Wetland Restoration Plan for the Moore Property

Johnston County, North Carolina

Project ID No. 060673501

Prepared for:

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Executive Summary

The Moore Site lies within Johnston County, North Carolina within the Rolling Coastal Plain Level IV Ecoregion and Neuse River Basin. The site wetlands make up part of the Swift Creek floodplain. The site contains two wetland areas as defined by their dominant soils and hydrology. The Wehadkee Tract, WED, consists of primarily Wehadkee soils and receives seasonal inflows from Swift Creek. The Tomotley Tract, TOM, consists of primarily Tomotley soils and receives most of its hydrologic inputs from upslope overland flow. The site also contains a cleared riparian buffer, RPN, that makes up part of a Levee Forest adjacent to the stream.

Through ditching and crowning, the landowner has modified the landscape of the site to facilitate drainage of surface waters off the site. These modifications have eliminated conditions required to maintain wetlands and have led to the conversion of on-site wetlands to a non-wetland state. The designer has designed the project to reverse the hydrologic alterations and restore hydrology required to support and maintain wetlands. To achieve this goal, the restoration design diminishes the capacity of the site to remove hydrology through the removal of ditches, spot grading to remove crowns, and extending / restoring berms with emergency spillways to control water surface elevations above the site's main lateral ditch. Restoration of the hydrology should restore hydric character to site soils and provide the environment necessary to support reforestation of wetland vegetation.

Restoration of the site wetlands and riparian buffer should restore important ecological functions to the site that include:

- Nutrient Removal
- Water Quality Improvements
- Habitat

The design must consider potential impacts to the neighboring Johnston County Airport and protected species living in Swift Creek. The design limits the amount of open space, such as open water, that could provide an environment leading to harmful conditions for local aircraft using the Johnston County Airport. Eliminating open water should limit the potential for inhabitation of the site by water fowl that may collide with low flying aircraft. The design also limits disturbance caused by construction to the existing and proposed riparian buffer so that sediments do not enter the stream and harm freshwater shellfish.

Restoration Table 1 provides a breakdown of restoration potential on site.

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Restoration Drawings

1.0 Project Site Identification and Location

1.1 Directions to Project Site

The Moore Property, referred to in this report as project site or site, lies within Johnston County, North Carolina. Directions to the site from Raleigh, North Carolina begin by heading east on I-40 toward US-70. On I-40, take exit 306 to US-70 and head east on US-70. Continue east on US-70 past the Town of Clayton. Follow US-70 Business at the US-70 Business – US-70 Bypass split. Continue east on US-70 Business towards the Johnson County Airport. Turn right at the SR-1501 (Swift Creek Road) intersection and head towards the airport. After passing the Johnston County Airport and crossing the Swift Creek Bridge, the site will be on the left (Figure 1 Project Site Vicinity Map and Figure 2 Project Site Map).

1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

The site lies within the Neuse River Basin in the USGS HUC **03020201**110070 and within the DWQ 03-04-02 basin.

2.0 Watershed Characterization

The site contains two distinct tracts with two different primary watersheds. The eastern tract, (WED), primarily receives inflows from Swift Creek. The WED tract also receives runoff from the immediate surrounding area. The western tract, (TOM-A and TOM-B or collectively TOM), receives hydrologic inputs from Swift Creek and from a small watershed covering an area to the west of the site. Figure 3 shows the watersheds.

2.1 Drainage Area

The site covers approximately 84 acres of which approximately 71.7 acres are involved with the restoration design. Near the site, Swift Creek drains approximately 145.7 square miles. The small TOM watershed to the west of the site covers approximately 0.2 square miles. The TOM tracts cover approximately 39.8 acres. The immediate area surrounding the WED tract that drains into the tract covers approximately 0.03 square miles. The WED tract covers approximately 10.4 acres. Table 2 shows the drainage areas.

2.2 Surface Water Classification / Water Quality

The North Carolina Department of Natural and Environmental Resources Division of Water Quality (NCDWQ) has assigned the section of Swift Creek adjacent to the site a stream index number of 27-43-(8) and describes it as the section "From dam at Lake Benson to Neuse River". NCDWQ has classified this section as Class "C, NSW" effective May 1, 1988. The class C designation indicates freshwaters protected for secondary recreation, fishing, aquatic life including propagation and survival, and wildlife. NSW, or nutrient sensitive waters, are waters that are prone to microscopic or macroscopic vegetation blooms from excess nutrient inputs.

2.3 Physiography, Geology, and Soils

The site lies within the Coastal Plain physiographic province and within the Rolling Coastal Plain Level IV Ecoregion of the Southeastern Plains Level III Ecoregion. The site sits within an active floodplain and tilts slightly from north to south with a slope of 0.2%. The topography is generally flat with a shallow ridge running north to south near the center of the site. This ridge may have functioned as an inter-stream divide during the recent past, but the linear drainage that earlier existed west of the ridge has been modified into a series of drainage ditches. The western boundary of the site forms the base of a hillside that gently climbs westward. Site elevations range from 120 to 130 feet.

Soils on the site are typical of a fluvial floodplain. The topographic low areas of the site contain Wehadkee and Tomotley soils, Altavista, Dogue, State, and Nason soils are found in areas with higher topography (Figure 4). Wehadkee and Tomotley are hydric soils. Altavista, Dogue, State and Nason are non-hydric.

2.4 Land Use and Development Trends

Prior to 1980, the small TOM watershed included approximately 40% forested area and 60% agricultural area. Figure 4 shows land cover circa 1980. From 1980 to around the year 2000, land use within the watershed shifted to approximately 30% forested area and 70% agricultural use. Figure 3 shows current land cover. Based on analysis of zoning data, land use for the next ten years will not likely deviate significantly from the year 2000 land use. Table 3 provides a breakdown of land use within the small TOM watershed. The immediate WED drainage area lies entirely within the site. Prior to 1990, a small forested area covered less than 10% of the immediate WED drainage area, and after 1990 nearly all of the drainage area was covered in pasture.

The landowner has cleared the site and currently uses it for pasture. The landowner has also ditched and crowned the site to expedite conveyance of water off-site. Prior to 1990, forests covered two-thirds of the site including much of the northern and western sections of the site.

2.5 Threatened and Endangered Species

During the site research for the feasibility (Kimley-Horn and Associates, Inc. 2003) and mitigation plans (Kimley-Horn and Associates, Inc. 2005), KHA found that the North Carolina Natural Heritage Program (NCNHP) listed four federally listed species that occur adjacent to the project site. NCNHP has mapped these four species in locations immediately upstream and downstream of the Swift Creek Road Bridge that crosses the stream north of the site. The species of interests include one federally listed endangered species, *Alasmidonta heterodon* (dwarf wedgemussel) and three federal species of concern: *Lythrurus matutinus* (Pinewoods shiner), *Elliptio lanceolata* (yellow lance), and *Fusconaia masoni* (Atlantic pigtoe).

During an on-site field review meeting, KHA and NCDOT discussed issues relating to the threatened and endangered species with the United States Fish and Wildlife Service (USFWS). The USFWS recommended that the restoration design limit all land disturbing restoration work to outside of the top of bank of Swift Creek and adjacent existing riparian areas, and that the construction documents include extensive measures for soil erosion and sediment control to prevent the sedimentation of Swift Creek.

The restoration design will not remove the existing man-made berm that runs along Swift Creek. The landowner has periodically repaired the berm and left unattended, the berm with likely breach during significant flooding events. Most of the species growing on the berm are invasives (e.g. *Ligustrum sinense*) or succesional species (e.g. *Betula nigra*). The invasive species will be treated and replaced with a mixture of species more representative of a natural community. The design does not call for grading adjacent to the stream. Extensive sediment and erosion control measures will be installed between the stream and the site.

2.6 Cultural Resources

During the field visits for the feasibility study, KHA did not observe historic structures or evidence of past historic structures on the property. KHA submitted a letter requesting information from the State Historic Preservation Office (HPO) on October 28, 2002. KHA received a letter from HPO dated December 2, 2002 stating that HPO had reviewed the proposed project and HPO was not aware of any historic resources that would be affected by the project. Therefore, HPO has no

comment on the project. HPO also sent a letter to the Ecosystem Enhancement Program (EEP) dated April 11, 2007 stating that an archeological survey was not needed.

2.7 Potential Constraints

2.7.1 Property Ownership and Boundary

NCDOT purchased a conservation easement from Mr. Todd Moore of Johnston County. Prior to the purchase, Mr. Moore had cattle grazing on the land. He eventually removed the cattle from the land and the land sat fallow.

2.7.2 Site Access

The site lies adjacent to Swift Creek Road, a state maintained 2 lane highway. Construction equipment may access the site directly from Swift Creek Road using ditch crossing. The designer does not anticipate significant access limitations. The site itself has been traversed for farming operations and should be accessible to construction equipment.

2.7.3 Utilities

KHA did not observe utilities within the site boundaries and available GIS data did not show utilities on-site.

2.7.4 FEMA / Hydrologic Trespass

Flood Insurance Rate Map, FIRM Map, 3720167500 J (December 2, 2005) covers the site and shows that almost the entire site falls within Zone AE. The FIRM Map describes Zone AE as the area inundated by the 1% annual chance flood where base flood elevations have been determined. Zone X covers a fringe of land along the western boundary of the site. The FIRM Map describes Zone X as areas inundated by the 0.2% annual chance flood. The portion of Zone AE nearest Swift Creek falls within a floodway. The FIRM map describes a floodway as the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% chance flood can be carried without substantial increases in flood heights. The base flood elevations range from 134 feet at the northern portion of the site to less than 133 feet at the southern portion of the site. Figure 5 shows the flood zone delineations. The upland areas surrounding the western and northern borders of the site lie at elevations that are several feet above the proposed pooling elevation of the wetland and are not likely to be affected by hydrologic trespass.

2.7.5 Regulatory Constraints

The US Army Corps of Engineers (USACE) had issued a violation notice for impacts to wetlands for the property owner's activities to clear cut and convert his property to pasture. Per the following excerpt from an E-mail sent from Jean B. Manuele, Chief of the USACE Raleigh Regulatory Office to Ed Hajnos of EEP on July 17, 2006, the site is eligible for mitigation credits.

> '. . .The violation on Mr. Moore's property was resolved through the verification of Nationwide Permit Number 26 prior to it's expiration in 1999. Accordingly, there are no outstanding violations on the subject property. . . '

Appendix 7 provides a copy of the email.

The site lies adjacent to the Johnston County Airport. Due to the proximity to the airport and the potential for wetland habitat to encourage an increase in bird populations, the Federal Aviation Administration (FAA) has concerns regarding how wetland restoration may promote a danger to aviation by increasing the opportunity for collisions between aircraft and birds. The NCDOT mitigation plan investigated these concerns. The investigation including several correspondences with government agencies and at least one field visit resulted in a letter dated March 28, 2003 from Michael Begier, a wildlife biologist with the USDA. The letter provides recommendations concerning implementing a wetland restoration plan near an airport and concludes that restoration of a forested wetland will not likely pose a danger to airport operations, but that the site should be monitored during and after construction to assure that site conditions such as extended ponding that may promote wildfowl habitation do not develop. The letter recommends that the airport maintain a wildlife log to document wildlife use. The letter also recommends that should the site develop conditions that allow wildlife to become a hazard, a site visit should be conducted and an operational plan to remedy the situation should be enacted without delay. Appendix 5 provides a copy of the letter.

2.7.6 Hazardous Materials

The Environmental Database Resource (EDR) report did not identify any hazardous issues on, near, or adjacent to the property. The search area radii used ASTM Standard E1527 of the available databases and indicated no potential hazardous materials. A field review of the site revealed no visible evidence of any current or past hazardous material potential on the site. The property has been and is currently used for agriculture. The landowner has applied agricultural chemicals including pesticides and fertilizers to the site. KHA did not find evidence that these chemicals were not used and applied according to the manufacture labels or based on the local agricultural extension agent recommendations. KHA did not observe evidence of any chemical transfer points, storage facilities, or discarded agricultural chemical containers on site.

3.0 Project Site Wetlands

The 84-acre site lies within the Swift Creek 1% chance floodplain and floodway. Approximately 71.7 acres have been incorporated into the restoration design. The remaining acreage either falls within the existing buffer of Swift Creek or includes a strip of land south of the main lateral ditch on the southern end of the project. Swift Creek flows north to south along the eastern boundary, and a gently sloping hillside that rises westward forms the western boundary. The site can be divided into two primary tracts that are divided by a shallow ridge. The eastern tract, Wehadkee tract or WED, runs north to south parallel to Swift Creek. The western tract, Tomotley tract or TOM, covers the area from the ridge westward to the western project boundary. The land owner has modified the site topography through ditching and crowning. This has affected site hydrology as described in section 3.2. Hydric soils dominate the landscape and relic wetland features including pockets of wetland vegetation lie scattered throughout the landscape. Design Sheet 1 shows existing site conditions.

When viewing in the field, the Wehadkee tract appears as a very shallow swale that has standing water or saturated soils during most of the year. The swale may be a relic portion of Swift Creek. The entire Wehadkee tract serves as active pasture. Between the Wehadkee tract and Swift Creek lies a levee forest, RPN. Portions of the levee forest have been cleared, reshaped, or created by the landowner. The landowner has created a berm within the levee forest along the strip of land farthest away from the creek. The grading plan in the design sheets shows the berm. He noted that flood waters periodically breach the berm and he has attempted to repair the breaches and maintain the berm.

The Tomotley tract may be subdivided into two sub-tracts based on existing land use and dominant hydrology. The TOM-A sub-tract covers the largest area. Surface water provides the primary source of hydrology and pasture dominates the land cover. The TOM-B sub-tract covers a small area in the central western boundary. A slope side seep and surface water provide the primary sources of hydrology. Scattered hardwoods cover this area.

3.1 Jurisdictional Wetlands

During the field assessments, KHA determined that the site did not contain jurisdictional wetlands. During the August 5, 2003 field meeting between the United States Army Corps of Engineers (USACE), NCDOT, and KHA to determine the extent of jurisdictional wetlands onsite, Mr. Eric Alsmeyer of the USACE confirmed that the site did not contain any jurisdictional wetlands. Modification of the site hydrology though ditching and crowning has removed the hydrological component. Maintained planting of pasture vegetation has removed the vegetation component. An investigation of site soils showed the existence of hydric indicators. Figure 6 shows National Wetlands Inventory (NWI) mapping performed by the United States Fish and Wildlife Service.

3.2 Hydrological Characterization

Figure 5 shows the site hydrologic features. Surface water inputs provide the primary source of hydrology for both the Tomotley and Wehadkee tracts. Overland flow from upslope surrounding land provides the greatest inputs followed by direct precipitation and overbank flooding. Groundwater inputs do not appear to be a primary hydrological input with the exception of a seep

located along the western site boundary. Hydrology leaves the site primarily through surface water outflows with some removal through evapotranspiration and groundwater flows.

The Wehadkee area may be a relic abandoned linear drainage feature of Swift Creek in the floodplain (i.e. abandoned channel, oxbow, or slough). The Altavista soil between the Wehadkee and Tomotley tracts serves as an upland ridge, labeled as ALT in the existing conditions map, within the floodplain and may be a relic levee of the stream-floodplain system. The sandy ridge of Altavista soil provides a natural barrier within the floodplain that allowed the area of Tomotley soils to develop as a backwater ponded area along the toe-of-slope of the floodplain.

Historically, the Tomotley tract was likely periodically flooded, detaining flood events for longer periods than the present due to the natural barrier of the Altavista ridge. In addition, surface flow into the Tomotley tract (other than the overbank flow from Swift Creek) was likely detained along the toe-of-slope from rainfall events and contributing area runoff. The site currently does not retain input hydrology for a sufficiently long duration to strongly support wetland hydrology criteria. A few remaining pockets of wetland woody vegetation scattered throughout the south portion of the site provide evidence of wetter conditions.

The Tomotley tract appears to have historically extended north and south of the site. These off-site wetlands have been hydrologically disconnected from the site due to lateral ditching. The northern extension, Offsite Tomotley North, lies above Swift Creek Road and the ditching on either side of the road diverts surface flows from Offsite Tomotley North to Swift Creek and away from the Tomotley Tract to the south. Based on a review of orthophotography from several time periods, landowners have not disturbed the Offsite Tomotley North site and the site remains a functioning wetland with maturing woody wetland vegetation and remote signatures of wetland hydrology. The southern extension, Offsite Tomotley South, lies below the main lateral ditch of the project site that flows directly into Swift Creek. Figure 8 shows Offsite Tomotley South. The landowners have modified the site through ditching and clearing. During a field inspection, KHA did not observe any signs of grading. Several functioning wetland patches, including a reference wetland, TOM-REF, lie scattered throughout this area. These patches have not been severely altered by the site disturbances and have maintained woody wetland vegetation, hydric soils, and adequate hydrology to support the wetlands.

The Wehadkee Tract extends south off site. The southern extension, Offsite Wehadkee South, lies below the main lateral ditch of the project site. Figure 8 shows Offsite Wehadkee South. The lateral ditch separates the surface flows of the project site from Offsite Wehadkee South. Offsite Wehadkee South exhibited hydric soils and wetland hydrology. The landowner had cleared the site within the past 10 years and the regenerating vegetative community includes a mix of successional, mature community, and exotic/invasive woody vegetation. This project uses a portion of Offsite Wehadkee South as a reference wetland, WED-REF.

Had the Tomotley and Wehadkee Tracts remained in a less disturbed condition, the tracts would very likely support functional wetlands. Site soils continue to show indicators of recent historic hydric conditions. However, during the past decades, the landowner modified the landscape through ditching and crowning to promote site drainage. These alterations have removed the wetland hydrology from the site. Reversal of these field modifications should allow the site wetlands to regain functionality.

In creating the NCDOT Mitigation Plan, KHA performed an analysis of groundwater hydrology for the Tomotley Tract. The analysis incorporated soil conductivity tests, groundwater gauges (see

Figure 5 for gauge locations and Appendix 4 for gauge data), and a DRAINMOD model. The analyses concluded that groundwater flows were a minor component of the tracts hydrology and that the hydrology was driven by the behavior of the surface water through on- and off-tract inputs and on-tract retention. The soil conductivity tests demonstrated that the water infiltration rates averaged 0.09 inches an hour throughout the soil column (0 to 53 inches) and 0.02 inches an hour between the depths of 20 to 30 inches. Vertical infiltration rates are slow enough that available water stays within the upper layers for soil for an extended period of time. The DRAINMOD analysis estimated the influence of the drainage ditches in removing groundwater thus providing a measure of the horizontal movement of groundwater. The DRAINMOD analysis showed that the ditches have limited influence on groundwater movement and by association shows that groundwater moves slowly along the horizontal plane. Gauge data for one growing season showed that the water table elevations meet minimum criteria (i.e. consecutive days totaling 5% of the growing season) for wetland hydrology for most of Tomotley tract gauges (G-2, G-3, G-4) according to the 1987 USACE Wetland Delineation Manual. However, the period evaluated includes large storm events (remnants of hurricanes that passed over the site in August 2004) and may not be representative of the hydroperiod under normal conditions. Therefore, based on cumulative analysis of soil conductivity, DRAINMOD, and groundwater gauges, KHA concluded that the primary hydrological influence of the drainage ditches was to convey surface water flows quickly off the site and minimize ponding.

Off-site drainage and direct precipitation provide the dominant influxes of hydrology. An area of approximately 151 acres drains into the Tomotley Tract. Historically, a larger area drained into the site, but the road side ditch to the north of Swift Creek Road drains approximately 62 acres that would previously have flowed into the site. Figure 3 shows the diverted drainage areas.

Based on local rainfall data from the Smithfield WETS Station (NC7994), the site typically receives approximately 47.4 inches of rainfall per year. The rainfall distributes relatively evenly throughout the year with the wettest period covering the period between March and September. The rain fall data collected by the on-site rain gauge during 2004 generally agrees with these trends.

Swift Creek provides periodic hydrological inputs via over bank flooding. Almost the entire site lies within the 1% chance flood plain. The Flood Study for Swift Creek (Dated 12/02/2005) (FEMA - NC 2005) models the 10% chance flood inundating elevations up to 130 feet in the north section of the site and 129 feet in the south section of the site. The Wehadkee Tract lies within a FEMA FIRM floodway and presumably receives more regular hydrological influxes from Swift Creek than the rest of the site. The landowner has also stated that Swift Creek has backed up into the ditches several times over the years that he has lived there.

A section of the western hillside contains a seep that contributes hydrology to the site. The watershed draining into and around this border contains several springs that indicate that this hillslope effectively stores and conveys groundwater and surface water down valley and down slope. The seep provides sustained hydrological input that appears to augment surface runoff.

3.3 Soil Characterization

Wehadkee and Tomotley soils constitute the sites primary wetland soils. During the NCDOT feasibility study, KHA sampled soil cores to determine the depth to hydric indicators. Analysis of the sampling showed that the zones of hydric soils (hydric indicators within 12 inches of the surface) or near hydric soils (hydric indicators within 18 inches of the surface) mapped similarly to the mapping of Wehadkee and Tomotley soils.

The Wehadkee area may have been a relic abandoned linear drainage feature of Swift Creek in the floodplain (i.e. abandoned channel, oxbow, or slough). The USDA soils series description for Wehadkee soils is as follows:

> *Wehadkee* soil series is a very deep, poorly drained soil formed on floodplains along streams in loamy sediments. Wehadkee is classified by the NRCS as a fine-loamy, mixed, active, nonacid, thermic Fluvaquentic Endoaquepts soils with a seasonal high water table 0 to 12 inches.

Historically, the area of Tomotley Soils was likely periodically flooded detaining flood events for longer periods due to the natural barrier of the Altavista ridge. In addition, surface inputs from rainfall events and contributing area runoff into the Tomotley area (other than the overbank flow from Swift Creek) was likely detained along the toe-of-slope. The USDA soils series description for the Tomotley Soils is as follows:

> *Tomotley* soil series is a very deep, poorly drained soil formed in loamy marine and fluvial sediments. Tomotley is in a fine-loamy family and is found on flats and in slight depressions. It is classified by the NRCS as a fine-loamy, mixed, semiactive, thermic Typic Endoaquults with seasonal high water table between 0 to 12 inches.

Steve Melin, a Licensed Soil Scientist with the Catena Group, Inc. performed a study of the site's Tomotley Soils in August 2004 to evaluate hydraulic conductivity of the project area soils, as well as to characterize the soil series evaluated in the field. The results confirmed the NRCS soil description and are provided in Appendix 6.

The Altavista soil between the Wehadkee and Tomotley serves as an upland ridge within the floodplain and may be a relic levee of the stream-floodplain system. The sandy ridge of Altavista soil provides a natural barrier within the floodplain which allowed the area of Tomotley soils to develop as a backwater ponded area along the toe-of-slope of the floodplain. The USDA soils series description for the Altavista Soils is as follows:

> *Altavista* soil series is a very deep, moderately well drained soil formed in loamy marine and fluvial sediments on stream terraces in the Piedmont and upper Coastal Plain. Altavista is classified by the NRCS as fine-loamy, mixed, semiactive, thermic Aquic Hapludults with seasonal high water table greater than 72 inches.

3.4 Plant Community Characterization

The plant communities located on-site include a Coastal Plain Brownwater Levee forest and pasture areas with off-site adjacent Coastal Plain Brownwater Levee, Bottomland, and Swamp forests. Plant community classification was based on the Classification of the Natural Communities of North Carolina, fourth approximation (Schafale, Mike 2002). The species listed within the following communities represent those species observed within and adjacent to the site. Some of the species are invasive and are not considered part of the natural community. The Coastal Plain Brownwater Levee forest is composed of *Celtis laevigata* (Hackberry), *Fraxinus pennsylvanica* (Green Ash), *Quercus nigra* (Water Oak), *Quercus alba* (White Oak), *Carya cordiformis* (Bitternut Hickory), *Liquidambar styraciflua* (Sweetgum), *Betula nigra* (River Birch), *Liriodendron tulipifera* (Yellow Popular), *Acer rubrum* (Red Maple), *Carpinus caroliniana* (Muscle Wood), *Ligustrum sinense* (Chinese Privet), *Arundinaria gigantea* (Giant Cane), *Toxicodendron radicans* (Poison Ivy), *Vitis sp.* (Grape), *Lonicera japonica* (Japanese Honeysuckle), *Parthenocissus quinquefolia* (Virginia

Creeper), *Campsis radicans* (Trumpet Vine), *Smilax bona-nox* (Green Brier), *S. rotundafolia* (Green Brier), and *Phytolacca americana* (Pokeberry). The Coastal Plain Brownwater Bottomland and Swamp forests adjacent to the site contains Sweetgum, *Nyssa biflora* (Swamp Blackgum), Red Maple, *Quercus phellos* (Willow Oak), *Pinus taeda* (Loblolly Pine), *Crategus sp.* (Hawthorn), *Diospyros virginiana* (persimmon), Chinese Privet, Japanese Honeysuckle, Giant Cane, *Carex sp.*, and Green Brier. The pasture areas contain a variety of grasses.

4.0 Reference Wetland

The restoration project proposes three reference wetlands to aid and confirm restoration design of the site wetlands. The reference wetlands for the Wehadkee Tract are WED-REF that sits in an area immediately south of the site in an area of Wehadkee Soils and WED-REF2 that sits southeast of the Johnston County Airport in an area of Wehadkee Soils. The reference wetland for the Tomotley Tract (TOM-REF) sits in an area immediately south of the site in an area of Tomotley Soils. Figures 7 and 10 show the locations of the reference sites.

4.1 Hydrologic Characterization

TOM-REF sits within a similar setting to the On-Site Tomotley Wetland. Surface inflows from overland flow and precipitation provide the primary hydrologic inputs. A ditched remnant channel runs along the west side of the wetland. The ditch likely functions like the on-site ditches in that it conveys surface flows and less likely draws down groundwater.

WED-REF sits directly south of the On-Site Wehadkee Wetland. The project site's primary lateral ditch separates the reference wetland from the site wetland. WED-REF sits within the same landscape setting as the WED tract. Surface flows including overland flow, precipitation, and overbank flooding provide the primary hydrologic inputs. Groundwater flows provide minimal inputs. During the field assessment, KHA observed several apparent hydrologic indicators including hydric soils, standing water, wetland vegetation, and staining. As shown in Figure 8, the contributing watershed for the reference wetlands is similar to the watersheds of the on-site wetlands.

WED-REF2 lies southeast of the Johnston County Airport in an area of Wehadkee Soils adjacent to Swift Creek. The reference sits in a similar landscape setting as the WED tract. Like WED-REF, surface flows including overland flow, precipitation, and overbank flooding provide the primary hydrologic inputs and groundwater flows provide minimal inputs. During the field assessment, KHA observed several apparent hydrologic indicators including hydric soils, standing water, wetland vegetation, and staining.

4.1.1 Gauge Data Summary

The site design relies on the on-site gauges installed by NCDOT to supplement design parameters. The primary rationale for the approach of restoring wetland hydrology on the project site relies on the comparison of the project site with adjacent sites with observable wetland hydrology. The comparison suggests that modification of surface water hydrology of the project site through ditching and crowning have removed wetland hydrology from the project site. Removal of the hydrological modifications should restore wetland hydrology to the project site. Gauges have not been installed in the reference wetlands, but will be installed prior to the completion of construction to provide reference values for groundwater hydrology. These reference values will be used to compare reference and restoration wetland groundwater hydrology for the purpose of measuring restoration success.

4.2 Soil Characterization

The Tomotley and Wehadkee soils found in the reference wetlands are part of the mapping units that includes the site wetlands. An assessment of the soils confirmed that they are similar to their mapping unit. Figure 9 shows the soils of the reference wetlands.

4.3 Plant Community Characterization

The following plant community descriptions reflect Schafale's fourth approximation of North Carolina Natural Communities. With restoration design, the landscape of the restoration site should support several Coastal Plain Brownwater Hardwood Communities including Levee, Bottomland, and Swamp Forests. The existing on-site forested areas and off-site areas south of the site contain natural communities that will serve as reference for design. The eastern edge of the site along Swift Creek contains a Coastal Plain Brownwater Levee Forest Community (LVE-REF). The Tomotley Reference Wetland (BTM-REF1) contains Coastal Plain Brownwater Bottomland Hardwood Forest Communities. WED-REF2 contains a Cypress-Gum Swamp (Brownwater Subtype) (SWP-REF2). WED-REF1 contains remnants of a mixed Brownwater Bottomland Hardwood and Cypress-Gum Swamp (SWP-REF). Figure 11 shows the location of the reference communities.

4.3.1 Community Description

The Coastal Plain Brownwater Levee Forest Community should cover the eastern fringe of the site, the Altavista Ridge and the western upland edge of the site. Schafale divides the Brownwater Levee Forest Community into three subtypes. The site should support the two driest subtypes: High Levee and Medium Levee. The Levee Forests occur on natural levee deposits along Brownwater Coastal Plain Rivers. The primary tree species include *Fraxinus pennsylvanica* (Green Ash), *Celtis laevigata* (Sugar Berry), *Platanus occidentalis* (Sycamore), *Betula nigra* (River Birch), *Acer negundo* (Box Elder), and *Ulmus americana* (American Elm). The High subtype also includes rich-site and marginal wetland species that dominate the vegetation and include *Aesculus sylvatica* (Painted Buckeye), *Lindera benzoin* (Spicebush), *Laportea canadensis* (Canadian Woodnettle), *Nemophila microcalyx* (Smallflower Baby Blue Eyes), and *Corydalis flavula* (Yellow Fumewort). The Medium subtypes tend to include less rich-site and marginal species, but include more species adapted to wetter conditions such as *Taxodium distichum* (Bald Cypress), *Nyssa aquatica* (Black Gum), *Carya aquatica* (Water Hickory), and occasionally *Populus deltoides* (Eastern Cottonwood).

