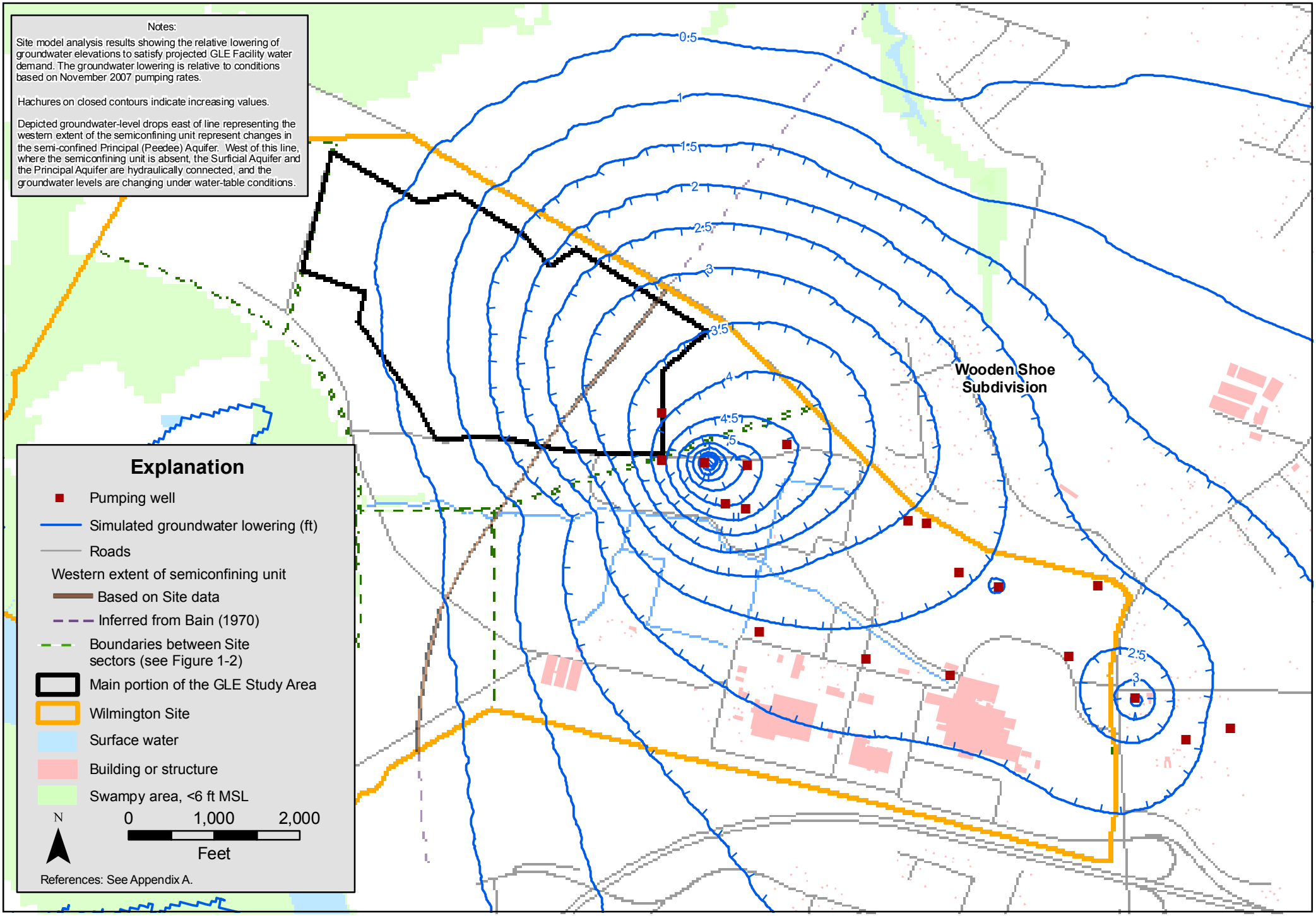

Figure 4.4-10. Simulated lowering of groundwater elevations from Proposed GLE Facility water demand.

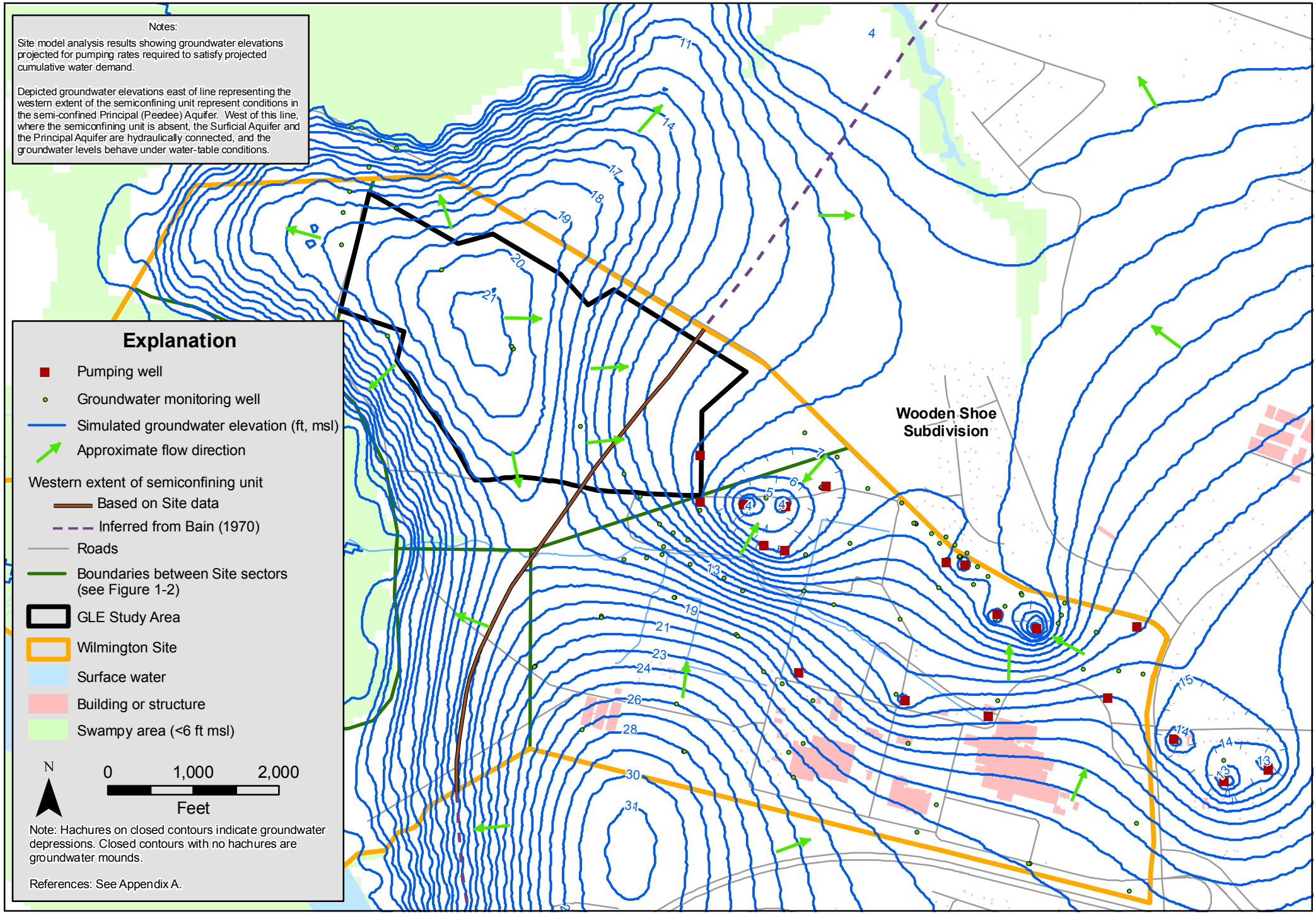

Figure 4.4-11. Simulated groundwater elevations from cumulative water demand.