The Coastal Plain Brownwater Bottomland Forest Community should cover most of the Tomotley and Wehadkee Tracts. Three of Schafale's subtypes for the Brownwater Bottomland Forest Community apply to the site: High Oak, Low, and Swamp Transition. The Bottomlands lie within river floodplains and terraces. Current or pre-existing overbank floods distinguish these sites from other communities. Oaks and Sweetgums dominate the canopy and *Carpinus caroliniana* (Ironwood) and *Acer rubrum* (Red Maple) often populate the understory. High Oak subtypes feature mesophytic hardwoods such as *Quercus michauxii* (Swamp Chestnut Oak) and *Quercus pagoda* (Cherrybark Oak). Low Oak subtypes feature flood tolerant species such as *Quercus lyrata* (Overcup Oak), *Carya aquatica* (Water Hickory), *Ulmus americana* (American Elm), and *Quercus laurifolia* (Laurel Oak).

The wettest portions of the site located near the southern end of the Wehadkee Tract and depressions within the Tomotley Tract should support species found in the Coastal Plain Brownwater Bottomland Forest Swamp Transition subtype and Cypress-Gum Swamp Brownwater subtype.

These communities experience extended periods of flooding from adjacent brownwater creeks. Species include flood tolerant species such as *Quercus lyrata* (Overcup Oak), *Quercus laurifolia* (Laurel Oak), *Taxodium distichum* (Bald Cypress), *Populus heterophylla* (Swamp Cottonwood), *Fraxinus profunda* (Pumpkin Ash), *Fraxinus pennsylvanica* (Green Ash), *Nyssa aquatica* (Black Gum), and *Nyssa biflora* (Swamp Black Gum).

5.0 Project Site Restoration Plan

5.1 Restoration Project Goals and Objectives

The Moore Property Wetland Restoration project strives to restore ecological functions to 50.2 acres of riparian wetlands and 5.0 acres of riparian forests.

Targeted ecological functions may be defined in terms of the Hydrogeomorphic (HGM) approach that covers functions in the areas of hydrodynamics, biogeochemical processes, and biotic resources. Using HGM riverine wetland types as a base for comparison, the restored site will provide improvements to the following functions: dynamic water storage, energy dissipation, nutrient cycling removal of imported elements and compounds, retention of particulates, organic carbon export, maintain characteristic plant and detrital biomass, maintain spatial structure of habitat, and maintain interspersion and connectivity.

Specific functions include:

- Provide habitat protection for federally protected species in Swift Creek through the establishment of a permanent conservation easement along the west bank of Swift Creek through the project area.
- Improve water quality functions within the restoration area by providing longer residence time and filtering for runoff through the wetland area prior to entering Swift Creek.

The restoration design plans to meet the project goals thorough the following objectives:

- Reestablishment of wetland hydrology and natural water table hydroperiod of floodplain wetlands
- Reforestation to wooded wetlands and riparian forest to establish natural wetland, upland, and riparian communities

The designer developed the plans to meet the above objectives while considering the following site conditions:

- Minimize impacts to listed threatened and endangered species found in Swift Creek adjacent to the site
- Minimize the potential for hydrologic trespass
- Conform to FAA guidelines by minimizing open water and reducing the potential for the establishment water fowl populations

The following sections describe the approach to restoration design.

Wetland Restoration Approach

Direct alterations to site hydrology through crowning and ditching have provided the means for degradation of the site to a non-wetland state. Surrounding areas within the same landscape where landowners have not modified on-site hydrology continue to function as wetlands. Ditches along Swift Creek road and the south end of the Moore Site have segregated some of these wetlands from their original water sources, but these wetlands continue to show signs of wetland hydrology,

maintain hydric character of soils, and support predominantly wetland vegetation. The Moore Site maintains the ability to support wetlands and should support wetlands if restoration construction reverses the hydrological modifications that expedite the removal of water from the system. The primary method of restoration will be to reverse the hydrologic modifications using methods described in section 5.2. In addition to reversing the hydrologic modifications, the design calls for creating microtopography such as small vernal pools, oxbow features, and small upland hummocks typical of upper coastal plain floodplain wetland complexes. The addition of microtopography should support additional water detention and provide habitat. The design sets the elevation for standing surface water (i.e. the invert elevations for water control structures at the bottom of the project) to a value that allows upslope water to freely drain to the site and minimize the potential for hydrologic trespass. The design limits the creation of open spaces or standing water to minimize the risks of creating waterfowl habitat that could go against FAA regulations. The design limits construction along the eastern border of the site adjacent to Swift Creek to avoid direct impacts to this stream buffer and minimize sedimentation of threatened and endangered species habitat in the stream. Restoration of the site will link surrounding natural communities and provide ecological connectivity.

Wildlife Hazard Reduction

The site is located adjacent to the Johnston County Airport along the eastern property boundary. The Federal Aviation Administration (FAA) rules and recommendations govern the airport's operations, as well as activities on and adjacent to the airport. The FAA recommends not placing wetland mitigation within 5,000 feet of an airport because of the potential hazardous wildlife attractant. The USDA Wildlife Services conducted a wildlife hazard assessment of the site. The wildlife hazard assessment looked at issues regarding wetland restoration and mitigation measures to insure the site does not become a wildlife hazard attraction.

The site is currently in pasture and fallow field. The area in its current condition provides for foraging habitat for *Branta canadensis (*Canada Goose). The goal of the wetland restoration is to have a closed canopy forest. The plan will include the construction of numerous vernal pool features throughout the site. These pools will be limited in size to less than a half acre and will be shallow. These vernal pools will be periodically flooded and will likely have standing water for only short periods of the year. It is likely these pools will develop herbaceous cover along with flood-tolerant planted trees and shrubs which will provide forest structure to discourage the use of the pools by Canada geese. *Aix sponsa* (Wood Ducks) may use the area because of the periodic standing water and heavy cover with available food. However, the restored site would not likely attract large numbers of waterfowl, and specifically will not likely be attractive to Canada geese.

Based on the results of the site visit and proposed project, the USDA Wildlife Services recommends that during the initial stages of reforestation, it will be important to monitor the site for waterfowl habitat. Habitat of interest includes temporary or ephemeral pools or water that may become permanently established. This monitoring will be especially important during the first few years and during this time, the site should be maintained to remove any permanent, deep, open pools (i.e. pools without woody vegetation). The Wildlife Services advocates that airport operations offices maintain a wildlife log and EEP monitor the area for wildlife use. Continuous communication between these groups concerning wildlife use will be important in preventing a wildlife hazard situation. Use of the area by water fowl (e.g. Canada Geese) will require immediate action to mitigate potential wildlife hazards.

Revegetation Approach

The site consists of several potential hardwood communities that differ based on landscape setting and hydrology. By restoring wetland hydrology to the site, the site should better support riparian and wetland forest communities. The communities range from drier levee systems to the predominant bottomland systems and to swamp communities in the wettest sections. The planting plan, described in section 5.4, must account for the control of invasives and minimize open space to address FAA concerns. Surrounding communities should provide a source of target species as well as invasives that will require control.

5.1.1 Designed Wetland Type

The site wetlands may be categorized as Palustrine (Cowardin) or Riverine – Moderate Energy Floodplain (HGM). The Cowardin classification may be further expanded to PFO1E – Palustrine Forested with Broad Leaf Deciduous vegetation and Seasonally Flooded Saturated.

5.1.2 Target Wetland Communities / Buffer Communities

Several target communities exist on the site. The ATL and RPN tracts lie at higher elevations and are less wet than the remaining tracts. The design for the ATL and RPN tracts uses the Brownwater Coastal Plain Levee Community as a template. The larger portion of the WED and TOM tracts use the Brownwater Coastal Plain Bottomland Communities as templates. The wettest portions of the landscape that lie within the lowest elevations of the WED and TOM tracts will use the Brownwater Coastal Plain Swamp Communities as templates.

5.1.3 Hydrologic Trespass

The areas surrounding the site with the potential to experience hydrologic trespass include the Moore residence and adjacent forested area and a Horse Ring. The Horse Ring lays well above (greater than 127 feet) the proposed pooling elevation (124 feet) of the adjacent wetland (TOM-A and TOM-B) and run-off from these systems should not be affected. Much of forested area adjacent to the house lies at or above 125 feet. The design does not modify the two features, a ditch and a culvert, that drain this area and the pooling elevation of the wetland will not impair drainage. The house sits at an elevation of 127 feet.

5.2 Hydrologic Modification

5.2.1 Narrative of Modifications

The primary hydrologic inputs for the site are overland flow, precipitation, overbank flooding, and a seep. The design does not significantly alter inputs from precipitation or the seep. These inputs should continue to function as they did before construction. The design augments overland flow by diverting a portion of the storm flows in the ditches along the side of Swift Creek Road onto the site. A swale will provide a surface water hydrological connection between the road side ditch and a swale that extends to the middle of the TOM tract. The head of the swale at the interface with the ditch will be cut to an elevation of 125.3 feet and the bottom elevation of the swale will gently slope downward to 124 feet at end of the swale. A boulder sill will provide protection to the head of the swale. Due to its low slope, shallow depth, and grass lining, the swale will transport water at a low velocities and energies. This should allow the swale to be stable.

The attached restoration drawings provide schematic details for the proposed hydrologic modifications. The design will increase the hydrologic detention time through limiting the conveyance of surface water off the site by the existing network of ditches and creating microtopography to store pockets of water. The design fills the ditches with a combination of channel fill and clay channel blocks. The design also removes the culverts connecting the ditches. The design does not modify the main lateral ditch running along the bottom of the project. Two earthen berms with emergency rip-rap spillways located at the southern end of each the TOM and WED tracts will control the flow of water into the lateral ditch. The spillway elevation has been set to 123.5 feet for the TOM tract and the 123.5 for the WED tract. Holding water at this elevation will allow detention of surface water for periods adequate to support wetland hydrology. The design uses a spillway as a hydrologic detention device for several reasons. The spillway is stable and able to withstand stresses during flood flows and from the 6 foot or greater drop in elevation between the wetland grade and the bottom of the lateral ditch. The spillway will also require less maintenance than other water control devices.

Depending on the location within the landscape of the TOM and WED tracts, the design grades isolated spots to base elevations ranging from 125.5 to 123.5 feet. The base elevation for spot grading depends on the location within the TOM or WED tract. The attached restoration drawings show the base elevations. The spot grading will remove crowns and related features that accelerate surface runoff off site. The design calls for grading in microtopography such as local depressions and sloughs. The grading will be limited to the upper 18 inches of soils to limit exposing and infiltrating hardpan layers and to maintain fertile topsoil. Some higher elevations within the restoration area will not be graded to the design base elevations due to the grading depth limits. The design uses topographic mapping developed through NCDOT photogrammetry unit using aerial data acquired January 2003. Groundwater inflows and outflows will likely be limited because the soils have a high clay content and low conductivity in the upper surface.

The design does not disturb the man-made berm along the Swift Creek levee zone. The landowner currently maintains the berm and it is likely that the berm will breach during flood events as it has during past flooding events. Construction work will be limited to the west side of the berm. Limiting work to the west side and the installation of sediment control measures should limit impacts to threatened and endangered species living in Swift Creek.

5.3 Soil Restoration

The existing site soils maintain properties necessary to support wetland function. Returning wetland hydrology should increase the character and extent of hydric soils on-site. The hydrologic restoration should raise the water table and restore hydric soils to those areas where hydric indicators are currently within 18 inches of the surface. The design calls for limiting disturbance to the upper 18 inches of on-site soils. Any excavated topsoil will remain onsite and will be reapplied to graded areas. To facilitate reforestation, nutrients and conditioners will be added to the soil as directed by the North Carolina Department of Agriculture and Consumer Services Agronomic Division Soil Testing Report.

5.4 Natural Plant Community Restoration (See Planting Plan)

The goal of the forest restoration is to provide long-term improvements to ecological functions of the proposed and surrounding forest communities. The restoration plan has been developed to provide

these functional uplifts through the re-establishment of target natural communities. The target natural communities have been determined based on comparison of existing site conditions with established type communities with verification of appropriate species from proximate reference natural communities. Based on the Schafale's fourth approximation of North Carolina Communities, the site's riparian area most closely correlates to Coastal Plain Brownwater Levee, Bottomland, and Swamp Forest.

The goal of the planting scheme is to establish riparian and wetland communities consistent with the reference communities using an approach that accelerates the succesional process leading to a mature forest community. The planting plan uses reference plant communities as a base to design a planting scheme and develop a vegetation list.

Re-colonization of cleared riparian habitats characteristically begins with an invasion of pioneer species that creates an environment (e.g. shading) suitable for species more typical of a mature community. To initialize the proposed riparian and wetland communities, the restoration areas will be planted with a mix of pioneer species and species found in more mature communities that have been selected and arranged to meet the following objectives:

- Establish mix of shade intolerant canopy and shade tolerant understory species
- Provide vegetative source of dominant species
- Establish local seed sources for those species less likely to migrate into the restoration area
- Control exotic species
- Minimize areas of open water

The design of a planting plan involves several components. The planting zones have been developed considering site hydrology, soils, and disturbance regimes and are referenced to natural communities. Each zone has a unique environment that dictates species selection and community structure. The planting list is developed for each zone to match the vegetation in the reference community and meet the objectives given above. The planting list also reflects which species are readily available and have a reasonable expectation of survival. For a given zone and species, a plant source and planting type (e.g. containerized or bare root) is recommended. A planting schedule is developed so that site preparation and plant installation occur at the optimal time and season. After installation, the planting will be verified. The maintenance plan is developed to promote long-term success of the planting. These planting plan components are described below.

5.4.1 Planting Zones

The restoration drawings provide a delineation of the designed planting zones.

Zone LEV

The LEV vegetation zone covers the higher ground and mimics the Coastal Plain Brownwater Levee community.

Zone BMT

The BMT vegetation zone covers floodplain areas exposed to seasonal flooding and mimics the Coastal Plain Brownwater Bottomland community.

Zone SWP

The SWP vegetation zone covers floodplain areas exposed to seasonal flooding with extended periods of ponding and mimics the Coastal Plain Brownwater Swamp community.

5.4.2 Plant List

The plant list is provided in **Restoration Table IV – Designed Vegetative Communities**. The plant list is based on recommendations from the North Carolina Stream Restoration Institute (Hall, Karen 2001)and the North Carolina Ecosystem Enhancement Program (Smith, Cherri L. 2004). The list favors heavy mast species with a lesser number of pioneer (light-seeded) species. The heavy mast species would take longer to establish while the pioneer species will likely establish due to available adjacent seed sources and optimal bed conditions.

5.4.3 Plant Sources

The planting plan utilizes two sources of plants. Nursery stock will be tied directly to the initial planting and will be utilized in numbers to support permit guidelines. Recruitment will be factored into the selection of species in the plant list. The plant list includes a significant portion of species not likely to establish from natural propagation.

Nursery Stock

The planting plan may utilize any of the following nursery stock forms of woody species: bare roots, containerized seedlings, and ball and burlap. Additionally, the planting plan also may use sod or seeds from commercial sources. For the woody forms of vegetation, the planting plan prescribes that they are grown locally under environmental conditions similar to the target environment.

Recruitment

With the improvements to existing hydrology and soil conditions, the design anticipates that the restoration sites will be populated with species from adjacent communities. Flooding events from Swift Creek should carry additional seed from upstream sites. The restoration sites will be maintained to keep nuisance species to less than 15% and invasive species to less than 10% of the total population.

5.4.4 Plant Care and Installation

The plantings will be cared for and installed based on guidelines provided in the construction document to be generated after permit approval. When planted properly, bare root seedlings are the most cost-effective and successful plant material. Containerized plantings, live stakes, and other plant materials will be used based on the needs of the planting zone (e.g. immediate shading). Tree shelters will guard larger unprotected trees against herbivory and inhibit occupation by beavers. The tree shelters also should accelerate growth.

5.4.5 Schedule

The planting will be scheduled between wetland construction activities and the growing season. Special attention will be paid to stabilizing disturbed areas. The final vegetation planting will occur after proper site preparation (described below and in Section 5.4.7) during the appropriate season.

Planting should occur from late winter to early spring (February 14 to April 15), after construction to minimize or eliminate threats from the construction, exotic vegetation treatment, unpredictable weather, and beaver activity. Any treatment of problem areas should also occur between later winter and early spring.

5.4.6 Stabilization

Immediately after construction, the contractor will seed all disturbed areas with permanent and temporary seed mixes. Permanent seeding will be completed in conjunction with construction, with temporary seeding applied per Land Quality Section requirements.

5.4.7 Site Preparation

Invasive and nuisance species will likely require control. Numerous Loblolly Pines, a nuisance species, exist adjacent to the site and will likely provide available seed that can colonize the site unless flooding conditions on the site overtop the pine seedlings for prolonged periods during the growing season. The Pines should be controlled for the first five years to allow for the hardwood component of the stand to become established.

The planting area should be ripped to relieve any compaction from hoof shear as well as construction traffic. The site will likely be colonized by dog fennel the first couple of years which will reduce the likelihood of Canada geese using the site.

Prior to planting the riparian buffer and wetland areas, the design calls for efforts to eradicate fescue and invasive plants such as *Rosa multiflora* (Multiflora Rose), *Ligustrum sineses* (Chinese Privet), and *Lonicera japonica* (Japanese Honeysuckle). These efforts should include herbicide use during the spring and a follow-up spraying in early fall to eliminate any fescue that was not killed in the spring. A permanent seed mix can be used after application of the pre-emergent. Woody planting can follow during the dormant season.

5.4.8 Planting Review

After the final planting is complete, the planting supervisor will verify that the site was planted properly though inspection of stem counts and condition. The planting contractor will be responsible for replacing damaged plantings.

5.4.9 Monitoring and Maintenance

Monitoring will verify that the restoration area is meeting restoration goals. Damaged plantings will be removed and replanting will occur if the planting survival rate fails to meet restoration goals. If monitoring indicates that an area is trending towards greater than 15% coverage by nuisance vegetation or greater than 10% coverage of invasives, that area will be treated to remove the nuisance and/or invasive vegetation.

6.0 Performance Criteria

6.1 Wetland Success Criteria

The success of wetland restoration will be measured by comparison of the restored wetlands with similar, more functional wetlands with respect to vegetation, soils, and hydrology. Success criteria are summarized in the following sections.

6.1.1 Hydrology

Success of the restoration of wetland hydrology will be measured by improvements to the frequency and duration of saturated soils compared to the reference wetlands. For years 1 through 3, successful wetland hydrology is defined as saturation of soils for a period equal to or greater than 50% of the period measured in the reference wetlands. For year 4 and beyond until success criteria is met, successful wetland hydrology is defined as saturation of soils for a period equal to or greater than 80% of the period measured in the reference wetlands. The hydroperiod of the reference and site wetlands will be measured using groundwater gauges set to measure a 40 inch vertical column below the ground surface.

6.1.2 Vegetation

The prevalent vegetation should consist of macrophytes that typically are adapted for life in saturated soil conditions. These species should have the ability to grow, compete, reproduce, and persist in anaerobic soil conditions. Study plots showing that the composition and density of vegetation in the restoration areas compare favorably to the reference areas will indicate restoration success for vegetation. The measure of success for wetland vegetation will follow criteria used to measure riparian vegetation success described in section 6.2.

6.1.3 Soil

A primary measure of the enhancement and restoration of wetlands soils will be the establishment of hydric character as defined by USACE guidelines (United States Army Corps of Engineers 1987). Soil enhancement and restoration also may be inferred based on successful restoration of wetland hydrology and vegetation.

6.2 Vegetation Success Criteria

Vegetation success will measure the likelihood of the reforested stands developing into target communities. Stands that show progression towards a target species composition and overall abundance will be considered successful. The target composition will be the measure of reproductively viable populations of target species within the stand. A majority (85%) of the targeted species should be present in the reforestation area in numbers and condition conducive to continuing the species through the maturation of the community. Targeted species are determined based on those species found in reference communities for a particular planting zone. The population of nuisance species such as Loblolly Pine should be kept below 15% of the total population. Invasive species should constitute no more than 10% of the total population. Abundance

as measured by the total population of species within the reforested area should meet USACE guidelines for wetland mitigation.

Monitoring for the progress of vegetation restoration will follow protocol developed by the Carolina Vegetation Survey (CVS) Level 1 and 2 inventory plots. Level 1 maps and tracks the health of planted stems. Level 2 counts by size groups all woody stems including recruits. Modules, the standard area of inventory, have dimensions of 10 meters by 10 meters. The modules will be placed throughout the restoration area to produce representative samples with preference given to locations proximate to groundwater gauges. The total area inventoried by the modules will be based on the EEP spreadsheet "Computation of Minimum Number of Required Plot for EEP Projects". Based on the spreadsheet, 26 plots or approximately 1.3% of the total restoration area will be sampled. Permanent photo points will be set up for each quadrant.

Community composition and abundance will be tracked through plots measuring survival of planted and recruited stems. Survivability will be based on 320 stems per acre after three years and 260 stems per acre after five years.

6.3 Schedule / Reporting

The monitoring plan to evaluate the success of the stream restoration project is based on guidance provided by EEP. The collection and summarization of monitoring data will be conducted in accordance with the most current version of the EEP documents entitled "Content, Format, and Data Requirements for EEP Monitoring Reports".

Upon completion of the restoration project, an as-built assessment will be conducted that documents the following conditions:

- Wetland hydrology (gauge settings)
- Vegetation (wetland and riparian)

Wetland hydrology will be measured using groundwater gauges installed on-site and within the reference sites. The gauges will sample groundwater elevations on a daily basis throughout the monitoring period. The gauges will be downloaded on a bimonthly basis during the growing season.

Initial vegetation sampling will occur within 60 days of the plantings. The Year 1 monitoring will occur during September with subsequent year's samplings occurring between June 1 and October 31.

The monitoring will occur annually following construction for five years or until success criteria are met, whichever comes last.

7.0 References

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Schafale, Mike (2002). Fourth Approximation Guide to North Carolina Natural Communities - Coastal Plain.

Smith, Cherri L. (2004). Guidelines for Riparian Buffer Restoration. Raleigh, NC, North Carolina Department of Environmental and Natural Resources - Ecosystem Enhancement Program.

United States Army Corps of Engineers (1987). Corps of Engineers Wetlands Delineation Manual. Waterways Experiment Station, Environmental Laboratory.

8.0 Restoration Tables

Table I. Project Restoration Structure and Objectives							
Project Number 060673501 (Moore Property Wetland Restoration)							
Restoration Segment Reach ID	**Restoration Type**	**Priority Approach**	**Existing Linear Feet (lf) or Acreage (ac)**		**Designed Linear Feet (lf) or Acreage (ac)**		**Comment**
RPN	Buffer Restoration	N/A	5.0	ac	5.0	ac	Reforestation of buffer along Swift Creek
WED	Riparian Wetland Restoration	N/A	10.4	ac	10.4	ac	
TOM	Riparian Wetland Restoration	N/A	39.8	ac	39.8	ac	

Table II. Drainage Areas		
Project Number 060673501 (Moore Property Wetland Restoration)		
Tract	**Drainage Area (acres)**	**Drainage Area (mi^2)**
TOM	151.0	0.2
WED	20.0	0.03
Swift Creek at Top of Project	92,908.0	145.2

Table III. Land Use of Watershed			
Project Number 060673501 (Moore Property Wetland Restoration)			
Land Use	**Past 1980[1]**	**Present 2001[2]**	**Future 2010[3]**
Developed	0%	0%	0%
Agriculture	59%	70%	70%
Forested	41%	26%	26%
Grassland	0%	0%	0%
Wetland	0%	<1%	<1%
Open Water	0%	3%	3%

[1] Analysis based on review of 1980 Orthophoto

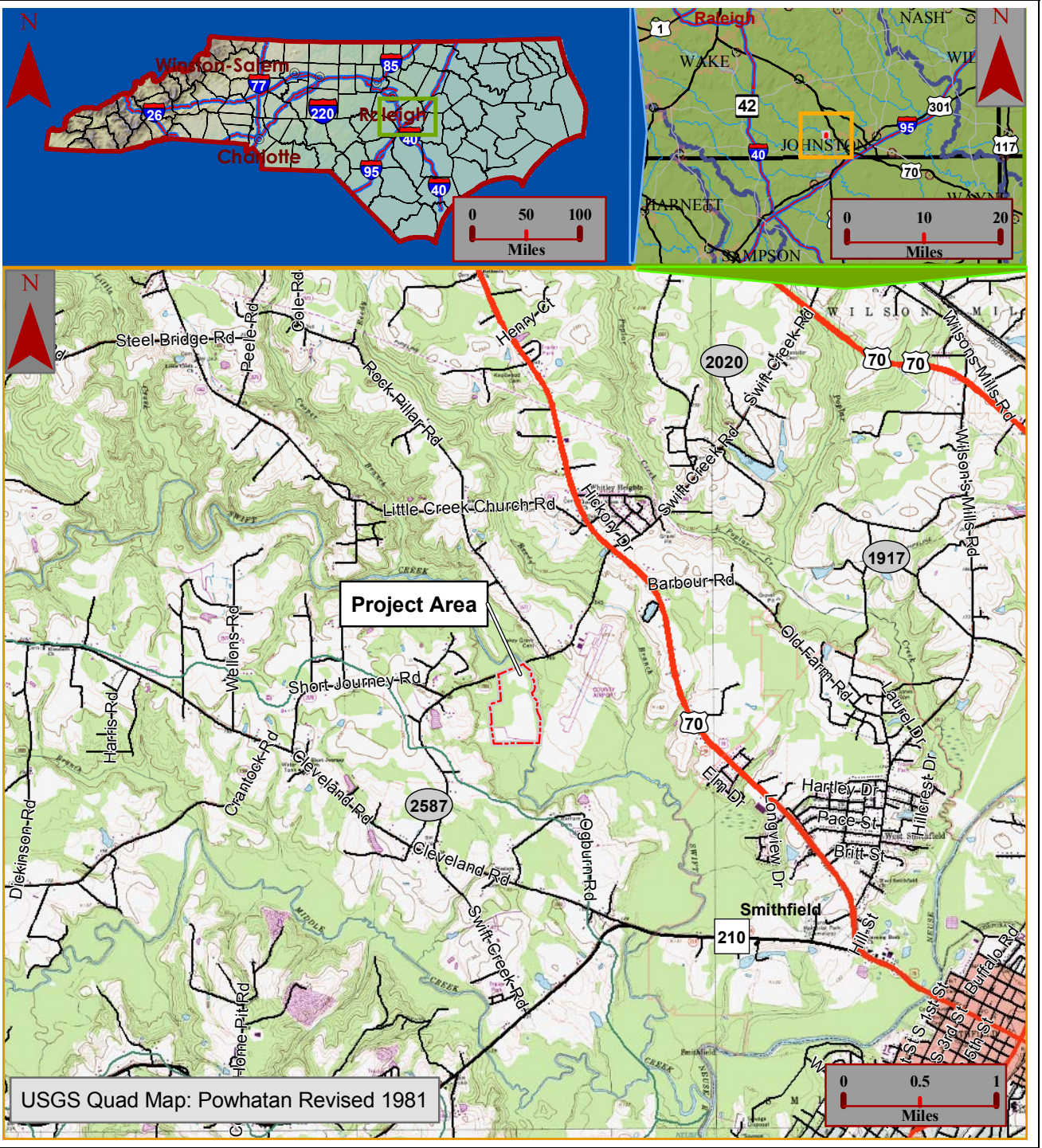
[2] Analysis based on Johnston County Landuse GIS data

[3] Analyis based on Johnston County Zoning GIS data

Table IV. Design Vegetative Communities Project Number 060673501 (Moore Property Wetland Restoration)																	
Scientific Name		**Common Name**	**X - Remove; R - Recruitment; B - Bare Root; C- Container**														
Genus	**Species**		**Coastal Plain Brownwater Levee Forest**				**Coastal Plain Brownwater Bottomland Hardwood**				**Coastal Plain Cypress-Gum Swamp (Brownwater Subtype)**						
Canopy			***LEV***				***BMT***				***SWP***						
Acer	*rubrum*	Red maple		R				R				R					
Betula	*nigra*	River Birch		R	B												
Carya	*aquatica*	Water Hickory							B				B				
Carya	*cordiformis*	Bitternut Hickory						R	B								
Carya	*ovata*	Shagbark Hickory							B								
Fraxinus	*pennsylvanica*	Green Ash		R	B												
Juglans	*nigra*	Black Walnut							B								
Liquidambar	*styraciflua*	Sweetgum		R				R									
Liriodendron	*tulipifera*	Yellow Poplar		R													
Nyssa	*aquatica*	Water Tupelo							B				B				
Nyssa	*biflora*	Swamp blackgum										R	B				
Pinus	*taeda*	Loblolly Pine	X				X				X						
Plantanus	*occidentalis*	Sycamore			B												
Populus	*deltoides*	Eastern Cottonwood			B												
Populus	*heterophylla*	Swamp Cottonwood											B				
Quercus	*laurifolia*	Laurel Oak							B	C			B	C			
Quercus	*lyrata*	Overcup Oak							B	C			B	C			
Quercus	*michauxii*	Swamp Chesnut Oak							B	C							
Quercus	*nigra*	Water Oak						R	B	C							
Quercus	*pagoda*	Cherrybark Oak							B	C							
Quercus	*phellos*	Willow Oak						R	B	C							
Quercus	*shumardii*	Shumard Oak							B	C							
Taxodium	*distichum*	Bald-Cypress											B				
Ulmus	*americana*	American Elm			B				B								
Understory																	
Acer	*negundo*	Box Elder		R													
Aesculus	*sylvatica*	Painted Buckeye			B												
Asimina	*triloba*	Pawpaw			B				B								
Carpinus	*caroliniana*	Ironwood		R	B			R	B								
Celtis	*laevigata*	Hackberry		R	B			R	B								
Cephalanthus	*occidentalis*	Buttonbush											B	C			
Crataegus	*sp.*	Hawthorn						R	B								
Diospyros	*virginiana*	Persimmon						R	B								
Ilex	*decidua*	Possumhaw							B								
Ilex	*opaca*	American Holly							B								
Ligustrum	*sinense*	Chinese Privet	X				X				X						
Lindera	*benzoin*	Spicebush			B												

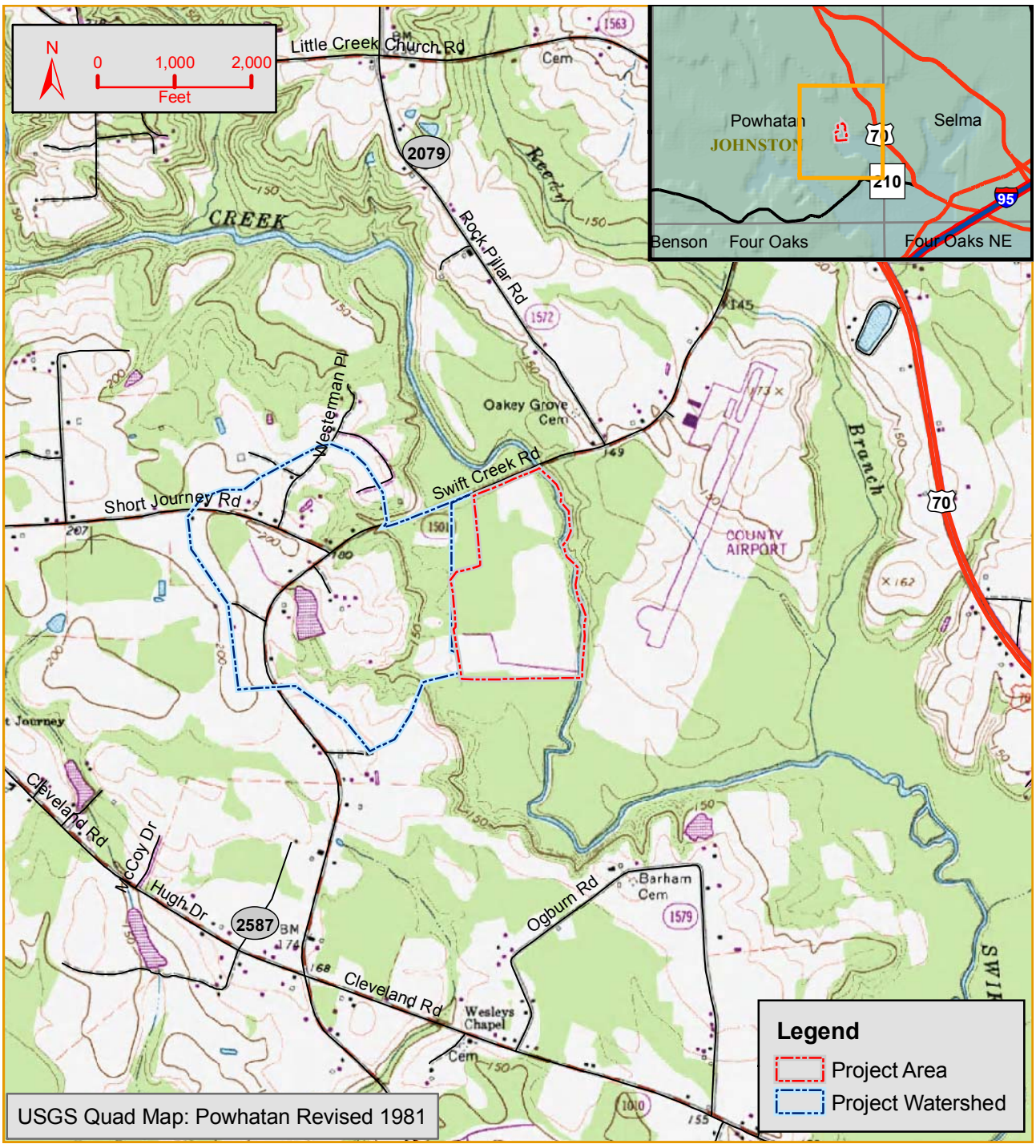
9.0 Figures

Figure 1



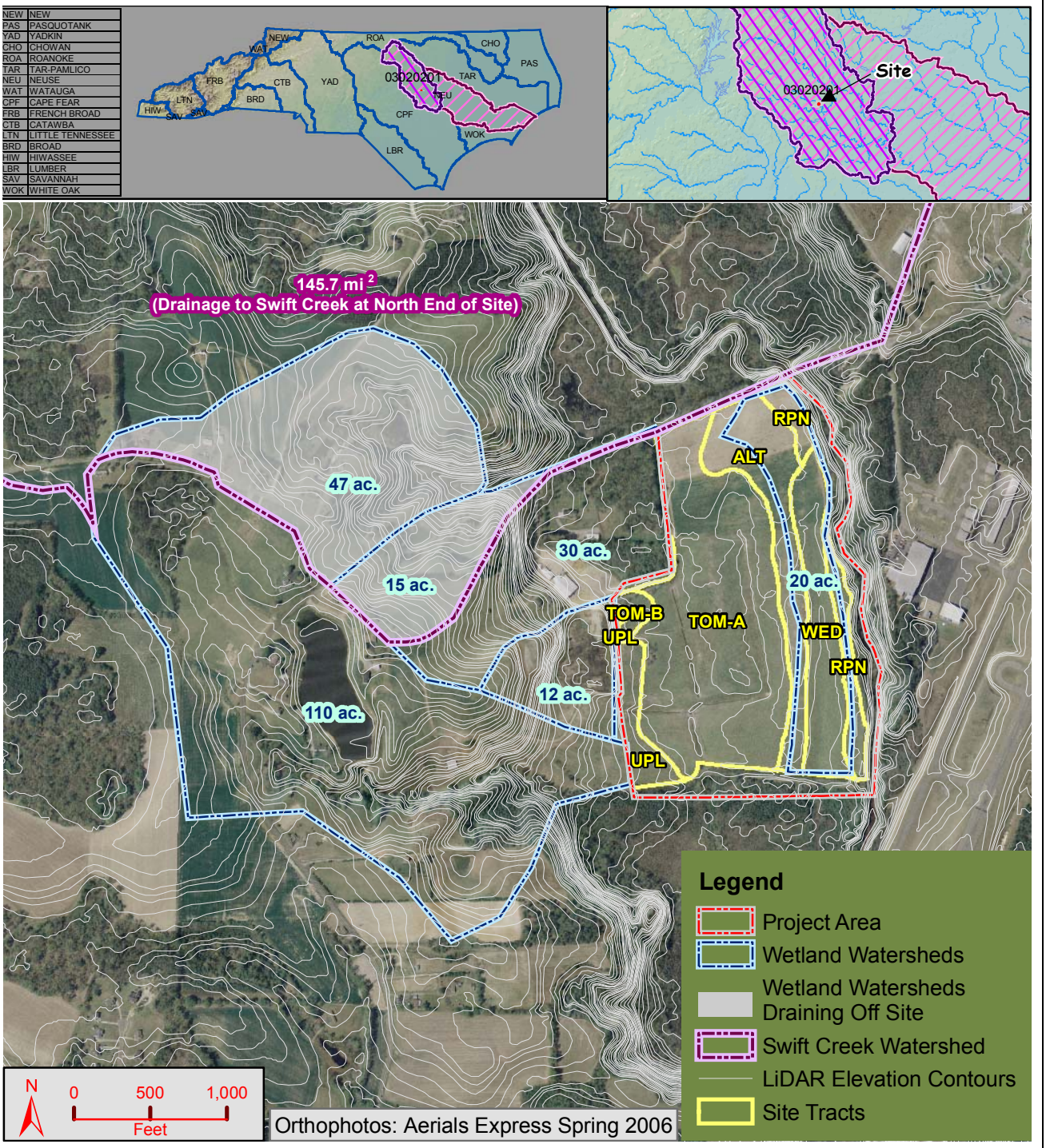
Title	**Project Site Vicinity Map**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 2



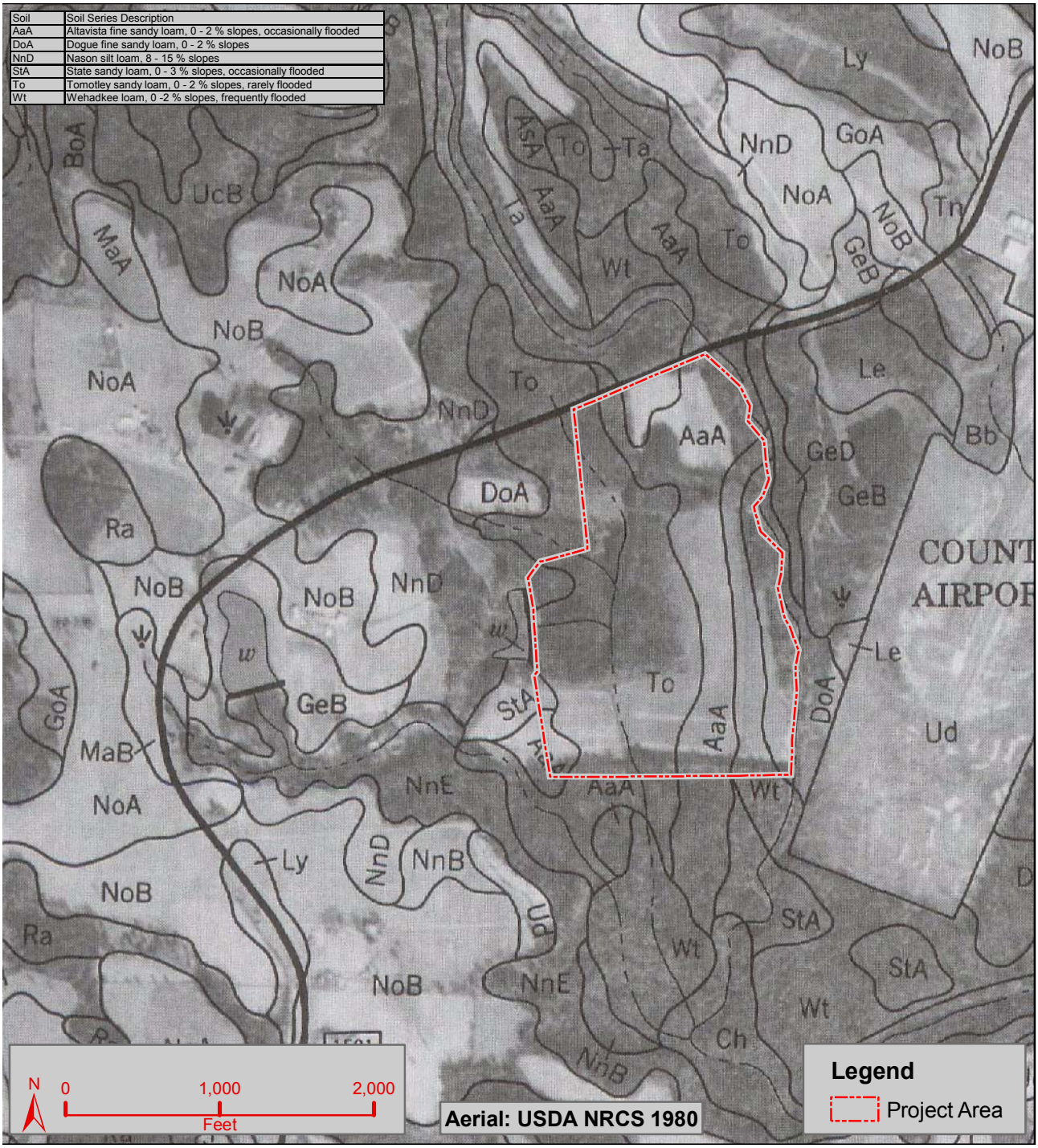
Title	**Project Site Location**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 3



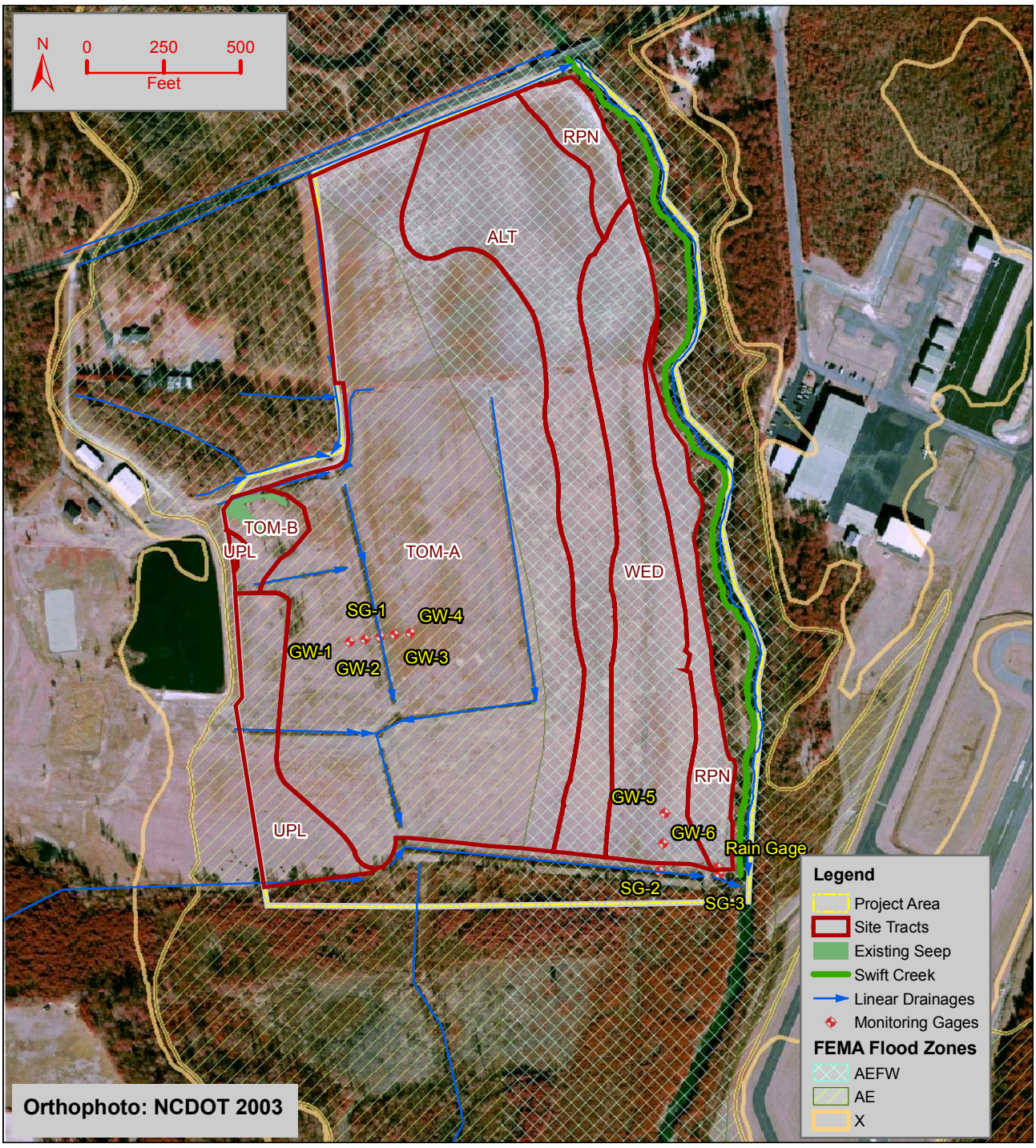
Title	**Project Site Watershed Map**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 4



Title	**Project Site NRCS Soil Survey Map (1980)**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 5

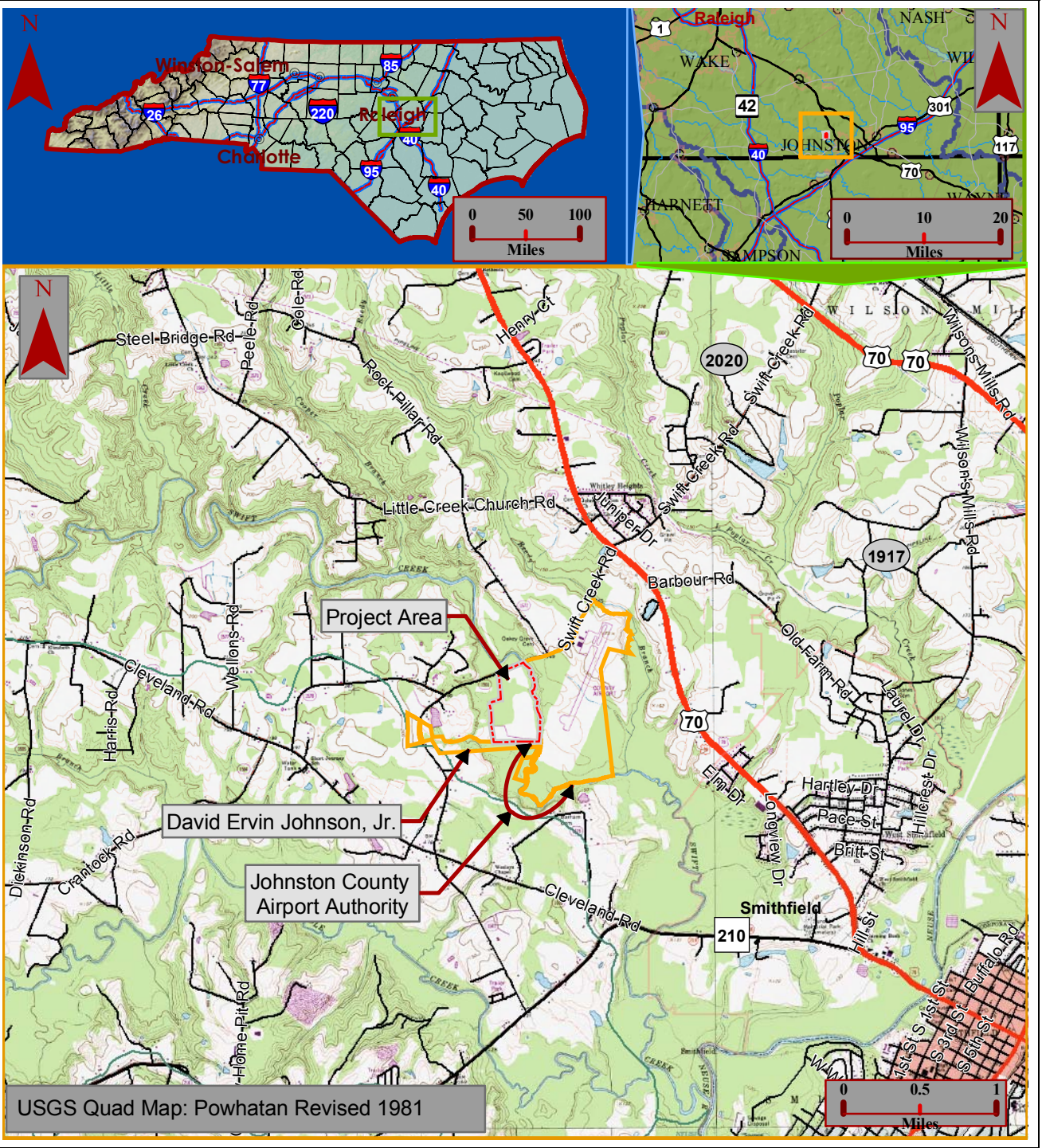


Title	**Project Site Hydrologic Features Map with Gauge Locations**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 6

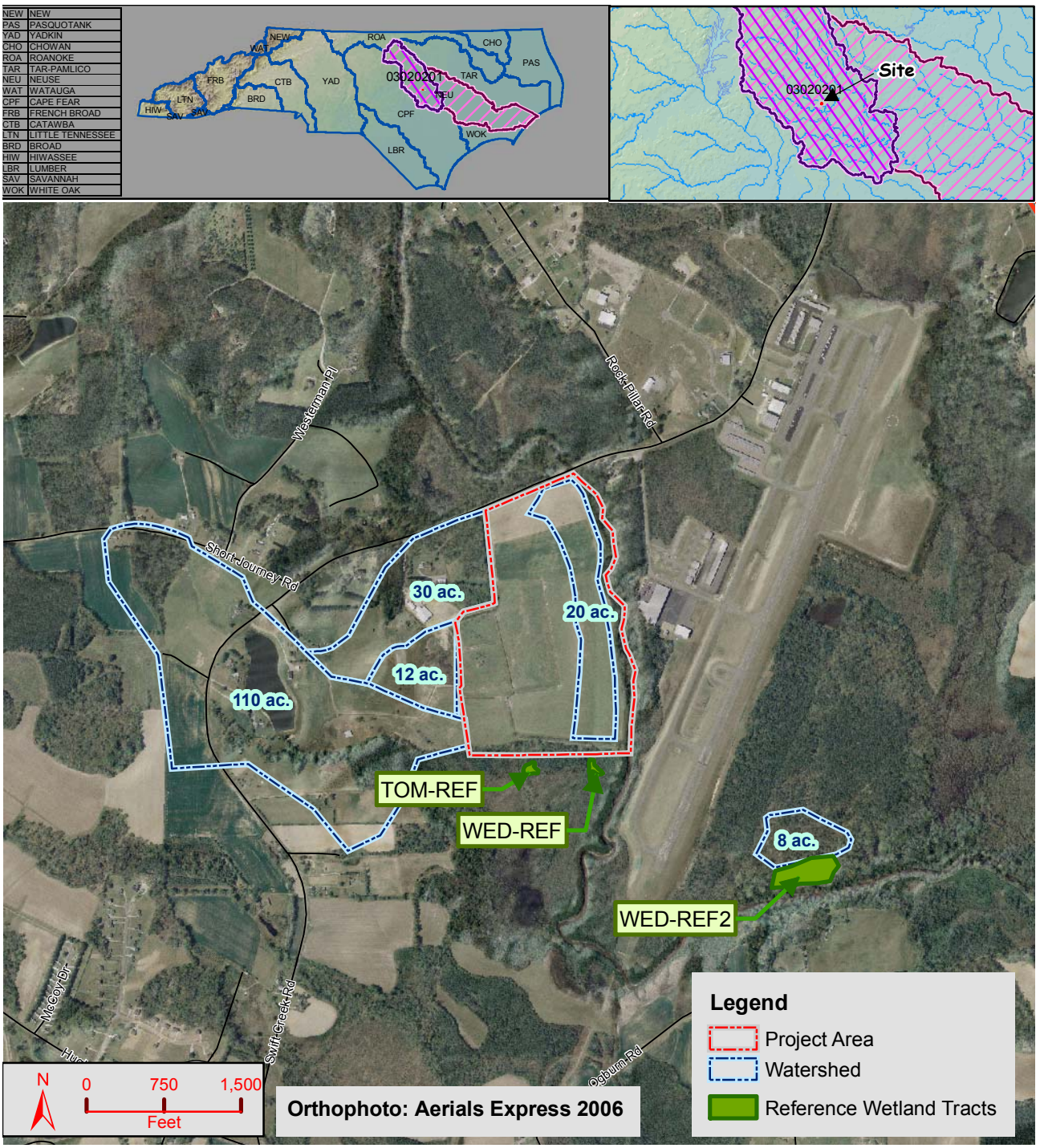
Title	**Site Wetland Delineation Map**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 7



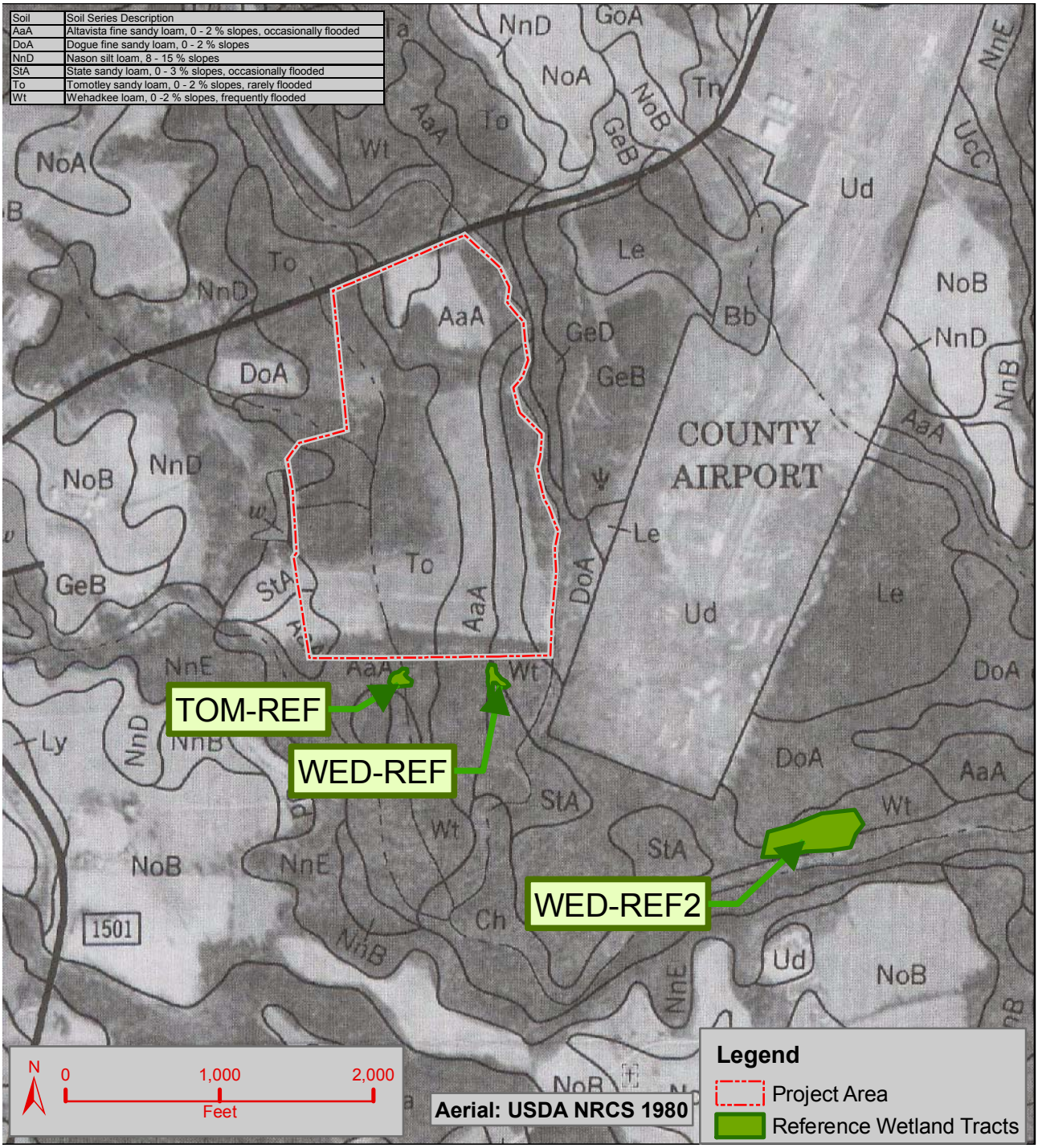
Title	**Reference Site Vicinity Map**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 8



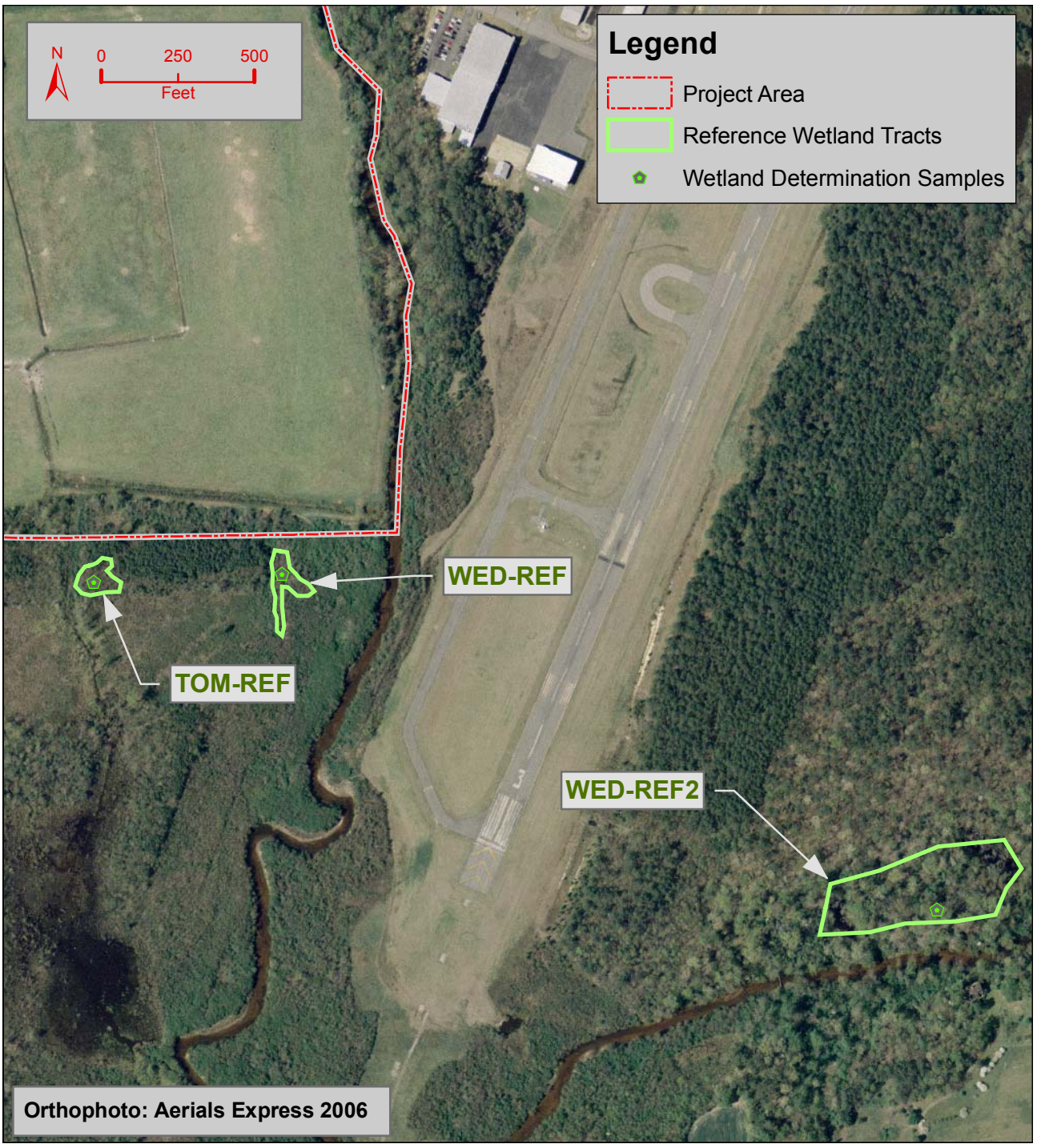
Title	**Reference Site Watershed Map**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 9