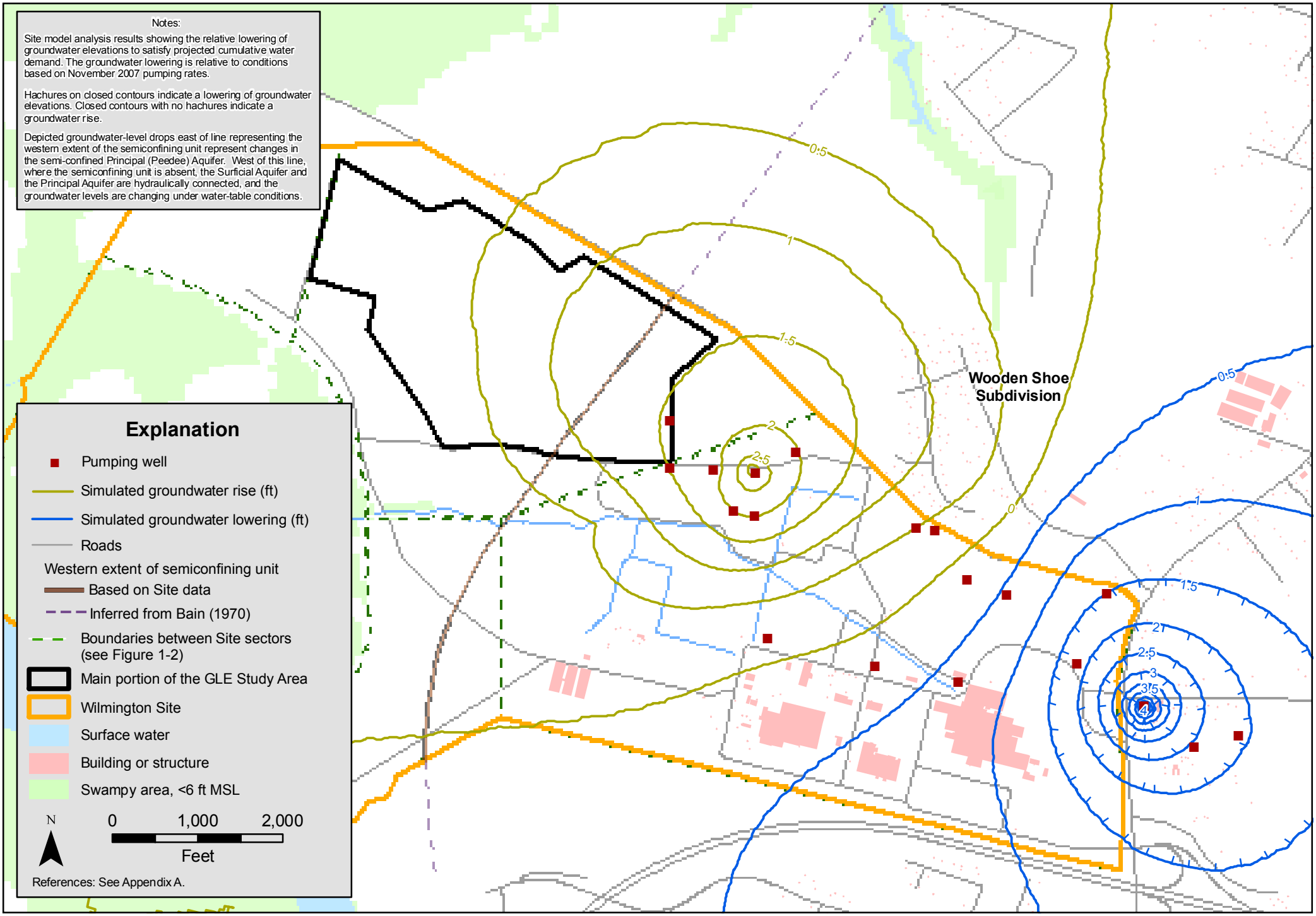

Figure 4.4-12 Simulated change in groundwater elevations from cumulative water demand.