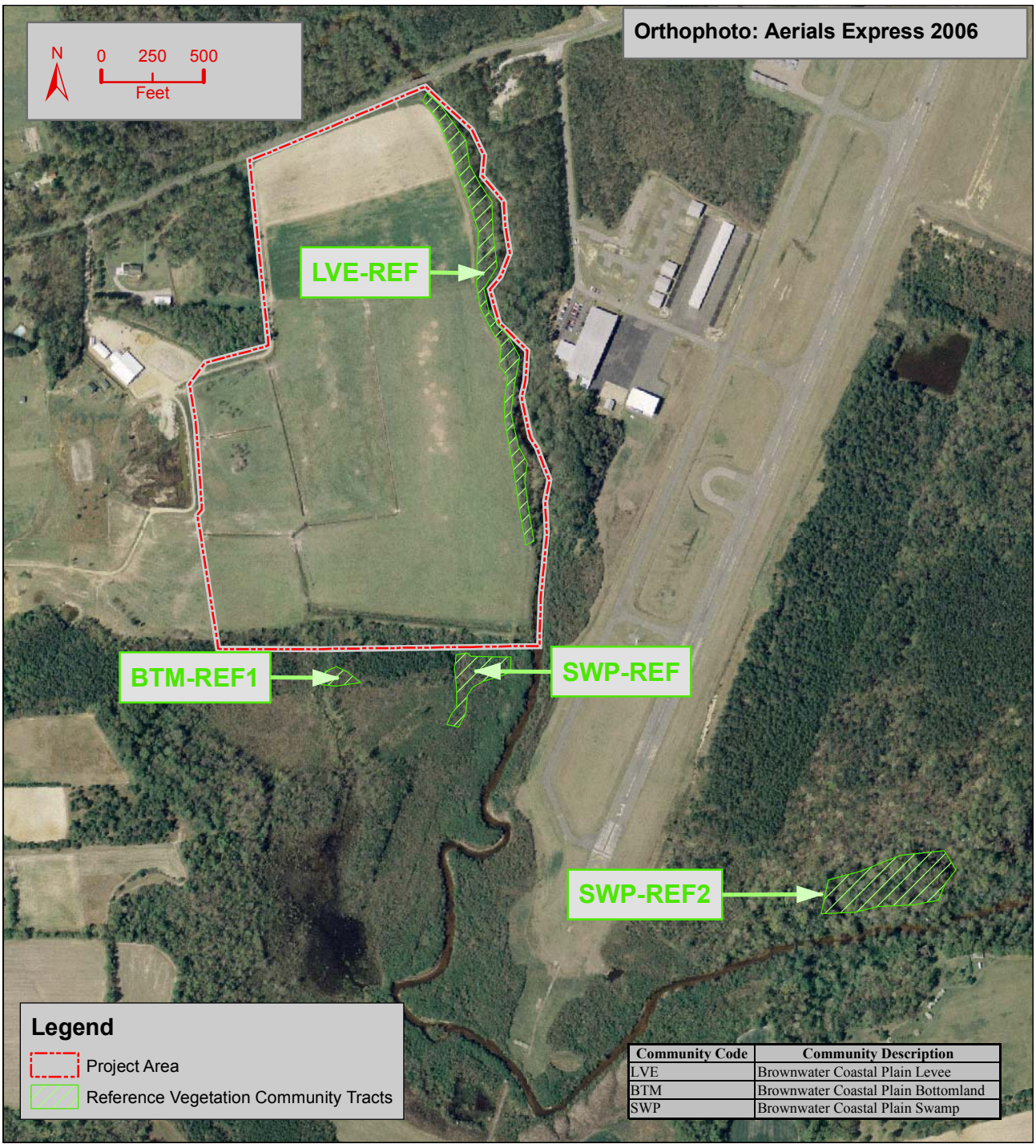
Title	**Reference Site NRCS Soil Survey Map (1980)**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 10



Title	**Reference Site Wetland Determination Sample Locations**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

Figure 11



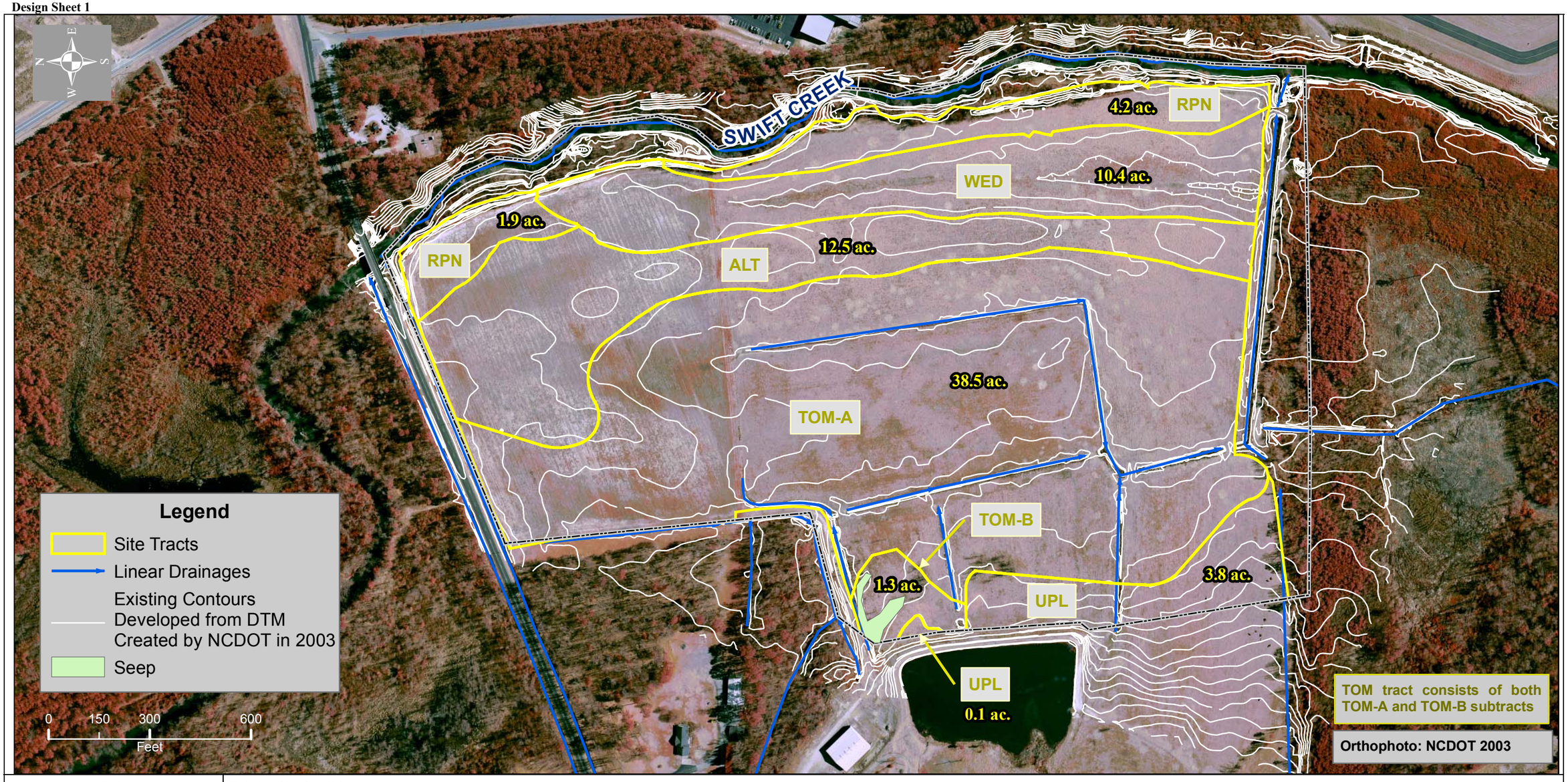
Title	**Reference Site Vegetative Communities Map**		
Prepared For	**Project**	Final Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	8/17/2007	SCO# 060673501 KHA# 011795023	

10.0 Design Sheets

Sheet 1

Existing Site Conditions

Design Sheet 1



Title	**Existing Site Conditions**		
Prepared For	**Project**	Wetland Restoration Plan for Moore Property Johnston County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	5/25/2007	SCO# 060673501 KHA# 011795023	

Sheet 2

Design Site Conditions
See Attached Restoration Drawings

Sheet 3

Design Vegetative Communities Map
See Attached Restoration Drawings

11.0 Appendices

Appendix 1

Project Site Photographs

Photo Page 1

Photo 1: Site overview looking north toward WED tract (11/17/06 – Typical)

Photo 2: Site overview looking northwest toward WED tract (11/17/06 – Typical)

Prepared For	Project		Prepared By
Ecosystem Enhancement Program	**Project**	Wetland Restoration Plan for Moore Property (SCO ID: 060673501) Johnston County, North Carolina	Kimley-Horn and Associates, Inc.

Photo 3: Site overview looking west toward WED tract (11/17/06 – Typical)

Photo 4: Standing water at southern end of WED tract (11/17/06 – Typical)

Prepared For	Project		Prepared By
Ecosystem Enhancement Program	**Project**	Wetland Restoration Plan for Moore Property (SCO ID: 060673501) Johnston County, North Carolina	Kimley-Horn and Associates, Inc.

Photo 5: Southern section of TOM-A tract (11/17/06 – Typical)

Photo 6: Seep section of TOM tract (11/17/06 – Typical)

Prepared For	Project		Prepared By
Ecosystem Enhancement Program		Wetland Restoration Plan for Moore Property (SCO ID: 060673501) Johnston County, North Carolina	Kimley-Horn and Associates, Inc.

Photo 7: Road side ditch flowing to north section of TOM-A tract (10/18/04 – Typical)

Photo 8: Site ditch flowing from middle section to southern section of TOM-A tract (9/17/2002 – Typical)

Prepared For	Project		Prepared By
Ecosystem Enhancement Program	**Project**	Wetland Restoration Plan for Moore Property (SCO ID: 060673501) Johnston County, North Carolina	Kimley-Horn and Associates, Inc.

Photo 9: Site ditch flowing from section of TOM-A tract to lateral ditch (11/17/06 – Typical)

Photo 10: Lateral ditch at southern end of site flowing to Swift Creek (10/18/04 – Typical)

Photo 11: Swift Creek below lateral ditch (10/18/04 – Typical)

Appendix 2

Reference Site Photographs

Photo Page 1

Photo 1: Soil sample of TOM-REF tract (2/7/07 – Typical)

Photo 2: View of vegetation and standing water in TOM-REF tract (2/7/07 – Typical)

Prepared For	Project		Prepared By
Ecosystem Enhancement Program		Wetland Restoration Plan for Moore Property (SCO ID: 060673501) Johnston County, North Carolina	Kimley-Horn and Associates, Inc.

Photo 3: Soil sample of WED-REF tract (2/7/07 – Typical)

Photo 4: View of vegetation and standing water in WED-REF tract (2/7/07 – Typical)

Prepared For	Project		Prepared By
Ecosystem Enhancement Program	**Project**	Wetland Restoration Plan for Moore Property (SCO ID: 060673501) Johnston County, North Carolina	Kimley-Horn and Associates, Inc.

Photo 5: Vegetation of SWP-REF2 reference community (7/20/07 - Typical)

Photo 6: Vegetation of LVE reference community along stream banks (10/17/02)

Prepared For	Project		Prepared By
Ecosystem Enhancement Program	**Project**	Wetland Restoration Plan for Moore Property (SCO ID: 060673501) Johnston County, North Carolina	Kimley-Horn and Associates, Inc.

Appendix 3

Reference Site USACE Routine Wetland Determination Data Forms

DATA FORM

ROUTINE WETLAND DETERMINATION
1987 COE Wetlands Delineation Manual

Project/Site:	Moore Property	**Date:**	2/8/2007
Applicant/Owner:	NC-EEP	**County:**	Johnston
Investigator:	Andrew Kiley; Laura Lang	**State:**	North Carolina
Do Normal Circumstances exist on this site?	Y	**Community ID:**	
Is the site significantly disturbed (Atypical Situation?)	N	**Transect ID:**	
Is the area a potential Problem Area?	N	**Plot ID:**	TOM-REF

Vegetation

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Quercus phellos*		FACW-	9.		
2. *Betula nigra*		FACW	10.		
3. *Quercus michauxii*		FACW-	11.		
4. *Acer rubrum*		FAC	12.		
5. *Liquidambar styraciflua*		FAC+	13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FACU): 90%

Remarks:

Hydrology:

RECORDED DATA:

- [ ] Stream, Lake, or Tide Gauge
- [ ] Aerial Photographs
- [ ] Other
- [x] No Recorded Data Available

PRIMARY INDICATORS:

- [x] Inundated
- [x] Saturated in Upper 12 inches
- [x] Water Marks
- [ ] Drift Lines
- [ ] Sediment Deposits
- [ ] Drainage Patterns in Wetlands

FIELD OBSERVATIONS:

Depth to Surface Water:	0	(in)
Depth to Free Water in Pit:	na	(in)
Depth to Saturated Soil:	0	(in)

SECONDARY INDICATORS:

- [x] Oxidized Root Channels in Upper 12 inches
- [ ] Water Stained Leaves
- [ ] Local Soil Survey Data
- [x] Fac-Neutral Test
- [ ] Other

WETLAND HYDROLOGY INDICATORS:

SOILS

Map Unit Name
(Series and Phrase): Tomotley

Drainage Class: Poorly drained

Taxonomy (Subgroup): Typic Endoaquults

Field Observations
Confirm Mapped Type? (Y/N)

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-16	B	7.5YR 6/1	7.5 YR 6/6	10%	Clay loam

HYDRIC SOIL INDICATORS

- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Aquic Moisture Regime
- [x] Reducing Conditions
- [x] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic Streaking in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [x] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (Explain in remarks)

Hydric Soil Present? (Y/N) Y

Remarks:

WETLAND DETERMINATION (Y/N)

Hydrophytic Vegetation Present? Y
Wetland Hydrology Present? Y
Hydric Soils Present? Y
Is this sampling point a Wetland? Y

Remarks:

DATA FORM

ROUTINE WETLAND DETERMINATION
1987 COE Wetlands Delineation Manual

Project/Site:	Moore Property	**Date:**	2/8/2007
Applicant/Owner:	NC-EEP	**County:**	Johnston
Investigator:	Andrew Kiley; Laura Lang	**State:**	North Carolina
Do Normal Circumstances exist on this site?	Y	**Community ID:**	
Is the site significantly disturbed (Atypical Situation?)	N	**Transect ID:**	
Is the area a potential Problem Area?	N	**Plot ID:**	WED-REF

Vegetation

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Platanus occidentalis*		FACW-	9.		
2. *Betula nigra*		FACW	10.		
3. *Ligustrum sinense*		FAC	11.		
4. *Acer rubrum*		FAC	12.		
5. *Liquidambar styraciflua*		FAC+	13.		
6. *Ulmus americana*		FACW	14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FACU): 80%

Remarks:

Hydrology:

RECORDED DATA:

- [ ] Stream, Lake, or Tide Gauge
- [ ] Aerial Photographs
- [ ] Other
- [x] No Recorded Data Available

PRIMARY INDICATORS:

- [x] Inundated
- [x] Saturated in Upper 12 inches
- [x] Water Marks
- [ ] Drift Lines
- [ ] Sediment Deposits
- [ ] Drainage Patterns in Wetlands

FIELD OBSERVATIONS:

Depth to Surface Water:	0	(in)
Depth to Free Water in Pit:	na	(in)
Depth to Saturated Soil:	0	(in)

SECONDARY INDICATORS:

- [x] Oxidized Root Channels in Upper 12 inches
- [ ] Water Stained Leaves
- [ ] Local Soil Survey Data
- [x] Fac-Neutral Test
- [ ] Other

WETLAND HYDROLOGY INDICATORS:

SOILS

Map Unit Name
(Series and Phrase): Wehadkee

Drainage Class: Poorly drained

Taxonomy (Subgroup): Typic Fluvaquents

Field Observations
Confirm Mapped Type? (Y/N)

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12	B	7.5YR 7/1	7.5 YR 7/6	15%	Clay loam

HYDRIC SOIL INDICATORS

- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Aquic Moisture Regime
- [x] Reducing Conditions
- [x] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic Streaking in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [x] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (Explain in remarks)

Hydric Soil Present? (Y/N) Y

Remarks:

WETLAND DETERMINATION (Y/N)

Hydrophytic Vegetation Present? Y
Wetland Hydrology Present? Y
Hydric Soils Present? Y
Is this sampling point a Wetland? Y

Remarks:

DATA FORM

ROUTINE WETLAND DETERMINATION
1987 COE Wetlands Delineation Manual

Project/Site:	Moore Property	**Date:**	2/8/2007
Applicant/Owner:	NC-EEP	**County:**	Johnston
Investigator:	Andrew Kiley	**State:**	North Carolina
Do Normal Circumstances exist on this site?	Y	**Community ID:**	
Is the site significantly disturbed (Atypical Situation?)	N	**Transect ID:**	
Is the area a potential Problem Area?	N	**Plot ID:**	WED-REF2

Vegetation

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Taxodium distichum*		OBL	9.		
2. *Fraxinus pennsylvanica*		FACW	10.		
3. *Quercus michauxii*		FACW-	11.		
4. *Nyssa sylvatica*		FAC	12.		
5. *Saururus cernuus*		OBL	13.		
6. *Fraxinus profunda*		OBL	14.		
7. *Acer rubrum*		FAC	15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FACU): 80%

Remarks:

Hydrology:

RECORDED DATA:

- [ ] Stream, Lake, or Tide Gauge
- [ ] Aerial Photographs
- [ ] Other
- [x] No Recorded Data Available

PRIMARY INDICATORS:

- [x] Inundated
- [x] Saturated in Upper 12 inches
- [x] Water Marks
- [ ] Drift Lines
- [ ] Sediment Deposits
- [ ] Drainage Patterns in Wetlands

FIELD OBSERVATIONS:

Depth to Surface Water:	1	(in)
Depth to Free Water in Pit:	na	(in)
Depth to Saturated Soil:	0	(in)

SECONDARY INDICATORS:

- [x] Oxidized Root Channels in Upper 12 inches
- [ ] Water Stained Leaves
- [ ] Local Soil Survey Data
- [x] Fac-Neutral Test
- [ ] Other

WETLAND HYDROLOGY INDICATORS:

SOILS

Map Unit Name
(Series and Phrase): Wehadkee

Drainage Class: Poorly drained

Taxonomy (Subgroup): Typic Fluvaquents

Field Observations
Confirm Mapped Type? (Y/N)

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12	B	7.5YR 7/1	7.5 YR 7/6	15%	Clay loam

HYDRIC SOIL INDICATORS

- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Aquic Moisture Regime
- [x] Reducing Conditions
- [x] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic Streaking in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [x] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (Explain in remarks)

Hydric Soil Present? (Y/N) Y

Remarks:

WETLAND DETERMINATION (Y/N)

Hydrophytic Vegetation Present? Y
Wetland Hydrology Present? Y
Hydric Soils Present? Y
Is this sampling point a Wetland? Y

Remarks:

Appendix 4

Hydrologic Gauge Data Summary, Groundwater and Rainfall Information

Monitoring Gage Serial #				8E851D9	9D900E1	8E574B8	8E83F51	8E52212	8E54CCD	DL8E53B4F	S2EAAF5	S2EAB27
Replacement Gage				8E83662		8E88731				DL89FA705		
Replacement Gage				9BEBD1B					9DE6AE9	9DE6D56		N3C6933F
Monitoring Gage ID				GW-2	SG-1	GW-3	GW-4	GW-5	GW-6	GW-1	SG-2	SG-3
Elev. Top of Casing (ft) *all elevations MSL												
Elev. Ground Surface				123.37	124.11	123.16	123.66	124.65	124.41	123.86	125.89	124.97
Elev. Top of Bank					124.11						125.89	124.97
Approx. Bottom of Ditch					120.61						119	
COE Wetland Det. Hydrology				122.37	123.11	122.16	122.66	123.65	123.41	122.86	124.89	123.97
Depth to Bottom of Well (from top of casing) (ft)												
Growing Season - (March 17 - November 4)												
Date dd-mm-yy	**Time h:mm**	**Date ID**	**Rainfall (inches)**									
1-Jan-04	7:00	37987.29										
2-Jan-04	7:00	37988.29										
3-Jan-04	7:00	37989.29										
4-Jan-04	7:00	37990.29										
5-Jan-04	7:00	37991.29										
6-Jan-04	7:00	37992.29										
7-Jan-04	7:00	37993.29										
8-Jan-04	7:00	37994.29										
9-Jan-04	7:00	37995.29	0.15									
10-Jan-04	7:00	37996.29										
11-Jan-04	7:00	37997.29										
12-Jan-04	7:00	37998.29										
13-Jan-04	7:00	37999.29	0.10									
14-Jan-04	7:00	38000.29										
15-Jan-04	7:00	38001.29						121.23				
16-Jan-04	7:00	38002.29		122.11		122.16	122.60	121.18	120.98			
17-Jan-04	7:00	38003.29		122.04		122.04	122.53	121.19	120.98			
18-Jan-04	7:00	38004.29		122.56		122.47	122.90	121.19	120.99			
19-Jan-04	7:00	38005.29	0.36	123.16		123.02	123.19	121.19	120.99			
20-Jan-04	7:00	38006.29	0.03	123.15		122.62	123.04	121.19	120.98			
21-Jan-04	7:00	38007.29		123.05		122.39	122.94	121.19	120.99			
22-Jan-04	7:00	38008.29		123.01	120.84	122.30	122.94	121.19	120.99			
23-Jan-04	7:00	38009.29	0.09	123.10	120.85	122.24	122.87	121.19	120.99			
24-Jan-04	7:00	38010.29		122.70	120.84	122.15	122.79	121.19	120.99			
25-Jan-04	7:00	38011.29	0.72	122.43	120.82	122.02	122.60	121.19	120.99			
26-Jan-04	7:00	38012.29	0.01	122.30	120.74	121.93	122.54	121.19	120.99			
27-Jan-04	7:00	38013.29		122.30	120.74	121.94	122.59	121.20	120.99			
28-Jan-04	7:00	38014.29	0.67	122.40	120.88	122.18	122.77	121.20	120.99			
29-Jan-04	7:00	38015.29		122.55	120.87	122.64	123.20	121.19	120.99			
30-Jan-04	7:00	38016.29		122.87	120.97	123.09	123.41	121.26	120.99			
31-Jan-04	7:00	38017.29		122.72	120.89	122.83	123.27	121.57	120.99			
1-Feb-04	7:00	38018.29	0.03	122.66	120.80	122.66	123.17	121.63	120.99			
2-Feb-04	7:00	38019.29	0.72	122.61	120.76	122.48	123.02	121.58	120.99			
3-Feb-04	7:00	38020.29		122.74	121.04	122.79	123.36	122.13	121.04			
4-Feb-04	7:00	38021.29		122.85	121.05	123.11	123.34	123.55	122.86			
5-Feb-04	7:00	38022.29	0.03	122.78	120.97	123.01	123.30	123.15	122.67			
6-Feb-04	7:00	38023.29	0.58	122.91	120.95	123.04	123.53	123.07	122.59			
7-Feb-04	7:00	38024.29		123.12	121.38	123.17	123.76	124.46	124.14			
8-Feb-04	7:00	38025.29		122.85	121.03	123.00	123.25	123.82	123.34			
9-Feb-04	7:00	38026.29	0.07	122.80	120.95	122.77	123.26	123.29	122.95			
10-Feb-04	7:00	38027.29	0.50	122.89	120.94	122.97	123.49	123.26	122.85			
11-Feb-04	7:00	38028.29		122.85	120.91	122.83	123.39	123.06	122.72			
12-Feb-04	7:00	38029.29	0.24	122.74	121.14	122.79	123.28	123.82	122.67			
13-Feb-04	7:00	38030.29	0.01	122.93	121.09	123.13	123.44	124.33	123.96			
14-Feb-04	7:00	38031.29	0.02	122.94	120.99	123.13	123.51	123.97	123.51			
15-Feb-04	7:00	38032.29	1.88	122.95	121.12	123.17	123.62	124.45	124.00			
16-Feb-04	7:00	38033.29	0.42	122.95	121.15	123.15	123.36	124.41	124.18			
17-Feb-04	7:00	38034.29		122.94	120.98	123.02	123.43	123.96	123.47			
18-Feb-04	7:00	38035.29		123.03	121.10	123.15	123.55	124.47	124.15			
19-Feb-04	7:00	38036.29	0.10	123.01	120.99	123.04	123.54	124.00	123.50			
20-Feb-04	7:00	38037.29		122.96	120.95	122.93	123.51	123.76	123.20			
21-Feb-04	7:00	38038.29	0.03	122.96	120.93	122.84	123.52	123.62	123.08			
22-Feb-04	7:00	38039.29	0.31	122.79	120.88	122.57	123.04	123.13	122.79			
23-Feb-04	7:00	38040.29	0.40	122.68	120.86	122.34	122.87	122.89	122.64			
24-Feb-04	7:00	38041.29	0.22	122.57	120.88	122.23	122.94	122.84	122.55			
25-Feb-04	7:00	38042.29	0.01	122.49	120.85	122.17	122.87	122.69	122.44			
26-Feb-04	7:00	38043.29	1.37	122.30	120.83	122.01	122.64	122.48	122.29			
27-Feb-04	7:00	38044.29	0.32	122.28	121.34	122.02	122.70	123.61	122.18			
28-Feb-04	7:00	38045.29		122.50	121.07	122.43	123.13	124.29	123.64			
29-Feb-04	7:00	38046.29		122.80	121.09	123.04	123.31	124.34	123.96			
1-Mar-04	7:00	38047.29		122.80	121.01	122.96	123.37	123.99	123.53			
2-Mar-04	7:00	38048.29		122.85	120.99	122.98	123.51	123.83	123.29			
3-Mar-04	7:00	38049.29		122.80	120.95	122.89	123.40	123.58	123.03			
4-Mar-04	7:00	38050.29		122.80	120.93	122.82	123.38	123.34	122.86			
5-Mar-04	7:00	38051.29		122.71	120.91	122.69	123.28	123.13	122.74			
6-Mar-04	7:00	38052.29		122.75	120.91	122.59	123.31	123.06	122.67			

Monitoring Gage Serial #				8E851D9	9D900E1	8E574B8	8E83F51	8E52212	8E54CCD	DL8E53B4F	S2EAAF5	S2EAB27
Replacement Gage				8E83662		8E88731				DL89FA705		
Replacement Gage				9BEBD1B					9DE6AE9	9DE6D56		N3C6933F
Monitoring Gage ID				GW-2	SG-1	GW-3	GW-4	GW-5	GW-6	GW-1	SG-2	SG-3
Elev. Top of Casing (ft) *all elevations MSL												
Elev. Ground Surface				123.37	124.11	123.16	123.66	124.65	124.41	123.86	125.89	124.97
Elev. Top of Bank					124.11						125.89	124.97
Approx. Bottom of Ditch					120.61						119	
COE Wetland Det. Hydrology				122.37	123.11	122.16	122.66	123.65	123.41	122.86	124.89	123.97
Depth to Bottom of Well (from top of casing) (ft)												
Growing Season - (March 17 - November 4)												
7-Mar-04	7:00	38053.29		122.63	120.88	122.43	123.09	122.88	122.56			
8-Mar-04	7:00	38054.29		122.55	120.86	122.31	122.99	122.72	122.45			
9-Mar-04	7:00	38055.29		122.30	120.80	122.08	122.76	122.46	122.28			
10-Mar-04	7:00	38056.29		122.15	120.82	121.92	122.64	122.30	122.13			
11-Mar-04	7:00	38057.29		122.01	120.79	121.81	122.50	122.15	121.98			
12-Mar-04	7:00	38058.29		121.91	120.79	121.75	122.50	122.08	121.88			
13-Mar-04	7:00	38059.29		121.80	120.74	121.69	122.39	121.91	121.76			
14-Mar-04	7:00	38060.29		121.67	120.74	121.62	122.24	121.72	121.64			
15-Mar-04	7:00	38061.29		121.65	120.74	121.59	122.30	121.69	121.56			
16-Mar-04	7:00	38062.29		123.45	121.21	123.20	122.93	124.00	121.78			
17-Mar-04	7:00	38063.29		123.45	121.04	123.20	123.21	123.97	123.14			
18-Mar-04	7:00	38064.29		122.89	120.85	123.14	123.10	123.35	122.82		121.42	
19-Mar-04	7:00	38065.29		123.46	121.02	123.21	123.27	123.91	123.21		121.42	
20-Mar-04	7:00	38066.29		122.80	120.84	122.86	123.14	123.24	122.83		121.42	
21-Mar-04	7:00	38067.29		122.76	120.84	122.93	123.48	123.26	122.78		121.42	
22-Mar-04	7:00	38068.29		122.60	120.77	122.61	123.00	122.74	122.56		121.42	
23-Mar-04	7:00	38069.29		122.35	120.73	122.29	122.77	122.41	122.36		121.42	
24-Mar-04	7:00	38070.29	2.55	122.12	120.72	122.10	122.61	122.25	122.20		121.42	
25-Mar-04	7:00	38071.29	0.01	121.98	120.70	121.99	122.54	122.13	122.04		119.12	
26-Mar-04	7:00	38072.29			120.69		122.49	122.03	121.92		119.32	
27-Mar-04	7:00	38073.29			120.69		122.52	121.96	121.80	122.30	119.32	
28-Mar-04	7:00	38074.29	0.04		120.69		122.54	121.86	121.70	122.30	119.32	
29-Mar-04	7:00	38075.29	0.15		120.68		122.42	121.68	121.59	122.12	119.32	
30-Mar-04	7:00	38076.29	0.02		120.68		122.37	121.59	121.49	122.11	119.32	
31-Mar-04	7:00	38077.29			120.70		122.41	121.55	121.39	122.29	119.32	
1-Apr-04	7:00	38078.29			120.74		122.50	121.52	121.34	122.42	119.32	
2-Apr-04	7:00	38079.29			120.70		122.45	121.37	121.25	122.45	119.32	
3-Apr-04	7:00	38080.29			120.68		122.34	121.36	121.19	122.22	119.32	
4-Apr-04	7:00	38081.29			120.68		122.32	121.36	121.12	122.16	119.32	
5-Apr-04	7:00	38082.29			120.67		122.16	121.35	121.07	121.89	119.32	
6-Apr-04	7:00	38083.29			120.67		122.03	121.33	121.05	121.78	119.32	
7-Apr-04	7:00	38084.29			120.67		122.03	121.32	121.02	121.89	119.32	
8-Apr-04	7:00	38085.29	0.52		120.68		122.08	121.32	121.02	121.95	119.32	
9-Apr-04	7:00	38086.29	0.05		120.67		122.06	121.31	121.01	121.79	119.32	
10-Apr-04	7:00	38087.29	0.29		120.67		121.94	121.30	121.01	121.73	119.32	
11-Apr-04	7:00	38088.29	0.26		120.77		122.49	121.30	121.01	122.11	119.28	
12-Apr-04	7:00	38089.29	0.03		120.72		122.26	121.30	121.01	122.21	119.32	
13-Apr-04	7:00	38090.29			120.84		122.67	121.30	121.01	122.90	119.32	
14-Apr-04	7:00	38091.29			120.82		122.89	121.31	121.01	123.38	119.37	
15-Apr-04	7:00	38092.29			120.74		122.63	121.33	121.01	123.19	119.32	
16-Apr-04	7:00	38093.29			120.69		122.39	121.33	121.01	122.64	119.40	
17-Apr-04	7:00	38094.29			120.68		122.27	121.33	121.01	122.42	119.51	
18-Apr-04	7:00	38095.29			120.68		122.20	121.32	121.01	122.29	119.48	
19-Apr-04	7:00	38096.29			120.68		122.16	121.31	121.01	122.21	119.48	
20-Apr-04	7:00	38097.29	0.01		120.68		122.22	121.31	121.01	122.20	119.57	
21-Apr-04	7:00	38098.29			120.69		122.22	121.30	121.01	122.09	119.59	
22-Apr-04	7:00	38099.29		119.89	120.68	119.67	122.15	121.30	121.01	121.90	119.59	
23-Apr-04	7:00	38100.29		121.58	120.69	121.39	122.10	121.30	121.01	121.82	119.71	
24-Apr-04	7:00	38101.29	0.65	121.50	120.68	121.33	122.07	121.30	121.01	121.74	120.02	
25-Apr-04	7:00	38102.29		121.44	120.68	121.26	121.99	121.29	121.01	121.65	119.93	
26-Apr-04	7:00	38103.29		121.40	120.68	121.21	121.99	121.29	121.01	121.70	119.62	
27-Apr-04	7:00	38104.29		122.65	120.79	121.89	122.43	121.29	121.01	121.89	120.32	
28-Apr-04	7:00	38105.29		121.99	120.71	121.63	122.11	121.29	121.01	121.64	120.35	
29-Apr-04	7:00	38106.29	0.35	121.68	120.71	121.39	121.93	121.29	121.01	121.54	119.62	
30-Apr-04	7:00	38107.29	1.90	121.50	120.73	121.27	121.85	121.29	121.02	121.59	120.02	
1-May-04	7:00	38108.29	0.28	121.42	120.75	121.19	121.87	121.29	121.02	121.64	120.43	
2-May-04	7:00	38109.29		121.80	120.84	121.44	121.99	121.29	121.02	121.79	121.07	
3-May-04	7:00	38110.29		123.54	122.19	123.29	123.57	124.53	124.14	123.48	122.14	
4-May-04	7:00	38111.29		123.46	121.00	123.22	123.53	123.68	123.67	123.59	121.24	
5-May-04	7:00	38112.29		123.38	120.90	122.77	123.19	122.93	123.03	123.21	120.18	
6-May-04	7:00	38113.29		122.90	120.91	122.44	122.83	122.40	122.66	122.78	119.93	
7-May-04	7:00	38114.29		122.60	120.93	122.20	122.58	121.99	122.29	122.50	119.90	
8-May-04	7:00	38115.29		122.35	120.94	121.99	122.47	121.74	121.90	122.32	120.21	
9-May-04	7:00	38116.29		122.15	120.93	121.82	122.37	121.43	121.59	122.19	120.57	
10-May-04	7:00	38117.29	0.11	121.98	120.92	121.69	122.32	121.38	121.31	122.07	120.46	
11-May-04	7:00	38118.29		121.85	120.89	121.56	122.24	121.38	121.09	121.94	120.04	
12-May-04	7:00	38119.29		121.72	120.89	121.46	122.18	121.37	121.03	121.79	120.15	
13-May-04	7:00	38120.29		121.61	120.94	121.38	122.12	121.34	121.03	121.74	120.46	

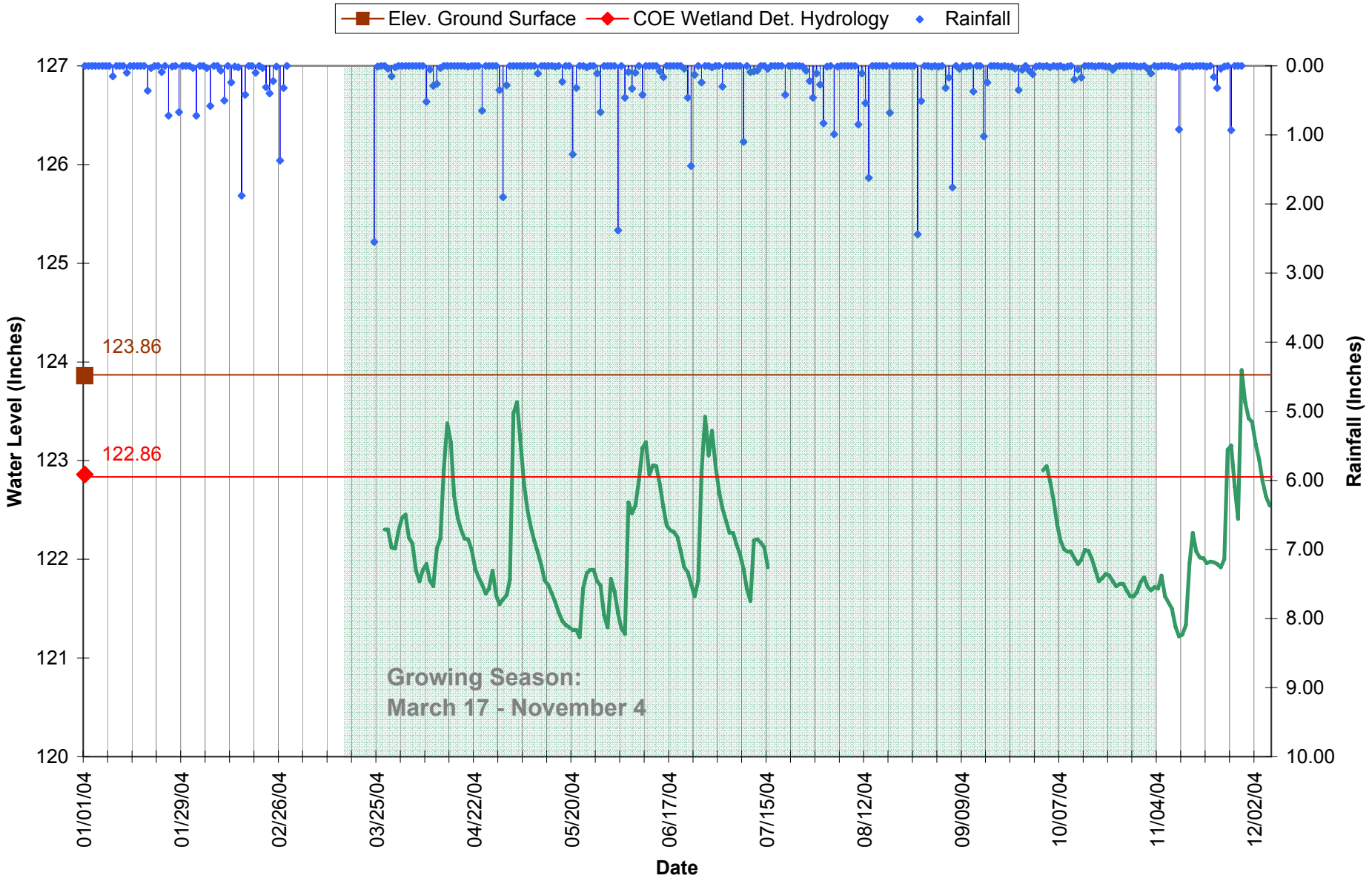
Monitoring Gage Serial #				8E851D9	9D900E1	8E574B8	8E83F51	8E52212	8E54CCD	DL8E53B4F	S2EAAF5	S2EAB27
Replacement Gage				8E83662		8E88731				DL89FA705		
Replacement Gage				9BEBD1B					9DE6AE9	9DE6D56		N3C6933F
Monitoring Gage ID				GW-2	SG-1	GW-3	GW-4	GW-5	GW-6	GW-1	SG-2	SG-3
Elev. Top of Casing (ft) *all elevations MSL												
Elev. Ground Surface				123.37	124.11	123.16	123.66	124.65	124.41	123.86	125.89	124.97
Elev. Top of Bank					124.11						125.89	124.97
Approx. Bottom of Ditch					120.61						119	
COE Wetland Det. Hydrology				122.37	123.11	122.16	122.66	123.65	123.41	122.86	124.89	123.97
Depth to Bottom of Well (from top of casing) (ft)												
Growing Season - (March 17 - November 4)												
14-May-04	7:00	38121.29		121.54	120.97	121.30	122.08	121.33	121.03	121.65	120.54	
15-May-04	7:00	38122.29	0.01	121.47	121.00	121.23	122.03	121.33	121.03	121.57	120.72	
16-May-04	7:00	38123.29		121.40	121.00	121.16	121.96	121.33	121.03	121.46	120.85	
17-May-04	7:00	38124.29	0.23	121.35	121.00	121.12	121.89	121.32	121.03	121.38	120.97	
18-May-04	7:00	38125.29		121.31	121.00	121.08	121.83	121.32	121.03	121.34	120.99	
19-May-04	7:00	38126.29		121.27	121.01	121.07	121.80	121.32	121.03	121.31	121.05	
20-May-04	7:00	38127.29	1.28	121.24	121.06	121.03	121.79	121.32	121.03	121.29	121.13	
21-May-04	7:00	38128.29	0.32	121.20	121.05	121.00	121.75	121.31	121.03	121.29	121.13	
22-May-04	7:00	38129.29		121.16	121.05	121.01	121.72	121.31	121.03	121.21	121.13	
23-May-04	7:00	38130.29		123.40	121.78	122.42	122.52	121.66	121.04	121.71	122.22	
24-May-04	7:00	38131.29	0.02	123.38	121.80	122.26	122.48	121.37	121.04	121.86	122.22	
25-May-04	7:00	38132.29		122.69	121.79	121.95	122.23	121.35	121.04	121.89	122.20	
26-May-04	7:00	38133.29		122.40	121.78	121.72	122.16	121.34	121.04	121.89	122.20	
27-May-04	7:00	38134.29	0.11	122.20	121.75	121.57	122.09	121.33	121.04	121.78	122.20	
28-May-04	7:00	38135.29	0.67	122.05	121.73	121.47	122.07	121.33	121.04	121.74	122.17	
29-May-04	7:00	38136.29		121.90	121.69	121.34	121.96	121.33	121.04	121.44	122.14	
30-May-04	7:00	38137.29		121.76	121.69	121.20	121.84	121.33	121.04	121.31	122.17	
31-May-04	7:00	38138.29		123.00	121.89	122.19	122.26	121.34	121.04	121.80	122.31	
1-Jun-04	7:00	38139.29		122.55	120.74	121.94	122.12	121.33	121.04	121.68	119.34	
2-Jun-04	7:00	38140.29	2.38	122.18	120.69	121.69	121.93	121.33	121.04	121.45	119.32	
3-Jun-04	7:00	38141.29		121.90	120.69	121.51	121.76	121.33	121.04	121.30	119.32	
4-Jun-04	7:00	38142.29	0.46	121.70	120.69	121.38	121.64	121.33	121.04	121.24	119.28	
5-Jun-04	7:00	38143.29	0.09	123.53	121.28	123.14	123.61	121.37	121.54	122.58	121.27	
6-Jun-04	7:00	38144.29	0.33	123.40	121.03	122.60	122.84	121.35	121.44	122.47	119.37	
7-Jun-04	7:00	38145.29	0.10	123.52	121.11	123.09	123.35	121.37	121.35	122.54	119.40	
8-Jun-04	7:00	38146.29		123.50	121.00	122.94	123.34	121.35	121.34	122.80	119.37	
9-Jun-04	7:00	38147.29	0.42	123.55	121.04	123.29	123.53	121.35	121.33	123.13	119.53	
10-Jun-04	7:00	38148.29		123.52	120.98	123.07	123.59	121.34	121.35	123.19	119.65	134.29
11-Jun-04	7:00	38149.29		123.15	120.89	122.77	122.84	121.34	121.28	122.86	119.32	133.32
12-Jun-04	7:00	38150.29		123.50	120.97	122.98	123.59	121.34	121.23	122.95	119.32	131.98
13-Jun-04	7:00	38151.29		123.44	120.92	122.80	122.94	121.34	121.12	122.94	119.32	132.42
14-Jun-04	7:00	38152.29	0.08	122.99	120.89	122.63	122.58	121.34	121.08	122.76	119.32	131.32
15-Jun-04	7:00	38153.29	0.16	122.75	120.81	122.44	122.39	121.34	121.04	122.53	119.28	130.03
16-Jun-04	7:00	38154.29		122.55	120.78	122.27	122.26	121.34	121.04	122.34	119.28	129.83
17-Jun-04	7:00	38155.29		122.38	120.77	122.13	122.19	121.34	121.04	122.29	119.28	129.71
18-Jun-04	7:00	38156.29		122.27	120.79	122.02	122.21	121.34	121.05	122.28	119.28	130.73
19-Jun-04	7:00	38157.29		122.15	120.72	121.89	122.18	121.33	121.04	122.23	119.28	128.42
20-Jun-04	7:00	38158.29		122.05	120.69	121.78	122.12	121.33	121.04	122.09	119.28	128.42
21-Jun-04	7:00	38159.29	0.04	121.91	120.69	121.66	122.03	121.33	121.04	121.92	119.28	
22-Jun-04	7:00	38160.29	0.46	121.81	120.69	121.56	121.98	121.33	121.04	121.87	119.28	128.81
23-Jun-04	7:00	38161.29	1.45	121.73	120.69	121.47	121.93	121.33	121.04	121.75	119.28	127.99
24-Jun-04	7:00	38162.29	0.13	121.66	120.70	121.38	121.84	121.33	121.04	121.63	119.28	128.38
25-Jun-04	7:00	38163.29		122.65	120.76	121.53	122.45	121.34	121.04	121.79	119.32	
26-Jun-04	7:00	38164.29	0.24	123.58	121.11	123.29	123.76	121.54	121.22	122.89	119.32	136.21
27-Jun-04	7:00	38165.29		123.55	120.94		123.69	121.38	121.45	123.44	119.32	136.80
28-Jun-04	7:00	38166.29		123.30	120.93	122.79	123.10	121.38	121.33	123.05	119.28	133.94
29-Jun-04	7:00	38167.29	0.02	123.50	121.04	122.76	123.43	121.36	121.19	123.30	119.32	134.57
30-Jun-04	7:00	38168.29		123.10	120.91	122.62	122.81	121.35	121.12	122.95	119.28	145.61
1-Jul-04	7:00	38169.29		122.90	120.89	122.47	122.54	121.35	121.08	122.69	119.28	138.60
2-Jul-04	7:00	38170.29	0.30	122.73	120.84	122.34	122.39	121.35	121.08	122.52	119.28	134.53
3-Jul-04	7:00	38171.29		122.58	120.80	122.19	122.30	121.35	121.08	122.39	119.28	131.87
4-Jul-04	7:00	38172.29		122.45	120.75	122.05	122.24	121.35	121.07	122.27	119.28	129.95
5-Jul-04	7:00	38173.29		123.00	120.83	122.39	122.45	121.35	121.04	122.27	119.32	
6-Jul-04	7:00	38174.29		122.70	120.74	122.07	122.29	121.34	121.04	122.15	119.28	
7-Jul-04	7:00	38175.29		122.48	120.70	121.92	122.19	121.34	121.04	122.05	119.28	125.92
8-Jul-04	7:00	38176.29	1.10	122.30	120.69	121.78	122.10	121.34	121.04	121.90	119.28	
9-Jul-04	7:00	38177.29		122.11	120.69	121.64	121.98	121.34	121.04	121.70	119.28	
10-Jul-04	7:00	38178.29	0.09	121.93	120.66	121.51	121.84	121.33	121.04	121.58	119.28	
11-Jul-04	7:00	38179.29	0.08	123.57	120.81	122.75	122.96	121.38	121.08	122.19	120.37	136.72
12-Jul-04	7:00	38180.29	0.07	123.11	120.75	122.37	122.49	121.36	121.04	122.20	119.90	131.48
13-Jul-04	7:00	38181.29		122.82	120.76	122.07	122.29	121.35	121.04	122.17	119.98	
14-Jul-04	7:00	38182.29		122.61	120.73	121.87	122.19	121.35	121.04	122.12	120.10	128.97
15-Jul-04	7:00	38183.29	0.04	122.43	120.72	121.69	122.08	121.35	121.04	121.92	120.18	127.72
16-Jul-04	7:00	38184.29			120.70	121.56	121.94	121.34			120.12	127.80
17-Jul-04	7:00	38185.29			120.70	121.44	121.81	121.34			119.84	
18-Jul-04	7:00	38186.29			120.71	121.27	121.74	121.34			119.76	
19-Jul-04	7:00	38187.29			120.74	121.11	121.67	121.34			119.67	
20-Jul-04	7:00	38188.29	0.42		120.74	121.03	121.59	121.34			119.57	

Monitoring Gage Serial #				8E851D9	9D900E1	8E574B8	8E83F51	8E52212	8E54CCD	DL8E53B4F	S2EAAF5	S2EAB27
Replacement Gage				8E83662		8E88731				DL89FA705		
Replacement Gage				9BEBD1B					9DE6AE9	9DE6D56		N3C6933F
Monitoring Gage ID				GW-2	SG-1	GW-3	GW-4	GW-5	GW-6	GW-1	SG-2	SG-3
Elev. Top of Casing (ft) *all elevations MSL												
Elev. Ground Surface				123.37	124.11	123.16	123.66	124.65	124.41	123.86	125.89	124.97
Elev. Top of Bank					124.11						125.89	124.97
Approx. Bottom of Ditch					120.61						119	
COE Wetland Det. Hydrology				122.37	123.11	122.16	122.66	123.65	123.41	122.86	124.89	123.97
Depth to Bottom of Well (from top of casing) (ft)												
Growing Season - (March 17 - November 4)												
21-Jul-04	7:00	38189.29			120.74	120.97	121.45	121.34			119.45	
22-Jul-04	7:00	38190.29			120.70	120.92	121.37	121.33			119.32	
23-Jul-04	7:00	38191.29			120.84	120.92	121.49	121.34			119.53	
24-Jul-04	7:00	38192.29			120.70	120.87	121.38	121.33			119.62	130.26
25-Jul-04	7:00	38193.29	0.01		120.69	120.82	121.26	121.33			119.67	131.91
26-Jul-04	7:00	38194.29	0.07		120.69	120.79	121.19	121.33			119.71	130.97
27-Jul-04	7:00	38195.29	0.22		120.67	120.76	121.12	121.33			119.67	128.77
28-Jul-04	7:00	38196.29	0.46		120.66	120.73	121.07	121.33			119.65	
29-Jul-04	7:00	38197.29	0.11		120.67	120.70	121.01	121.33			119.62	
30-Jul-04	7:00	38198.29	0.27		120.71	120.66	120.96	121.33			119.71	173.57
31-Jul-04	7:00	38199.29	0.83		120.71	120.89	121.86	121.34			120.18	148.12
1-Aug-04	7:00	38200.29	0.01		120.70	120.83	121.57	121.33			120.15	136.96
2-Aug-04	7:00	38201.29			120.74	120.86	121.49	121.34			120.35	140.99
3-Aug-04	7:00	38202.29	0.99		121.39	121.84	122.39	121.35			121.83	160.92
4-Aug-04	7:00	38203.29	0.01		120.78	121.52	122.04	121.34			120.82	152.38
5-Aug-04	7:00	38204.29			120.71	121.29	121.79	121.34			120.88	140.60
6-Aug-04	7:00	38205.29			121.15	122.51	123.34	121.38			120.18	179.36
7-Aug-04	7:00	38206.29			120.81	122.03	122.39	121.36			120.62	183.51
8-Aug-04	7:00	38207.29			120.87	121.69	121.99	121.35			119.34	154.69
9-Aug-04	7:00	38208.29			120.79	121.45	121.69	121.35			119.32	139.03
10-Aug-04	7:00	38209.29	0.85		120.74	121.26	121.54	121.35			119.32	134.10
11-Aug-04	7:00	38210.29	0.11		120.72	121.12	121.43	121.35			119.40	131.01
12-Aug-04	7:00	38211.29	0.54		120.71	121.04	121.34	121.35			119.42	129.60
13-Aug-04	7:00	38212.29	1.62		120.94	121.24	122.54	121.35			119.93	
14-Aug-04	7:00	38213.29			120.86	121.28	122.16	121.35			119.67	103.86
15-Aug-04	7:00	38214.29			120.93	123.08	123.74	121.36			120.23	126.02
16-Aug-04	7:00	38215.29			124.42	123.65	124.04	124.94			125.58	
17-Aug-04	7:00	38216.29			124.43	123.65	124.04	125.14			126.17	
18-Aug-04	7:00	38217.29			124.35	123.68	124.05	124.70			124.69	180.84
19-Aug-04	7:00	38218.29	0.68		121.03	123.25	123.68	124.63			119.32	115.65
20-Aug-04	7:00	38219.29			120.96	122.93	123.33	124.16			119.32	104.80
21-Aug-04	7:00	38220.29			120.90	122.70	123.12	123.47			119.32	97.95
22-Aug-04	7:00	38221.29			121.21	123.31		124.59			119.32	95.80
23-Aug-04	7:00	38222.29			120.98	123.00	123.54	123.94			119.32	110.79
24-Aug-04	7:00	38223.29			120.96	122.76	123.18	123.31			119.32	109.11
25-Aug-04	7:00	38224.29			120.92	122.56	122.94	122.94			119.32	98.46
26-Aug-04	7:00	38225.29			120.91	122.42	122.79	122.73			119.28	94.15
27-Aug-04	7:00	38226.29	2.44		120.87	122.29	122.70	122.53			119.32	91.53
28-Aug-04	7:00	38227.29	0.51		120.84	122.15	122.60	122.23			119.32	89.96
29-Aug-04	7:00	38228.29			120.81	122.04	122.54	122.10			119.32	88.79
30-Aug-04	7:00	38229.29			123.33	123.33	124.03	124.78			122.95	98.30
31-Aug-04	7:00	38230.29	0.01		123.64	123.69	123.88	124.67			123.87	
1-Sep-04	7:00	38231.29			121.92	123.13	123.60	124.35			122.31	164.98
2-Sep-04	7:00	38232.29	0.01		121.88	122.90	123.45	123.92			122.25	169.95
3-Sep-04	7:00	38233.29			121.13	122.72	123.15	123.39			119.32	115.26
4-Sep-04	7:00	38234.29	0.32		121.05	122.58	123.02	123.09			119.32	102.57
5-Sep-04	7:00	38235.29	0.17		120.95	122.44	122.90	122.89			119.32	96.58
6-Sep-04	7:00	38236.29	1.76		121.00	122.34	122.78	122.76			119.28	94.47
7-Sep-04	7:00	38237.29			121.04	122.40	122.82	122.99			119.28	106.92
8-Sep-04	7:00	38238.29	0.04		121.07	122.36	122.92	123.14			119.32	119.60
9-Sep-04	7:00	38239.29			122.50	123.32	123.26	124.70			122.92	
10-Sep-04	7:00	38240.29	0.01		121.56	123.22	123.24	124.45			121.92	146.85
11-Sep-04	7:00	38241.29			121.23	122.93	123.19	123.99			121.02	126.73
12-Sep-04	7:00	38242.29	0.37			122.74	123.04	123.54			119.51	106.84
13-Sep-04	7:00	38243.29				122.58	122.92	123.16			119.51	99.71
14-Sep-04	7:00	38244.29				122.45	122.81	122.93			119.48	94.82
15-Sep-04	7:00	38245.29	1.02			122.48	123.09	123.66			119.59	95.95
16-Sep-04	7:00	38246.29	0.24			122.41	123.01	123.23			119.53	103.78
17-Sep-04	7:00	38247.29				122.37	122.98	123.04			119.53	102.85
18-Sep-04	7:00	38248.29				123.28	123.78	124.64			120.35	136.83
19-Sep-04	7:00	38249.29				123.22	123.67	124.49			120.93	144.07
20-Sep-04	7:00	38250.29	0.01			122.88	123.53				121.13	147.56
21-Sep-04	7:00	38251.29				122.69	123.21				119.37	123.48
22-Sep-04	7:00	38252.29	0.01			122.53	123.03				119.32	103.35
23-Sep-04	7:00	38253.29	0.01			122.42	122.89				119.32	96.74
24-Sep-04	7:00	38254.29	0.04			122.31	122.76	122.79			119.32	94.51
25-Sep-04	7:00	38255.29	0.35			122.22	122.67				119.32	92.39
26-Sep-04	7:00	38256.29	0.06			122.13	122.57				119.32	90.86

Monitoring Gage Serial #				8E851D9	9D900E1	8E574B8	8E83F51	8E52212	8E54CCD	DL8E53B4F	S2EAAF5	S2EAB27
Replacement Gage				8E83662		8E88731				DL89FA705		
Replacement Gage				9BEBD1B					9DE6AE9	9DE6D56		N3C6933F
Monitoring Gage ID				GW-2	SG-1	GW-3	GW-4	GW-5	GW-6	GW-1	SG-2	SG-3
Elev. Top of Casing (ft) *all elevations MSL												
Elev. Ground Surface				123.37	124.11	123.16	123.66	124.65	124.41	123.86	125.89	124.97
Elev. Top of Bank					124.11						125.89	124.97
Approx. Bottom of Ditch					120.61						119	
COE Wetland Det. Hydrology				122.37	123.11	122.16	122.66	123.65	123.41	122.86	124.89	123.97
Depth to Bottom of Well (from top of casing) (ft)												
Growing Season - (March 17 - November 4)												
27-Sep-04	7:00	38257.29				122.06	122.50	122.48			119.32	90.75
28-Sep-04	7:00	38258.29	0.07			122.13	122.54	122.50			119.28	91.65
29-Sep-04	7:00	38259.29	0.12			122.10	122.55				119.32	93.84
30-Sep-04	7:00	38260.29	0.01			122.02	122.51				119.32	100.85
1-Oct-04	7:00	38261.29				121.98	122.44		121.94		119.32	97.72
2-Oct-04	7:00	38262.29	0.01	122.70	121.05	121.92	122.41		121.84	122.90	119.32	95.41
3-Oct-04	7:00	38263.29		122.60	121.03	121.86	122.38		121.81	122.94	119.32	95.17
4-Oct-04	7:00	38264.29	0.02	122.52	121.04	121.82	122.35		121.76	122.79	119.32	92.67
5-Oct-04	7:00	38265.29		122.40	121.01	121.75			121.71	122.60	119.32	93.76
6-Oct-04	7:00	38266.29	0.01	122.28	120.94	121.68			121.65	122.36	119.32	91.69
7-Oct-04	7:00	38267.29		122.15	120.90	121.59			121.60	122.19	119.34	90.16
8-Oct-04	7:00	38268.29	0.02	122.05	120.87	121.53			121.55	122.10	119.34	88.83
9-Oct-04	7:00	38269.29	0.01	121.96	120.86	121.48			121.49	122.08	119.32	87.77
10-Oct-04	7:00	38270.29		121.90	120.86	121.43			121.44	122.08	119.32	87.65
11-Oct-04	7:00	38271.29	0.20	121.82	120.84	121.38			121.39	122.01	119.34	87.61
12-Oct-04	7:00	38272.29	0.05	121.75	120.83	121.32			121.38	121.95	119.32	87.89
13-Oct-04	7:00	38273.29	0.17	121.71	120.84	121.30			121.34	121.99	119.32	87.89
14-Oct-04	7:00	38274.29		121.85	120.88	121.29			121.31	122.09	119.34	89.34
15-Oct-04	7:00	38275.29		121.77	120.86	121.28			121.25	122.09	119.32	95.33
16-Oct-04	7:00	38276.29		122.00	120.84	121.26			121.20	122.00	119.32	97.17
17-Oct-04	7:00	38277.29	0.01	121.86	120.79	121.23			121.19	121.89	119.34	94.00
18-Oct-04	7:00	38278.29		121.74	120.79	121.18			121.19	121.78	119.32	91.22
19-Oct-04	7:00	38279.29		121.70	120.80	121.14			121.22	121.81	119.28	90.36
20-Oct-04	7:00	38280.29	0.01	121.65	120.80	121.09			121.19	121.85	119.32	88.91
21-Oct-04	7:00	38281.29	0.01	121.60	120.81	121.05			121.19	121.84	119.32	88.28
22-Oct-04	7:00	38282.29	0.06	121.55	120.82	121.01			121.19	121.78	119.32	88.16
23-Oct-04	7:00	38283.29	0.01	121.46	120.80	120.96			121.19	121.73	119.34	88.16
24-Oct-04	7:00	38284.29		121.41	120.79	120.93			121.19	121.75	119.32	87.38
25-Oct-04	7:00	38285.29		121.38	120.81	120.91			121.19	121.75	119.32	87.46
26-Oct-04	7:00	38286.29		121.34	120.80	120.87			121.19	121.69	119.32	88.08
27-Oct-04	7:00	38287.29		121.30	120.79	120.84			121.20	121.63	119.32	88.08
28-Oct-04	7:00	38288.29		121.28	121.59	120.81			121.19	121.63	119.32	89.34
29-Oct-04	7:00	38289.29	0.01	121.28	121.60	120.79			121.19	121.67	119.32	89.22
30-Oct-04	7:00	38290.29	0.01	121.30	121.61	120.78			121.20	121.77	119.32	89.18
31-Oct-04	7:00	38291.29		121.34	121.62	120.77			121.19	121.82	119.32	89.02
1-Nov-04	7:00	38292.29	0.04	121.34	121.59	120.75			121.19	121.72	119.32	89.06
2-Nov-04	7:00	38293.29	0.11	121.34	121.59	120.74			121.19	121.69	119.32	89.02
3-Nov-04	7:00	38294.29		121.35	121.59	120.74			121.18	121.72	119.32	88.75
4-Nov-04	7:00	38295.29	0.01	121.35	121.60	120.73			121.18	121.70	119.32	88.91
5-Nov-04	7:00	38296.29		121.35	121.20	120.72			121.18	121.84	119.32	89.30
6-Nov-04	7:00	38297.29		121.32	120.89	120.69			121.20	121.63	119.34	91.49
7-Nov-04	7:00	38298.29		121.28	120.81	120.69			121.19	121.56	119.32	90.90
8-Nov-04	7:00	38299.29	0.01	121.23	120.79	120.69			121.19	121.50	119.34	89.65
9-Nov-04	7:00	38300.29	0.02	121.18	120.74	120.66			121.19	121.32	119.32	89.18
10-Nov-04	7:00	38301.29	0.92	121.13	120.72	120.64			121.18	121.22	119.32	88.08
11-Nov-04	7:00	38302.29	0.01	121.09	120.74	120.64			121.18	121.24	119.32	87.46
12-Nov-04	7:00	38303.29		121.07	120.79	120.64			121.18	121.34	119.32	86.75
13-Nov-04	7:00	38304.29		123.30	121.19	121.84			121.17	121.95	120.15	101.87
14-Nov-04	7:00	38305.29	0.01	123.31	120.90	121.62			121.17	122.27	120.10	116.74
15-Nov-04	7:00	38306.29		122.88	120.79	121.51			121.16	122.08	120.15	109.03
16-Nov-04	7:00	38307.29		122.61	120.76	121.44			121.15	122.02	120.15	99.05
17-Nov-04	7:00	38308.29		122.40	120.75	121.37			121.15	122.01	120.12	95.01
18-Nov-04	7:00	38309.29	0.01	122.21	120.74	121.29			121.15	121.96	120.10	92.23
19-Nov-04	7:00	38310.29		122.08	120.74	121.21			121.14	121.98	120.04	90.79
20-Nov-04	7:00	38311.29	0.16	121.95	120.73	121.15			121.15	121.97	119.96	89.10
21-Nov-04	7:00	38312.29	0.32	121.85	120.73	121.08			121.14	121.95	119.96	89.10
22-Nov-04	7:00	38313.29	0.04	121.74	120.71	121.01			121.14	121.92	119.90	89.45
23-Nov-04	7:00	38314.29	0.01	121.68	120.79	120.98			121.14	122.00	119.93	89.65
24-Nov-04	7:00	38315.29		123.41	120.91	121.77			121.14	123.11	120.57	103.16
25-Nov-04	7:00	38316.29	0.93		120.87	121.89			121.16	123.15	120.66	105.70
26-Nov-04	7:00	38317.29		122.96	120.78	121.77			121.16	122.74	120.49	102.02
27-Nov-04	7:00	38318.29		122.65	120.74	121.67			121.15	122.41	120.29	96.19
28-Nov-04	7:00	38319.29		122.83	121.70	123.31			123.26	123.92	121.67	116.31
29-Nov-04	7:00	38320.29		123.41	121.02	123.11			122.64	123.59	119.79	121.87
30-Nov-04	7:00	38321.29		123.40	120.85	122.83			122.29	123.43	119.57	112.16
1-Dec-04	7:00	38322.29		123.38	120.83	122.73	123.36	121.71	122.09	123.39	119.57	103.20
2-Dec-04	7:00	38323.29		123.25			123.08		121.77	123.17		
3-Dec-04	7:00	38324.29		122.91			122.89		121.54	123.01		

Monitoring Gage Serial #				8E851D9	9D900E1	8E574B8	8E83F51	8E52212	8E54CCD	DL8E53B4F	S2EAAF5	S2EAB27
Replacement Gage				8E83662		8E88731				DL89FA705		
Replacement Gage				9BEBD1B					9DE6AE9	9DE6D56		N3C6933F
Monitoring Gage ID				GW-2	SG-1	GW-3	GW-4	GW-5	GW-6	GW-1	SG-2	SG-3
Elev. Top of Casing (ft) *all elevations MSL												
Elev. Ground Surface				123.37	124.11	123.16	123.66	124.65	124.41	123.86	125.89	124.97
Elev. Top of Bank					124.11						125.89	124.97
Approx. Bottom of Ditch					120.61						119	
COE Wetland Det. Hydrology				122.37	123.11	122.16	122.66	123.65	123.41	122.86	124.89	123.97
Depth to Bottom of Well (from top of casing) (ft)												
Growing Season - (March 17 - November 4)												
4-Dec-04	7:00	38325.29		122.71			122.73		121.35	122.79		
5-Dec-04	7:00	38326.29		122.53			122.59		121.26	122.64		
6-Dec-04	7:00	38327.29		122.36			122.54			122.54		
7-Dec-04	7:00	38328.29					122.54					
8-Dec-04	7:00	38329.29					122.56					
9-Dec-04	7:00	38330.29					122.47					
10-Dec-04	7:00	38331.29										
11-Dec-04	7:00	38332.29					123.69					
12-Dec-04	7:00	38333.29					123.57					
13-Dec-04	7:00	38334.29					123.40					

Groundwater Monitoring Gage
ID: 9DE6D56
Location: GW-1



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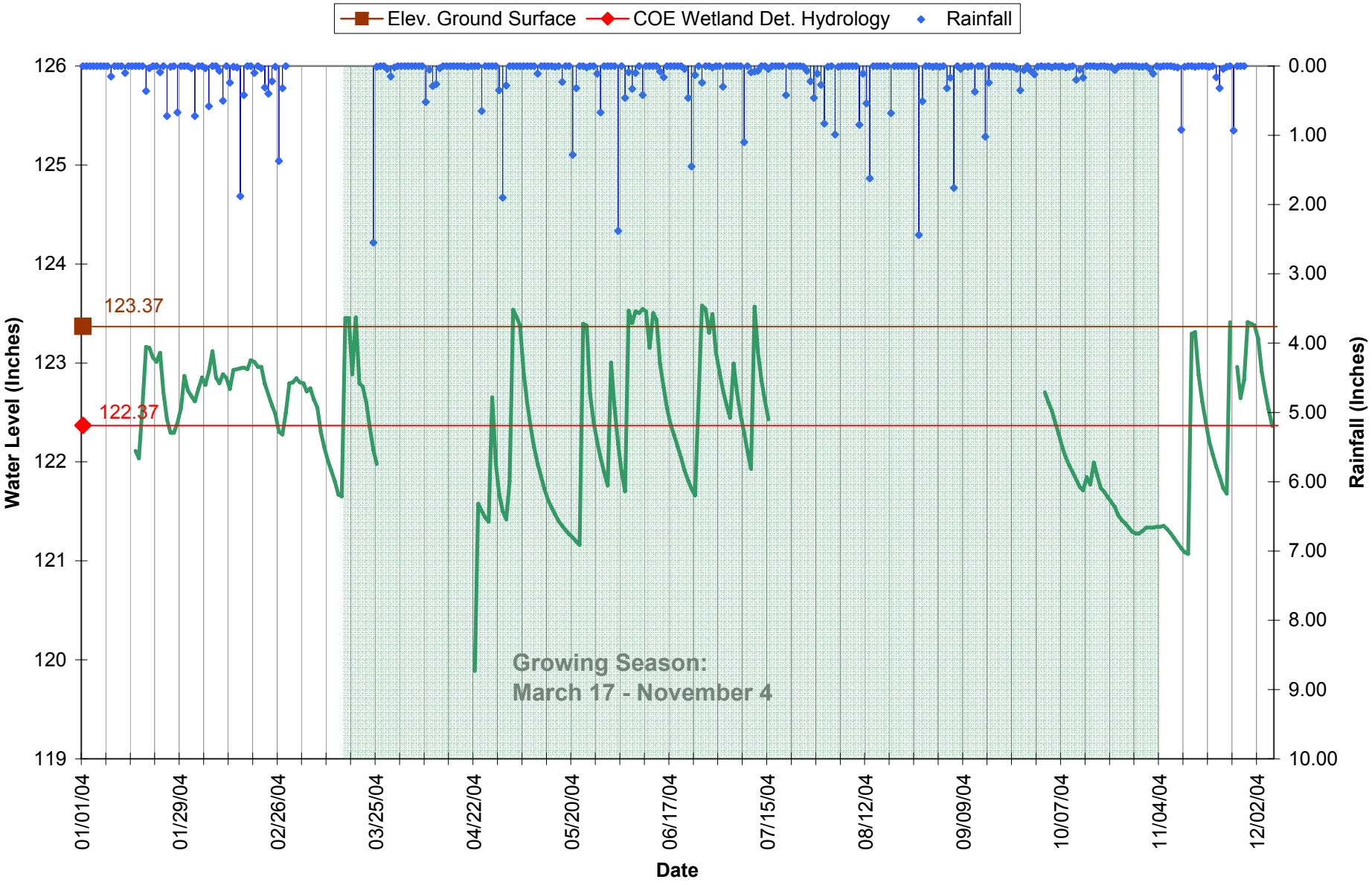
Groundwater Monitoring Gage
ID: 9BEBD1B
Location: GW-2



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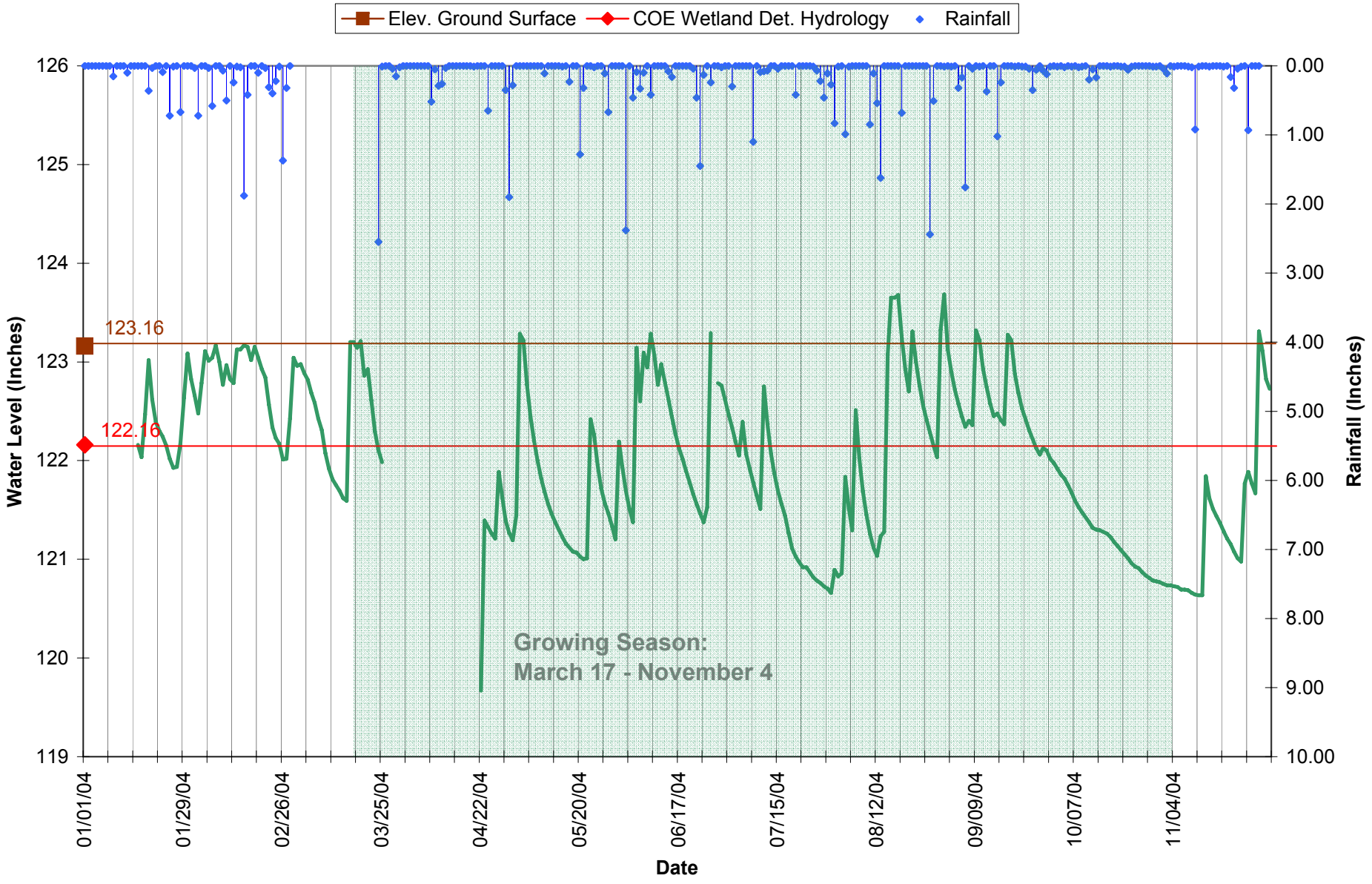
Location: GW-3



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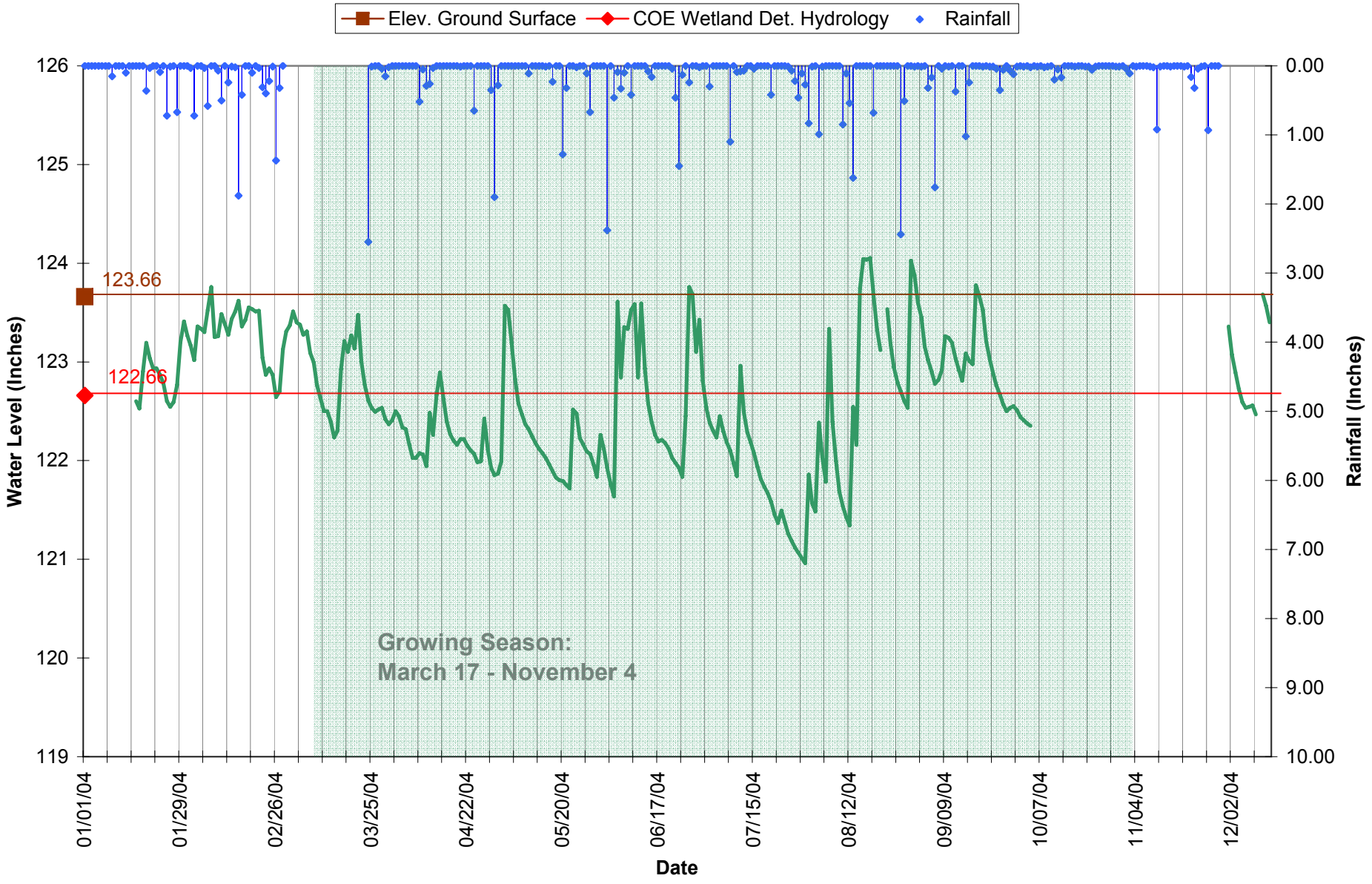

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Groundwater Monitoring Gage
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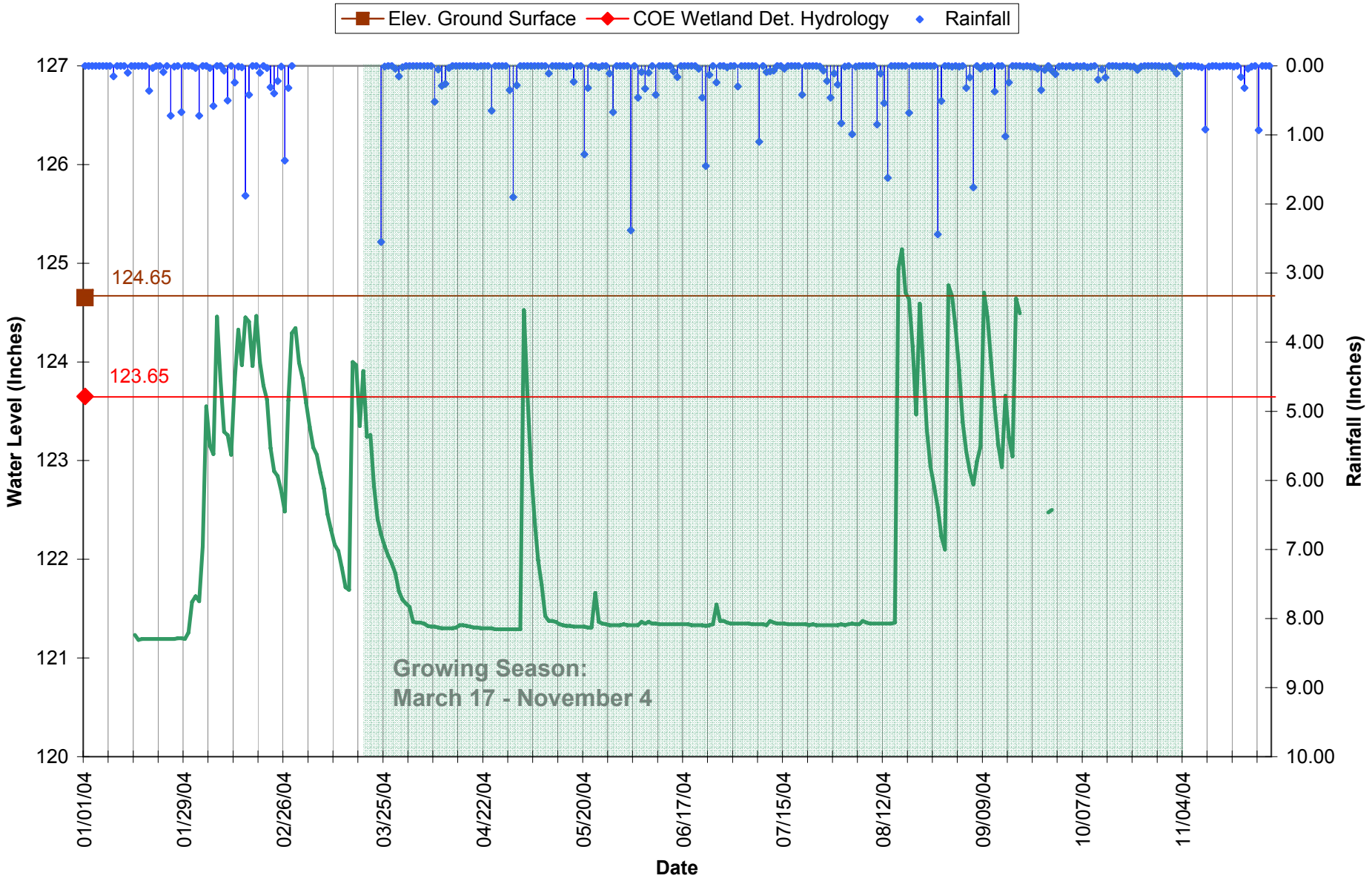
Location: GW-5



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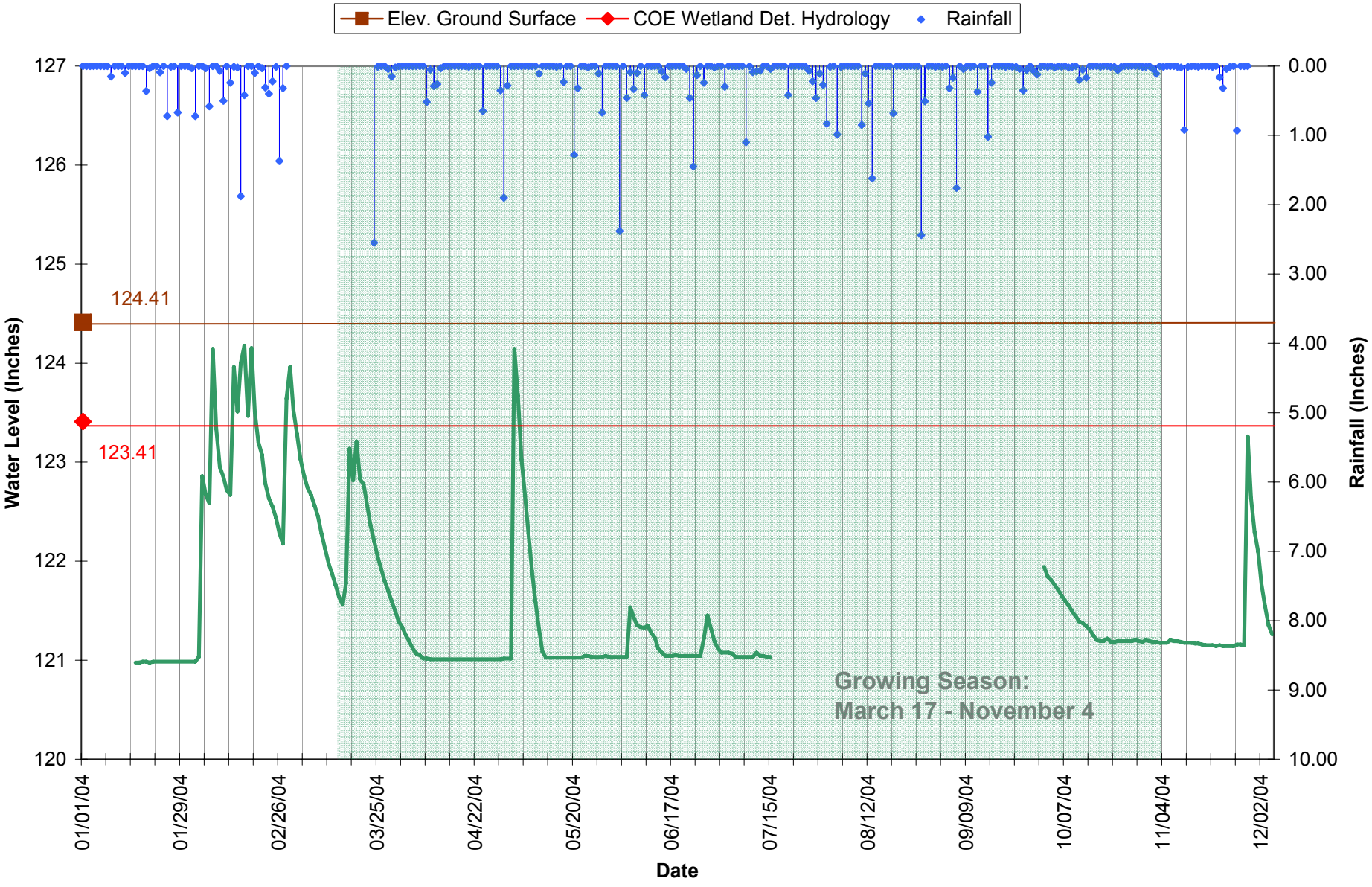
Groundwater Monitoring Gage
ID: 9DE6AE9
Location: GW-6



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Stream Monitoring Gage
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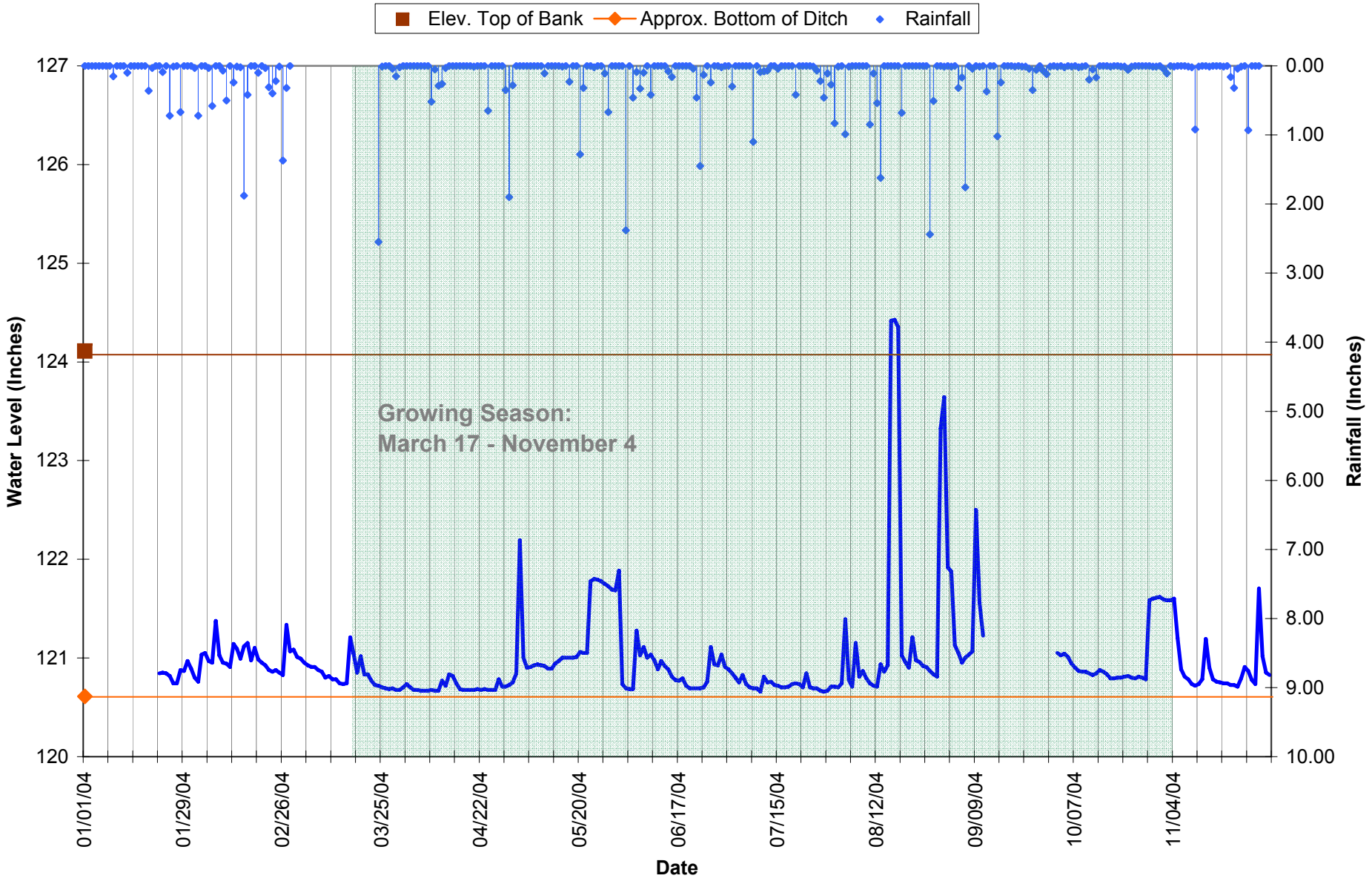
Location: SG-1



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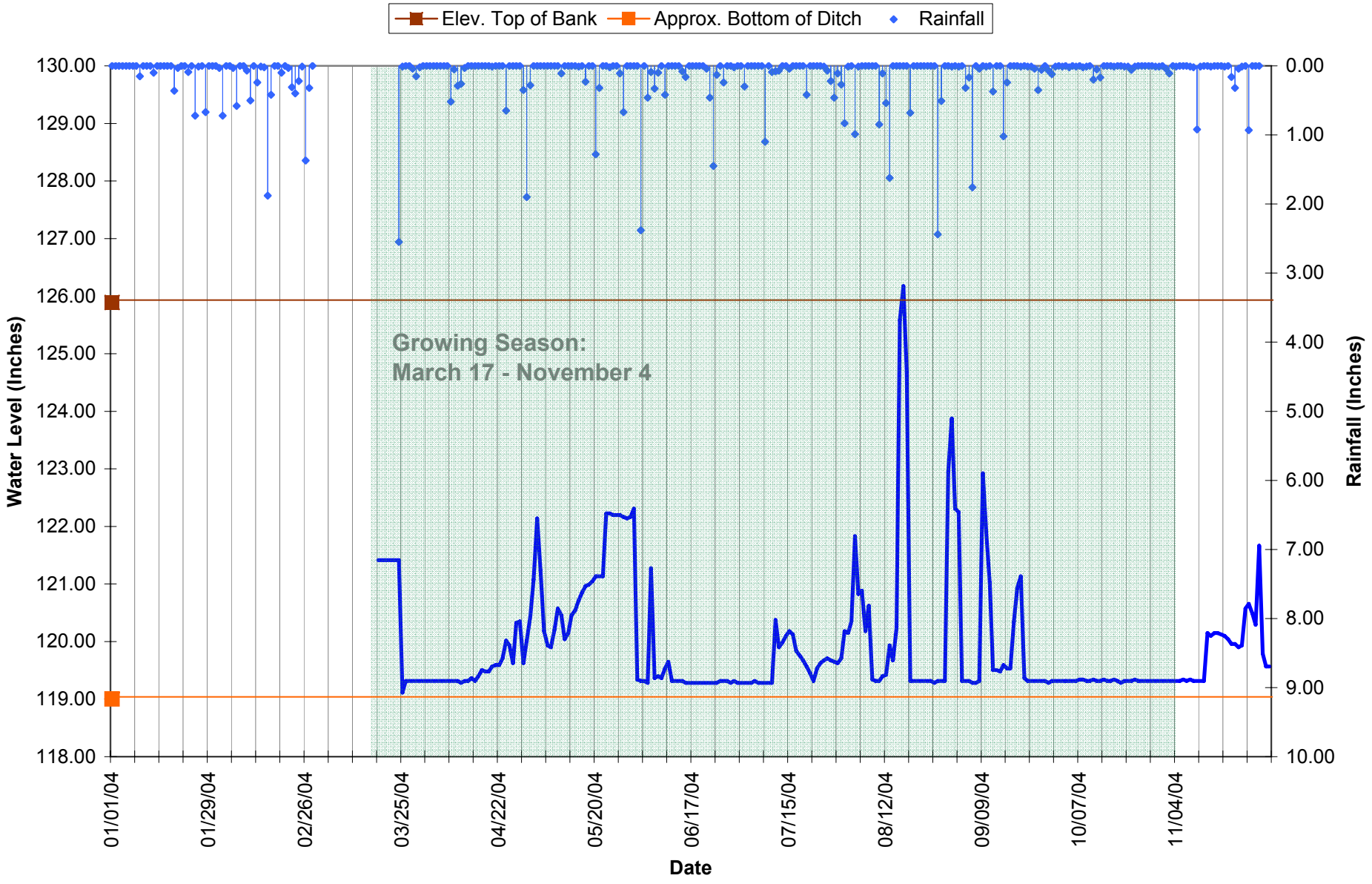
Stream Monitoring Gage
ID: S2EAAF5
Location: SG-2



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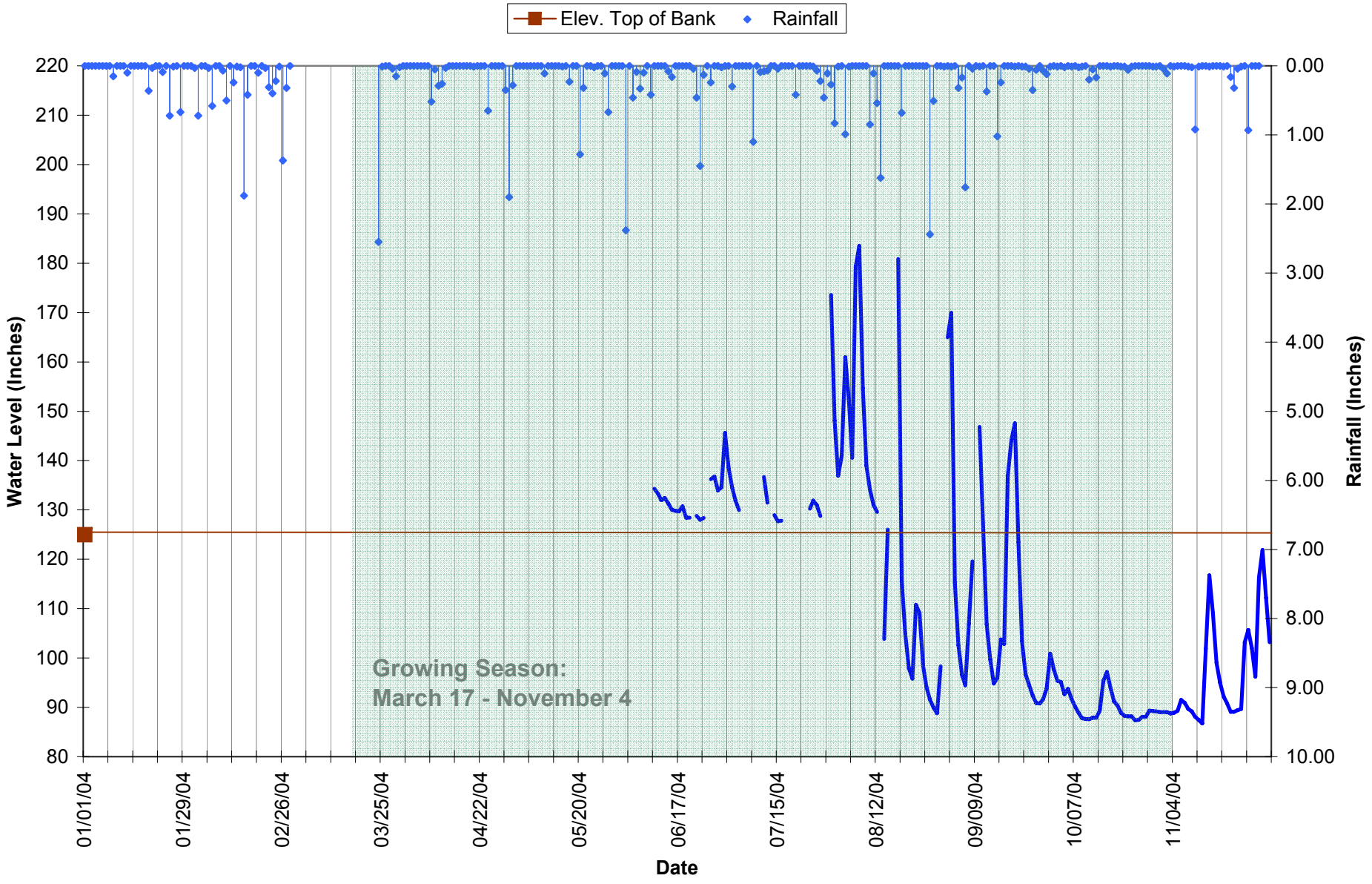
Stream Monitoring Gage
ID: N3C6933F
Location: SG-3



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Appendix 5

USDA FAA Wetland Mitigation Near Airports Guidance Letter (03-28-2003)

United States Department of Agriculture

Animal and Plant Health Inspection Service

Wildlife Services

EAD (USDA WS)
PSC Box 8006
BLDG 4223 Rifle Range RD
MCAS Cherry Point, NC
28533-0006

(252) 466-4964 telephone
(252) 466-2000 fax

DSN extension: 582

begiermj@cherrypoint.usmc.mil

FOR OFFICIAL USE ONLY **28 March 2003**

Norton Webster, Environmental Scientist
Kimley-Horn and Associates, Inc.
PO Box 33068
Raleigh, North Carolina 27636-3068

Greetings Norton:

This correspondence is in reference to the Wetland Mitigation Study project that your firm is handling at the behest of the North Carolina Dept. of Transportation (NC DOT). Specifically, this letter report serves as USDA Wildlife Services, North Carolina Program's assessment and comments related to our site visit on 25 February 2003, at the Moore property which lies to the west, southwest of the Johnston County Airport. The area is in close proximity to the approach airspace of the facility runway. The purpose of this visit was your firms desire to consult with Wildlife Services regarding the potential impacts of the proposed creation of a wetland mitigation bank at the site and how this may or may not serve as a wildlife attractant related to aviation safety.

The ability of Wildlife Services to render a professional opinion in this matter stems from our relationship with the Federal Aviation Administration as defined by the memorandum of understanding between our two agencies. The biological opinions and comments related to this project are in part guided by information contained in FAA Advisory Circular 150/5200-33, "Hazardous Wildlife Attractants On or Near Airports" and my training as a professional wildlife biologist trained in assessing wildlife damage management situations.

During our site visit, we traversed the site which is currently in agriculture and pasture. No standing agricultural crops were present during the visit. Currently, the property is graded (i.e., crowned) and ditched such that it drains to the Swift Creek. There also is an earthen berm between the creek and the property. Historically, the property was part of a bottomland hardwood stand that was periodically inundated when the Swift Creek was at flood stage. The surrounding properties that directly border the Moore property are currently forested.

While at the site we did not make any wildlife observations of notice except the calls of a flock of Canada geese. The geese were flying north of our location but remained unseen. During this event, we discussed anecdotal stories of Canada geese using the property at various times over the last year. You also made mention of large numbers of mourning doves being present in the autumn.

The current plan is to convert the property to a wetland mitigation bank to be

administered by the NC DOT. This will involve the removal of the current grading scheme and the filling of the drainage ditches. Holes also will be pushed through the earthen berm to re-establish the site as part of the Swift Creek flood plain. As per our discussion the site will be reforested with typical bottom land hardwood species suitable to the area. The target stem density is 500 stems per acre.

The guidance concerning wetlands and their siting in FAA Advisory Circular 150/5200-33 does not specifically address this type of wetland situation (i.e., bottom land hardwood/"green timber impoundment"). Generally, the creation of wetlands, close to an airport, where significant amounts of open water would be present would not be conducive to safe airport operations. However, the current agricultural and pasture use of the land lends itself to use by flocking birds as was evidenced during our discussion. In this situation, the reforestation of the land thereby eliminating the open field would be beneficial to aviation safety.

During the early stages of reforestation, (i.e., seedling through sapling stage) the area may become used more by white-tailed deer as a foraging area. Currently, white-tailed deer are the number one threat to aviation safety in the U.S., particularly the eastern U.S. Although the Swift Creek somewhat segregates the Moore property from the airport the creek itself is not an effective barrier to deer movements.

The re-establishment of the original grading scheme (i.e., removal of the crown) may allow water to pool on the land during rainy times. During the initial stages of reforestation (i.e., seedling stage) it will be important monitor the site in order to make sure temporary or ephemeral pools or water are not allowed to become permanently established. This type of situation may lead to "dead spots" in the reforested area. These areas may be suitable for waterfowl use which would constitute a wildlife hazard to aviation. The current stem density we discussed should provide enough of a "natural barrier" or impediment to Canada goose use of the area during the seedling stage. However, some use of the area by Canada geese may occur. Use of the area should be monitored for this situation and action taken without delay to mitigate the situation. The site will most likely become dominated by other herbaceous and shrub vegetation type that should preclude its use by Canada geese.

At all times, WS advocates that airport operations offices maintain a wildlife log. This log, similar to other general aviation type logs, should be used to document wildlife activities that are observed on the airport property. It is recommended that the airport operations department and the NC DOT monitor the area for wildlife use. These groups should routinely communicate with each other concerning wildlife use of the area especially the potential types of use previously mentioned. Monitoring will not only serve to note when but how the area may be used by wildlife. These observations and the ability of the airport to act upon them will be a key in preventing a wildlife hazard situation.

Although this project is not specifically covered the guidance provided in FAA Advisory Circular 150/5200-33 should be noted in this instance. Section 2-4 (Wetlands), subsection b (Wetland mitigation), part 3 mentions that a wildlife damage management plan be developed

to reduce wildlife hazards during wetland mitigation projects. If the area in question should become attractive to wildlife and thereby pose a hazard to aviation an airport site visit should be conducted and an operational plan to remedy the situation enacted without delay. Guidance, advice and service to assist in the event that a wildlife hazard situation develops can be better rendered if the airport operations department maintains a wildlife log (as discussed previously) and acts in a timely manner on the information recorded in the log.

Wildlife populations can be very unpredictable in their movements and habits. However, their activities and populations as they relate to habitat can oftentimes be effectively managed resulting in a safe airport environment. USDA Wildlife Services is very proud of the assistance our agency provides nationally to the aviation community. If you desire further information or assistance with wildlife and airport safety topics please contact us.

If you have any specific questions, please use my contact information on this correspondence.

Sincerely,

Michael J. Begier
Wildlife Biologist
mjbegier@cherrypoint.usmc.mil

cc: Johnston County Airport
Mr. Jack McSwain, FAA, Atlanta
Mr. Edward Cleary, FAA, Washington D.C.
Mr. E. C. Hunicutt, FAA, Atlanta
Mr. Rick Barkes, NC Division of Aviation
Mr. Todd Menke, USDA Wildlife Services, North Carolina
Mr. Rick Owens, USDA Wildlife Services, Eastern Regional Office

enc. FAA Advisory Circular 150/5200-33, "Hazardous Wildlife Attractants On or Near Airports"
Memorandum of Understanding between US DOT, FAA and USDA APHIS (ADC) Wildlife Services

Appendix 6

Hydraulic Conductivity Study

Soil Investigation Data Sheet

Location: Swift Creek
Date: 8/12/04

Investigator(s): SJM

Soil Description

Ap; 0-7 inches; brown (10YR 4/3) fine sandy loam; few fine prominent yellowish brown (10YR 5/6) soft masses of iron accumulation weak granular structure; very friable;

BA; 7-14 inches; dark grayish brown (10YR 4/2); common fine prominent yellowish brown (10YR 5/6) soft masses of iron accumulation; weak medium subangular blocky structure

Bt1; 14-20 inches; light brownish gray (10YR 6/2) sandy clay loam; weak medium subangular blocky structure; prominent strong brown (7.5YR 5/8) and yellowish brown (10YR 5/6) iron masses; friable;

Btg; 20-34 inches; 35 percent light brownish gray (2.5Y 6/2), 35 percent gray (10YR 6/1), and 30 percent yellowish brown (10YR 5/8) clay; weak medium subangular blocky structure

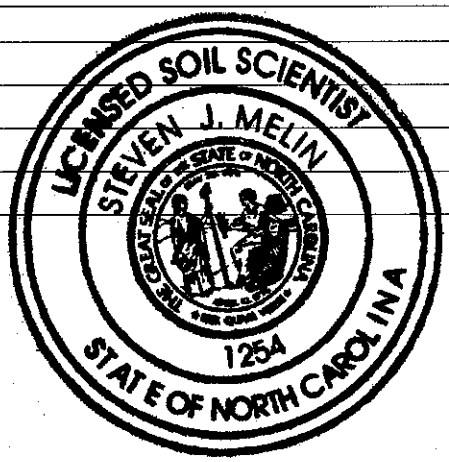
BCg; 34-46 inches; 35 percent light brownish gray (2.5Y 6/2), 35 percent greenish gray (10BG 6/1), and 30 percent yellowish brown (10YR 5/8) sandy clay;

C; 46+ inches; gray (10BG 6/1) loamy sand; prominent strong brown (7.5YR 5/8) masses of iron accumulation

Examination Method: auger
Soil Series: Tomotley
Parent Material: loamy marine and fluvial sediments
Drainage Class: poorly drained
Mineralogy: mixed
Particle Size Class: loamy
Temperature Regime: thermic
Classification: Fine-loamy, mixed, semiactive, thermic Typic Endoaquults
Slope: 0-2%
Weather: partly cloudy; 80 degrees

SIMILAR PROFILES:

NOTES:



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #1

Date: 8/12/2004
Location: 19.5"

SET UP

	cm	inches
Hole Depth (cm):	49.5	19.5
Reference (cm):	+ 10.2	4.0
Head (cm):	- 17.8	7.0
CHT Tube(s) setting:	= 41.9	16.5

	cm	inches
Target Water Level:	31.8	12.5
Beginning Water Level:	33.0	13.0
Ending Water Level:	30.5	12.0

Hole diameter (cm): 5.2
Hole radius (r): 2.6
coefficient A: 0.00079666

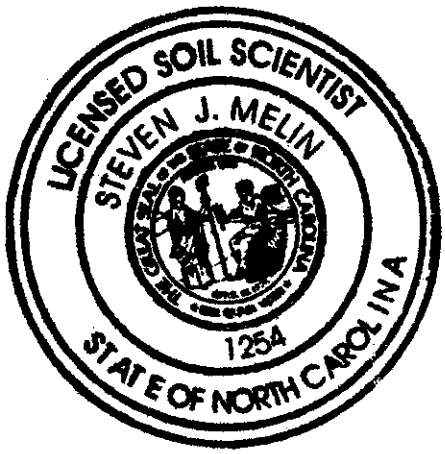
Valve Setting:

1-ON	2-ON
x	

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 20.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	(hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
35.3	0.0	20.0	0.0					
34.6	0.7	20.0	10.0	10.00	0.167	84.0	0.0669	0.0263
34.1	0.5	20.0	20.0	10.00	0.167	60.0	0.0478	0.0188
33.5	0.6	20.0	30.0	10.00	0.167	72.0	0.0574	0.0226
32.6	0.9	20.0	42.0	12.00	0.200	90.0	0.0717	0.0282
32.1	0.5	20.0	49.0	7.00	0.117	85.7	0.0683	0.0269
31.4	0.7	20.0	60.0	11.00	0.183	76.4	0.0608	0.0240
						Final Ksat	**0.065**	**0.025**



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #2

Date: 8/12/2004
Location: 24"

SET UP

	cm	inches
Hole Depth (cm):	61.0	24.0
Reference (cm):	+ 10.2	4.0
Head (cm):	- 17.8	7.0
CHT Tube(s) setting:	= 53.3	21.0

Valve Setting: x (1-ON / 2-ON)

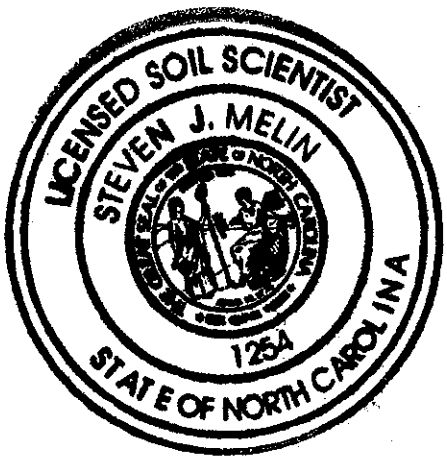
Coversion Factor (C.F.): 20.0

	cm	inches
Target Water Level:	43.2	17.0
Beginning Water Level:	43.2	17.0
Ending Water Level:	43.2	17.0

Hole diameter (cm): 5.2
Hole radius (r): 2.6
coefficient A: 0.00088437

NOTE: Readings based on Ending Water Level

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	Elapsed Time (hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
35.5	0.0	20.0	0.0					
35	0.5	20.0	15.0	15.00	0.250	40.0	0.0354	0.0139
34.7	0.3	20.0	30.0	15.00	0.250	24.0	0.0212	0.0084
34.4	0.3	20.0	45.0	15.00	0.250	24.0	0.0212	0.0084
34	0.4	20.0	64.0	19.00	0.317	25.3	0.0223	0.0088
						Final Ksat	**0.022**	**0.009**



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #3

Date: 8/12/2004
Location: 26"

SET UP

	cm	inches
Hole Depth (cm):	66.0	26.0
Reference (cm):	+ 10.2	4.0
Head (cm):	- 17.8	7.0
CHT Tube(s) setting:	= 58.4	23.0

Valve Setting: x (1-ON / 2-ON)

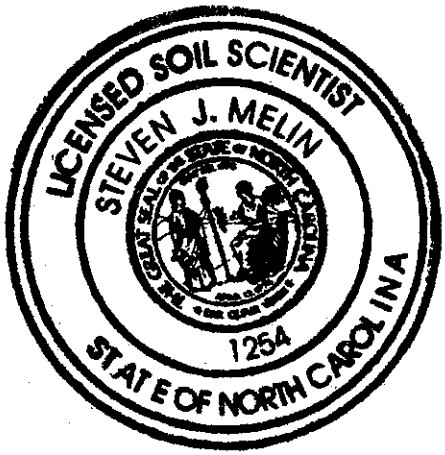
Coversion Factor (C.F.): 20.0

	cm	inches
Target Water Level:	48.3	19.0
Beginning Water Level:	48.3	19.0
Ending Water Level:	48.3	19.0

Hole diameter (cm): 5.2
Hole radius (r): 2.6
coefficient A: 0.00088437

NOTE: Readings based on Ending Water Level

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	(hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
28.9	0.0	20.0	0.0					
28.7	0.2	20.0	13.0	13.00	0.217	18.5	0.0163	0.0064
28.4	0.3	20.0	26.0	13.00	0.217	27.7	0.0245	0.0096
28.1	0.3	20.0	39.0	13.00	0.217	27.7	0.0245	0.0096
27.8	0.3	20.0	55.0	16.00	0.267	22.5	0.0199	0.0078
27.6	0.2	20.0	65.0	10.00	0.167	24.0	0.0212	0.0084
						Final Ksat	**0.023**	**0.009**



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #4

Date: 8/12/2004

Location: 28"

SET UP

	cm	inches
Hole Depth (cm):	71.1	28.0
Reference (cm):	+ 10.2	4.0
Head (cm):	- 17.8	7.0
CHT Tube(s) setting:	= 63.5	25.0

	cm	inches
Target Water Level:	53.3	21.0
Beginning Water Level:	54.6	21.5
Ending Water Level:	54.6	21.5

Hole diameter (cm): 5.2

Hole radius (r): 2.6

coefficient A: 0.00098846

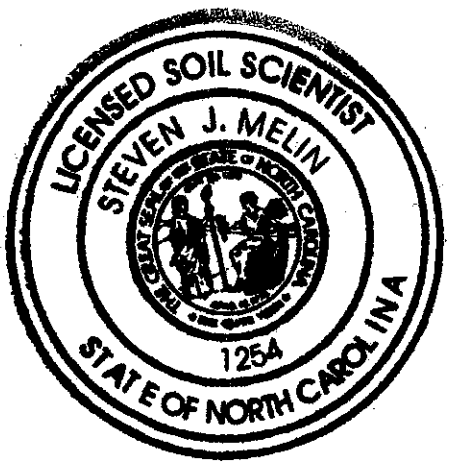
Valve Setting: x

1-ON 2-ON

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 20.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	(hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
30.7	0.0	20.0	0.0					
30.5	0.2	20.0	13.0	13.00	0.217	18.5	0.0182	0.0072
30.3	0.2	20.0	27.0	14.00	0.233	17.1	0.0169	0.0067
29.9	0.4	20.0	39.0	12.00	0.200	40.0	0.0395	0.0156
29.4	0.5	20.0	52.0	13.00	0.217	46.2	0.0456	0.0180
28.9	0.5	20.0	67.0	15.00	0.250	40.0	0.0395	0.0156
						Final Ksat	**0.042**	**0.016**



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #5

Date: 8/12/2004
Location: 28"

SET UP

	cm	inches
Hole Depth (cm):	71.1	28.0
Reference (cm):	+ 10.2	4.0
Head (cm):	- 17.8	7.0
CHT Tube(s) setting:	= 63.5	25.0

	cm	inches
Target Water Level:	53.3	21.0
Beginning Water Level:	53.3	21.0
Ending Water Level:	53.3	21.0

Hole diameter (cm): 5.2
Hole radius (r): 2.6
coefficient A: 0.00088437

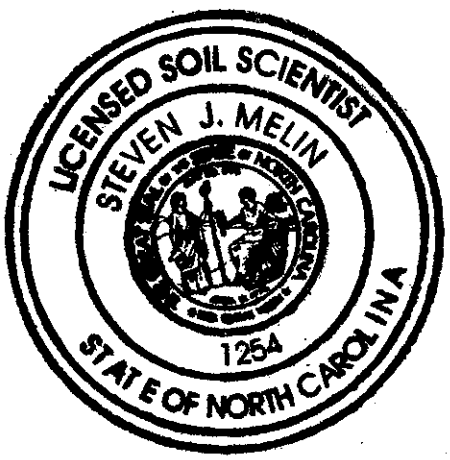
Valve Setting:

1-ON	2-ON
	x

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 105.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	(hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
36.6	0.0	105.0	0.0					
35.8	0.8	105.0	5.0	5.00	0.083	1008.0	0.8914	0.3510
35.1	0.7	105.0	10.0	5.00	0.083	882.0	0.7800	0.3071
34.4	0.7	105.0	15.0	5.00	0.083	882.0	0.7800	0.3071
33.8	0.6	105.0	20.0	5.00	0.083	756.0	0.6686	0.2632
33.1	0.7	105.0	25.0	5.00	0.083	882.0	0.7800	0.3071
						Final Ksat	**0.780**	**0.307**



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #6

Date: 8/12/2004
Location: 26"

SET UP

		cm	inches
Hole Depth (cm):		162.6	64.0
Reference (cm):	+	10.2	4.0
Head (cm):	-	17.8	7.0
CHT Tube(s) setting:	=	154.9	61.0

Valve Setting: x

1-ON 2-ON

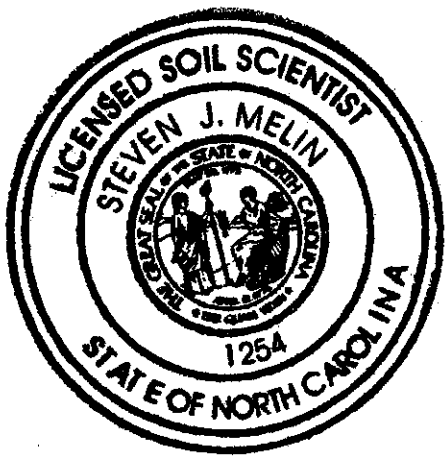
	cm	inches
Target Water Level:	144.8	57.0
Beginning Water Level:	144.8	57.0
Ending Water Level:	144.8	57.0

Hole diameter (cm): 5.2
Hole radius (r): 2.6
coefficient A: 0.00088437

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 20.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	(hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
24.7	0.0	20.0	0.0					
24	0.7	20.0	5.0	5.00	0.083	168.0	0.1486	0.0585
23.6	0.4	20.0	10.0	5.00	0.083	96.0	0.0849	0.0334
23	0.6	20.0	15.0	5.00	0.083	144.0	0.1273	0.0501
22.3	0.7	20.0	20.0	5.00	0.083	168.0	0.1486	0.0585
21.5	0.8	20.0	26.5	6.50	0.108	147.7	0.1306	0.0514
21.1	0.4	20.0	30.0	3.50	0.058	137.1	0.1213	0.0477
						Final Ksat	**0.132**	**0.052**



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #7

Date: 8/12/2004
Location: 8.5"

SET UP

	cm	inches
Hole Depth (cm):	21.6	8.5
Reference (cm):	+ 10.2	4.0
Head (cm):	- 17.8	7.0
CHT Tube(s) setting:	= 14.0	5.5

Valve Setting: 1-ON x 2-ON

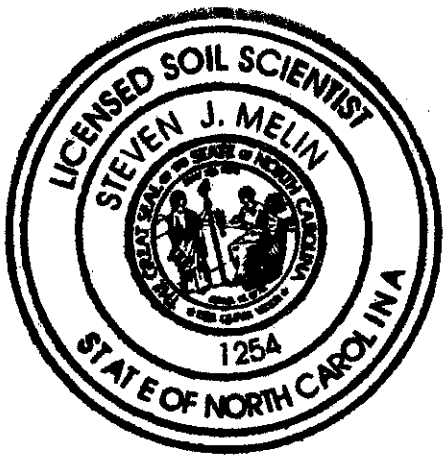
	cm	inches
Target Water Level:	3.8	1.5
Beginning Water Level:	5.1	2.0
Ending Water Level:	7.6	3.0

Hole diameter (cm): 5.2
Hole radius (r): 2.6
coefficient A: 0.0012657

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 105.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	(hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
29	0.0	105.0	0.0					
28.8	0.2	105.0	5.0	5.00	0.083	252.0	0.3190	0.1256
28.6	0.2	105.0	10.0	5.00	0.083	252.0	0.3190	0.1256
28.3	0.3	105.0	17.0	7.00	0.117	270.0	0.3417	0.1345
28.1	0.2	105.0	21.0	4.00	0.067	315.0	0.3987	0.1570
						Final Ksat	**0.345**	**0.136**



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #8

Date: 8/12/2004
Location: 7.5"

SET UP

	cm	inches
Hole Depth (cm):	19.1	7.5
Reference (cm):	+ 10.2	4.0
Head (cm):	- 15.2	6.0
CHT Tube(s) setting:	= 14.0	5.5

Valve Setting: x (1-ON / 2-ON)

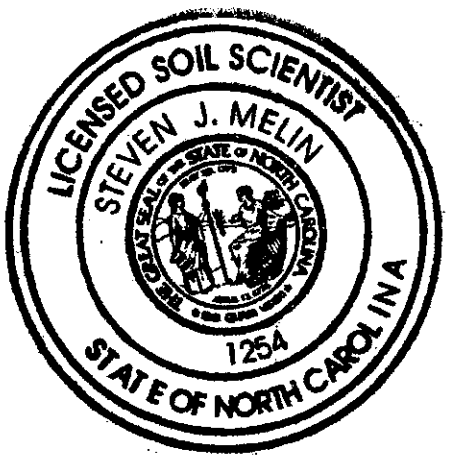
	cm	inches
Target Water Level:	3.8	1.5
Beginning Water Level:	6.4	2.5
Ending Water Level:	6.4	2.5

Hole diameter (cm): 5.2
Hole radius (r): 2.6
coefficient A: 0.00145403

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 20.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	(hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
35.1	0.0	20.0	0.0					
33.4	1.7	20.0	5.0	5.00	0.083	408.0	0.5932	0.2336
32	1.4	20.0	10.0	5.00	0.083	336.0	0.4886	0.1923
30.6	1.4	20.0	16.0	6.00	0.100	280.0	0.4071	0.1603
29.7	0.9	20.0	20.0	4.00	0.067	270.0	0.3926	0.1546
						Final Ksat	**0.429**	**0.169**



HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #9

Date: 7/20/2004

Location: 27"

SET UP

	cm	inches
Hole Depth (cm):	68.6	27.0
Reference (cm):	+ 10.2	4.0
Head (cm):	- 17.8	7.0
CHT Tube(s) setting:	= 61.0	24.0

Valve Setting: x

1-ON 2-ON

	cm	inches
Target Water Level:	50.8	20.0
Beginning Water Level:	52.1	20.5
Ending Water Level:	52.1	20.5

Hole diameter (cm): 5.2

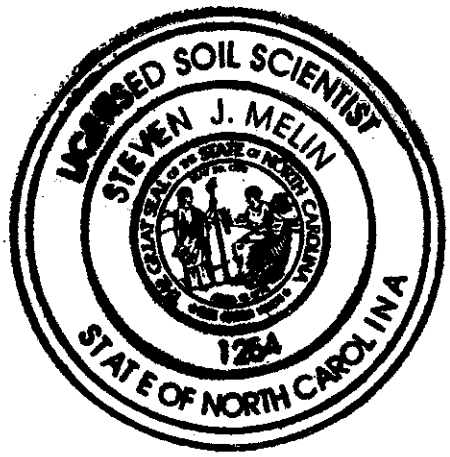
Hole radius (r): 2.6

coefficient A: 0.00098846

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 20.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	(hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
25.5	0.0	20.0	0.0					
25.3	0.2	20.0	6.0	6.00	0.100	40.0	0.0395	0.0156
25.1	0.2	20.0	10.0	4.00	0.067	60.0	0.0593	0.0233
24.9	0.2	20.0	15.0	5.00	0.083	48.0	0.0474	0.0187
24.7	0.2	20.0	19.0	4.00	0.067	60.0	0.0593	0.0233
						Final Ksat	**0.055**	**0.022**



HYDRAULIC CONDUCTIVITY STUDY

Swift Creek - #10

Date: 8/23/2004

Location: 41"

SET UP

		cm	inches
Hole Depth (cm):		104.1	41.0
Reference (cm):	+	10.2	4.0
Head (cm):	-	17.8	7.0
CHT Tube(s) setting:	=	96.5	38.0

	cm	inches
Target Water Level:	86.4	34.0
Beginning Water Level:	88.9	35.0
Ending Water Level:	88.9	35.0

Hole diameter (cm): 5.2

Hole radius (r): 2.6

coefficient A: 0.00111347

Valve Setting: x (1-ON / 2-ON)

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 20.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	Elapsed Time (hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
47.2	0.0	20.0	0.0					
44.5	2.7	20.0	16.0	16.00	0.267	202.5	0.2255	0.0888
41.5	3.0	20.0	30.0	14.00	0.233	257.1	0.2863	0.1127
39.8	1.7	20.0	38.0	8.00	0.133	255.0	0.2839	0.1118
38	1.8	20.0	46.0	8.00	0.133	270.0	0.3006	0.1184
						Final Ksat	**0.265**	**0.104**

HYDRAULIC CONDUCTIVITY STUDY
Swift Creek - #11

Date: 8/23/2004
Location: 53"

SET UP

	cm	inches
Hole Depth (cm):	134.6	53.0
Reference (cm):	+ 10.2	4.0
Head (cm):	- 17.8	7.0
CHT Tube(s) setting:	= 127.0	50.0

Valve Setting: x
1-ON 2-ON

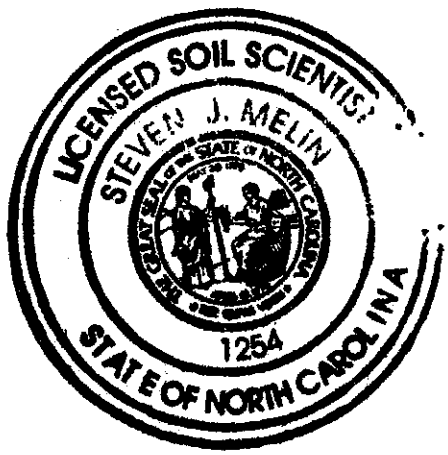
	cm	inches
Target Water Level:	116.8	46.0
Beginning Water Level:	116.8	46.0
Ending Water Level:	116.8	46.0

Hole diameter (cm): 5.2
Hole radius (r): 2.6
coefficient A: 0.0008844

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 20.0

Water Reading	change in water level	Chamber C.F.	clock time (min)	Elapsed Time (min)	Elapsed Time (hr)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
47.3	0.0	20.0	0.0					
43.1	4.2	20.0	12.0	12.00	0.200	420.0	0.3714	0.1462
39	4.1	20.0	24.0	12.00	0.200	410.0	0.3626	0.1428
34.9	4.1	20.0	36.0	12.00	0.200	410.0	0.3626	0.1428
33.5	1.4	20.0	40.0	4.00	0.067	420.0	0.3714	0.1462
						Final Ksat	**0.366**	**0.144**



Appendix 7

USACE E Mail Concerning Mitigation Credits (7-17-2006)

Subject: [Fwd: RE: Moore Property Wetland Mitigation Site]
From: Edward Hajnos <Edward.Hajnos@ncmail.net>
Date: Mon, 17 Jul 2006 11:25:58 -0400
To: Jeff Schaffer <jeff.schaffer@ncmail.net>, Julia Hunt <Julia.Hunt@ncmail.net>

FYI

-------- Original Message --------

Return-Path: <Jean.B.Manuele@saw02.usace.army.mil>
Received: from scc151.its.state.nc.us (207.192.33.38) by ms03.ncmail.net (7.2.069.1) id 44B6FD410001285A for Edward.Hajnos@ncmail.net; Mon, 17 Jul 2006 09:34:15 -0400
Received: from scc151.its.state.nc.us (127.0.0.1) by scc151.its.state.nc.us (7.2.075) id 44A72CD5000B5137 for Edward.Hajnos@ncmail.net; Mon, 17 Jul 2006 09:34:15 -0400
Received: from scc097.its.state.nc.us (207.4.219.18) by scc151.its.state.nc.us (7.2.075) id 44A72CD5000C0C28 for Edward.Hajnos@ncmail.net; Mon, 17 Jul 2006 09:34:15 -0400
Received: from cmx2.usace.army.mil (cmx2.usace.army.mil [140.194.245.34]) by scc097.its.state.nc.us (8.13.7/8.13.7/DRH) with ESMTP id k6HDYCw8012985 for <Edward.Hajnos@ncmail.net>; Mon, 17 Jul 2006 09:34:12 -0400 (EDT)
Received: from eis-ml1itl.eis.ds.usace.army.mil ([140.194.245.33]) by cmx2.usace.army.mil with Microsoft SMTPSVC(6.0.3790.1830); Mon, 17 Jul 2006 08:34:12 -0500
Received: from saw-ml1wil.saw.ds.usace.army.mil ([155.82.225.64]) by eis-ml1itl.eis.ds.usace.army.mil with Microsoft SMTPSVC(6.0.3790.1830); Mon, 17 Jul 2006 08:34:11 -0500
Content-class: urn:content-classes:message
MIME-Version: 1.0
Content-Type: text/plain; charset="US-ASCII"
Content-Transfer-Encoding: quoted-printable
X-MimeOLE: Produced By Microsoft Exchange V6.5
Subject: RE: Moore Property Wetland Mitigation Site
Date: Mon, 17 Jul 2006 09:32:58 -0400
Message-ID: <2D9ED1C2C1D0CB4F918C825EBFC11AD001220FF7@saw-ml1wil.saw.ds.usace.army.mil>
X-MS-Has-Attach:
X-MS-TNEF-Correlator:
Thread-Topic: Moore Property Wetland Mitigation Site
Thread-Index: AcaLBv0zbsLjEUcnTGWdqRIXnGn3JweniO1g
From: Manuele, Jean B SAW <Jean.B.Manuele@saw02.usace.army.mil>
To: Edward Hajnos <Edward.Hajnos@ncmail.net>
X-OriginalArrivalTime: 17 Jul 2006 13:34:11.0989 (UTC) FILETIME=[B057F450:01C6A9A5]
X-Spam-Status: Yes, hits=-99.4 required=6
X-Spam-Score: -99.4 J_CHICKENPOX_22,USER_IN_WHITELIST
X-Scanned-By: MIMEDefang 2.57 on 207.4.219.18

Ed,
Finally getting around to sending you the email that you requested regarding Mr. Moore's property. The violation on Mr. Moore's property was resolved through the verification of Nationwide Permit Number 26 prior to it's expiration in 1999. Accordingly, there are no outstanding violations on the subject property. Should you have any further questions, please do not hesitate to coordinate with me to address any outstanding issues. Have a great day.

Jean B. Manuele
Chief, Raleigh Regulatory Field Office

(919) 876-8441, Ext. 24

-----Original Message-----
From: Edward Hajnos [mailto:Edward.Hajnos@ncmail.net]
Sent: Thursday, June 08, 2006 10:22 AM
To: Manuele, Jean B SAW
Cc: Jeff Schaffer
Subject: Re: Moore Property Wetland Mitigation Site

Jean,
Have you had an opportuninty to investigate the NOV questions associated with the Moore Property in Johnston County? EEP needs clarity on this issue in order to move forward with design.
Thank you.

Edward Hajnos wrote:

> Good morning Jean,
>
> Since we are having trouble reaching each other on the phone I thought
> I would write my questions down in an email. EEP is in the process of
> contracting a designer to complete the final design of the Moore
> Property. I read the Executive Summary of NCDOT's Moore Property
> Wetland Mitigation Plan and discovered the former landowner was issued
> a NOV for clearing the wetland site. Unfortunately the document does
> not have any details regarding the NOV. Jeff Schaffer is cc:ed since
> his staff is responsible for Project Implementation in this CU. I
> have the following questions:
>
> 1. How many acres was this NOV written for? 2. How was this NOV
> resolved?
> As you are aware EEP will not implement projects on which credits
> cannot be obtained. If Mr. Moore was required to restore 34 acres of
> wetlands then the site has little value to our program. Thank you for
> taking the time to answer these questions. Have a nice holiday.
>

--
Ed Hajnos
Design and Construction Supervisor
NCDENR Ecosystem Enhancement Program
office 919-715-1953

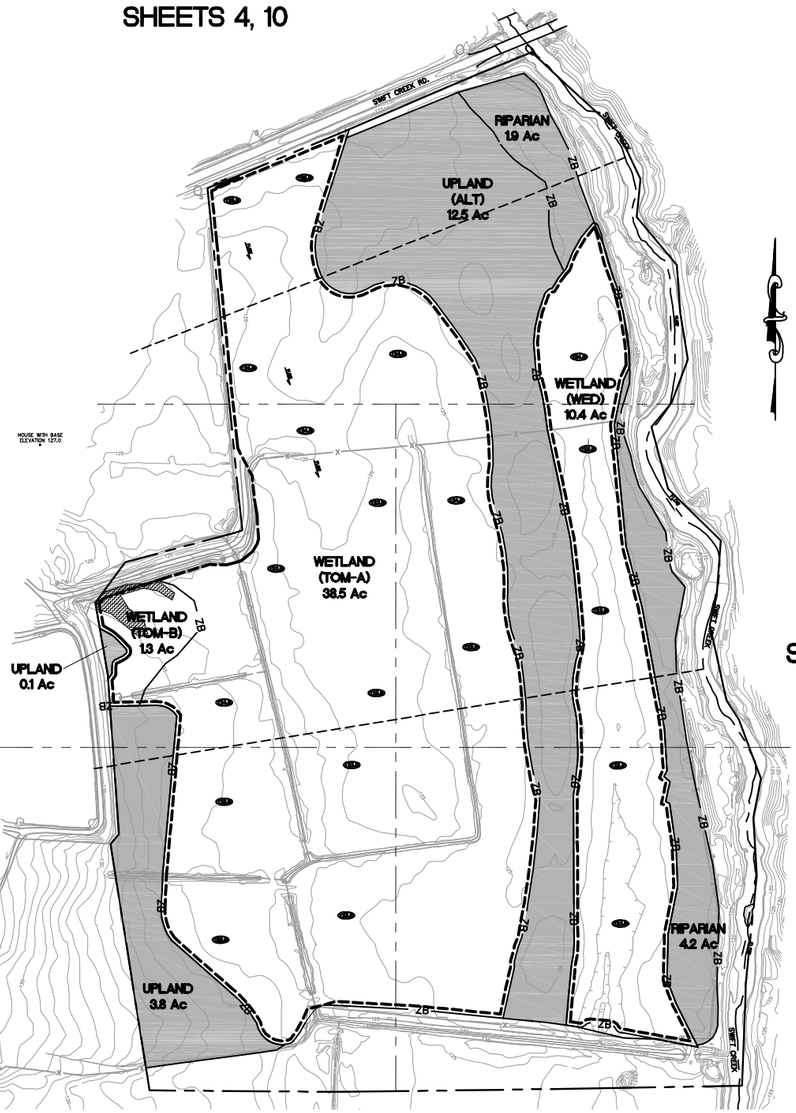
--
Ed Hajnos
Design and Construction Supervisor
NCDENR Ecosystem Enhancement Program
office 919-715-1953

Restoration Drawings

RESTORATION DRAWINGS FOR

MOORE PROPERTY

WETLAND RESTORATION PROJECT



LEGEND

- GRADING LIMITS
- ZB — ZONE BOUNDARY
- CROSS SECTION LINE
- LINEAR DRAINAGE
- 125 — EXISTING MAJOR CONTOUR (5 FT INVERVALS)
- EXISTING MINOR CONTOUR (1 FT INTERVALS)
- EXISTING FENCE
- PROJECT BOUNDARY
- EXISTING TREELINE
- EXISTING TREE
- o 123.8 EXISTING SPOT ELEVATION
- XXX.X PROPOSED SPOT ELEVATION
- 123 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- CLAY CHANNEL PLUG
- CHANNEL FILL
- SEEP AREA

INDEX OF SHEETS

PLANTING LEGEND

- BMT - COASTAL PLAIN BROWNWATER BOTTOMLAND
- LEV - COASTAL PLAIN BROWNWATER LEVEE
- SWP - COASTAL PLAIN BROWNWATER SWAMP

PRELIMINARY
NOT FOR CONSTRUCTION

REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
P.O. BOX 33068 - RALEIGH, NORTH CAROLINA 27636-3068
PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

TITLE: INDEX OF SHEETS

SEAL:

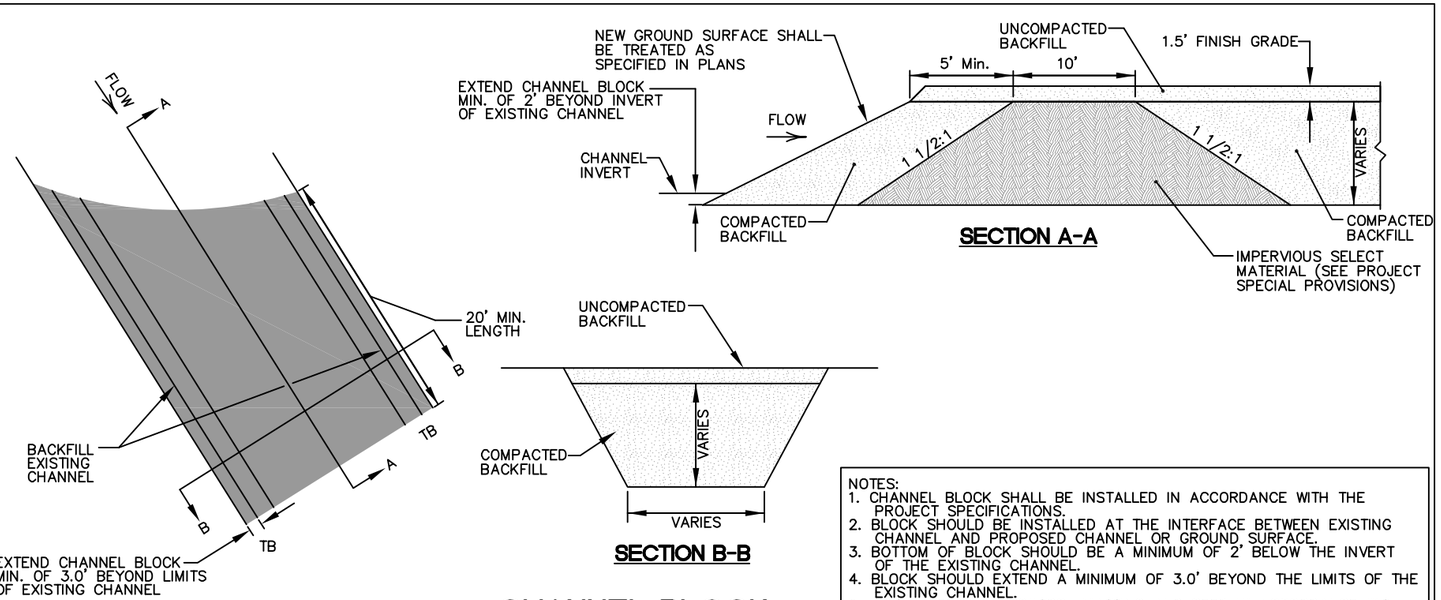
DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

ATTACHED REFERENCE FILES:

JOB NUMBER: 011795023

SHEET NUMBER: 1 OF 14



CHANNEL BLOCK

NOT TO SCALE

NOTES:
1. CHANNEL BLOCK SHALL BE INSTALLED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
2. BLOCK SHOULD BE INSTALLED AT THE INTERFACE BETWEEN EXISTING CHANNEL AND PROPOSED CHANNEL OR GROUND SURFACE.
3. BOTTOM OF BLOCK SHOULD BE A MINIMUM OF 2' BELOW THE INVERT OF THE EXISTING CHANNEL.
4. BLOCK SHOULD EXTEND A MINIMUM OF 3.0' BEYOND THE LIMITS OF THE EXISTING CHANNEL.
5. INSTALL EROSION CONTROL MATTING AND SEED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS IMMEDIATELY AFTER GRADING.
6. COMPACT BACKFILL TO EXTENT POSSIBLE OR AT THE DIRECTION OF THE ENGINEER.

PRELIMINARY
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PREPARED IN THE OFFICE OF:
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P.O. BOX 33068 - RALEIGH, NORTH CAROLINA 27636-3068
PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

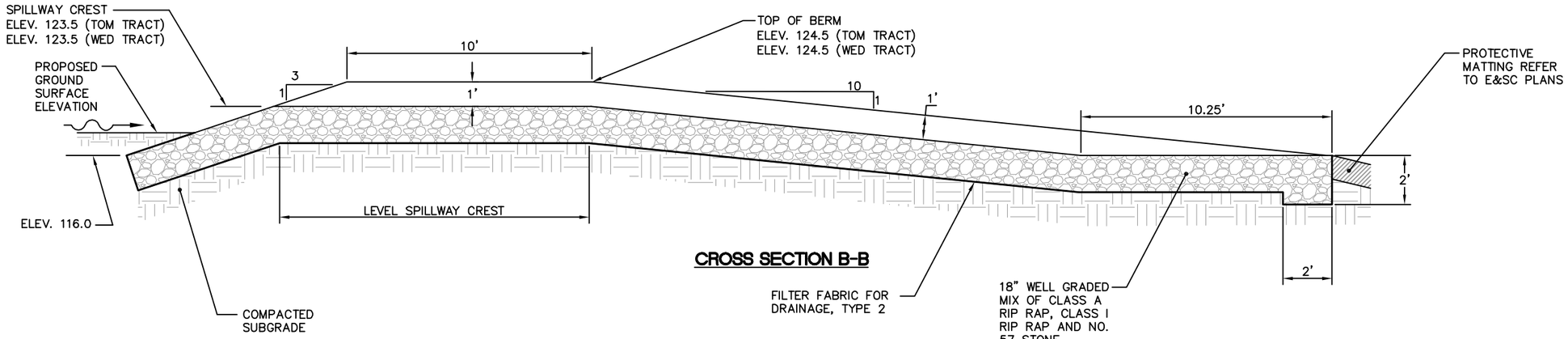
TITLE: DETAILS

SEAL:

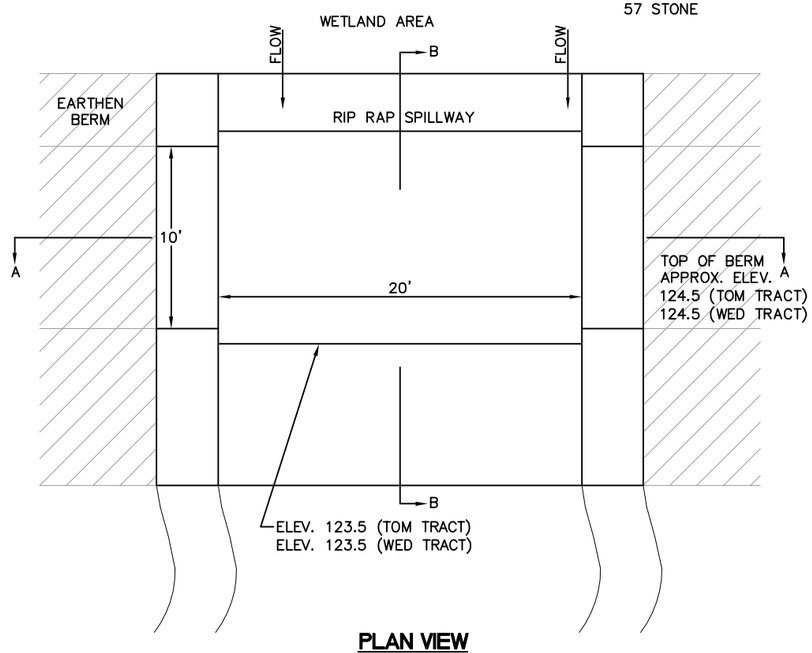
DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

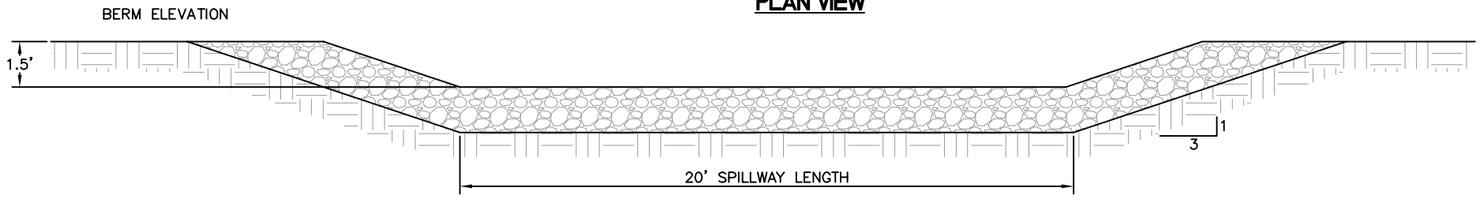
ATTACHED REFERENCE FILES:
JOB NUMBER: 011795023
SHEET NUMBER: 2 OF 14



CROSS SECTION B-B



PLAN VIEW



CROSS SECTION A-A

EMERGENCY SPILLWAY

NOT TO SCALE

PRELIMINARY
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REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

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PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

TITLE: DETAILS

SEAL:

DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

ATTACHED REFERENCE FILES:
JOB NUMBER: 011795023
SHEET NUMBER: 3 OF 14

LEGEND

GRADING LIMITS
ZB ZONE BOUNDARY
CROSS SECTION LINE
LINEAR DRAINAGE
125 EXISTING MAJOR CONTOUR (5 FT INVERVALS)
EXISTING MINOR CONTOUR (1 FT INTERVALS)
EXISTING FENCE
PROJECT BOUNDARY
EXISTING TREELINE
EXISTING TREE
123.8 EXISTING SPOT ELEVATION
XXX.X PROPOSED SPOT ELEVATION
123 PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
CLAY CHANNEL PLUG
CHANNEL FILL
SEEP AREA

100' 0 50' 100' 200'

NOTE:
WETLAND AREAS WILL BE SPOT GRADED TO LIE AT OR BELOW THE PROXIMATE PROPOSED SPOT ELEVATIONS. GRADING WILL BE LIMITED TO PREVIOUSLY CROWNED AREAS AND A MAXIMUM OF 1.5 FEET OF FILL WILL BE REMOVED FROM THESE AREAS. AREAS LYING BELOW PROXIMATE PROPOSED SPOT ELEVATIONS WILL REMAIN AT THE EXISTING ELEVATION. FINAL GRADING WILL ESTABLISH MICROTOPOGRAPHY.

SWIFT CREEK RD.
SWEET CREEK
RIPARIAN
UPLAND (ALT)
WETLAND SWALE
WETLAND (TOM-A)
WETLAND (WED)
UPLAND (ALT)
FLOW
BOULDER SILL EL. = 125.3
CROSS SECTION 1 CUT AT STA 5+18
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00

PRELIMINARY
NOT FOR CONSTRUCTION

MATCHLINE SEE SHEETS 5&6

REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

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Kimley-Horn and Associates, Inc.
P.O. BOX 33068 - RALEIGH, NORTH CAROLINA 27636-3068
PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

TITLE: GRADING PLAN

SEAL:

DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

ATTACHED REFERENCE FILES:

JOB NUMBER: 011795023

SHEET NUMBER: 4 OF 14

MATCHLINE SEE SHEET 3

HOUSE WITH BASE ELEVATION 127.0

WETLAND (TOM-A)

WETLAND (TOM-B)

UPLAND

UPLAND

SEEP AREA

REMOVE EXISTING CULVERT

FLOW

WE 134.6

MATCHLINE SEE SHEET 6

MATCHLINE SEE SHEET 7

LEGEND

- GRADING LIMITS
- ZB — ZONE BOUNDARY
- CROSS SECTION LINE
- LINEAR DRAINAGE
- 125 — EXISTING MAJOR CONTOUR (5 FT INVERVALS)
- EXISTING MINOR CONTOUR (1 FT INTERVALS)
- EXISTING FENCE
- PROJECT BOUNDARY
- EXISTING TREELINE
- EXISTING TREE
- 123.8 EXISTING SPOT ELEVATION
- XXX.X PROPOSED SPOT ELEVATION
- 123 — PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- CLAY CHANNEL PLUG
- CHANNEL FILL
- SEEP AREA

NOTE:
WETLAND AREAS WILL BE SPOT GRADED TO LIE AT OR BELOW THE PROXIMATE PROPOSED SPOT ELEVATIONS. GRADING WILL BE LIMITED TO PREVIOUSLY CROWNED AREAS AND A MAXIMUM OF 1.5 FEET OF FILL WILL BE REMOVED FROM THESE AREAS. AREAS LYING BELOW PROXIMATE PROPOSED SPOT ELEVATIONS WILL REMAIN AT THE EXISTING ELEVATION. FINAL GRADING WILL ESTABLISH MICROTOPOGRAPHY.

100' 0 50' 100' 200'

PRELIMINARY
NOT FOR CONSTRUCTION

REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
P.O. BOX 33068 - RALEIGH, NORTH CAROLINA 27636-3068
PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

TITLE: GRADING PLAN

SEAL:

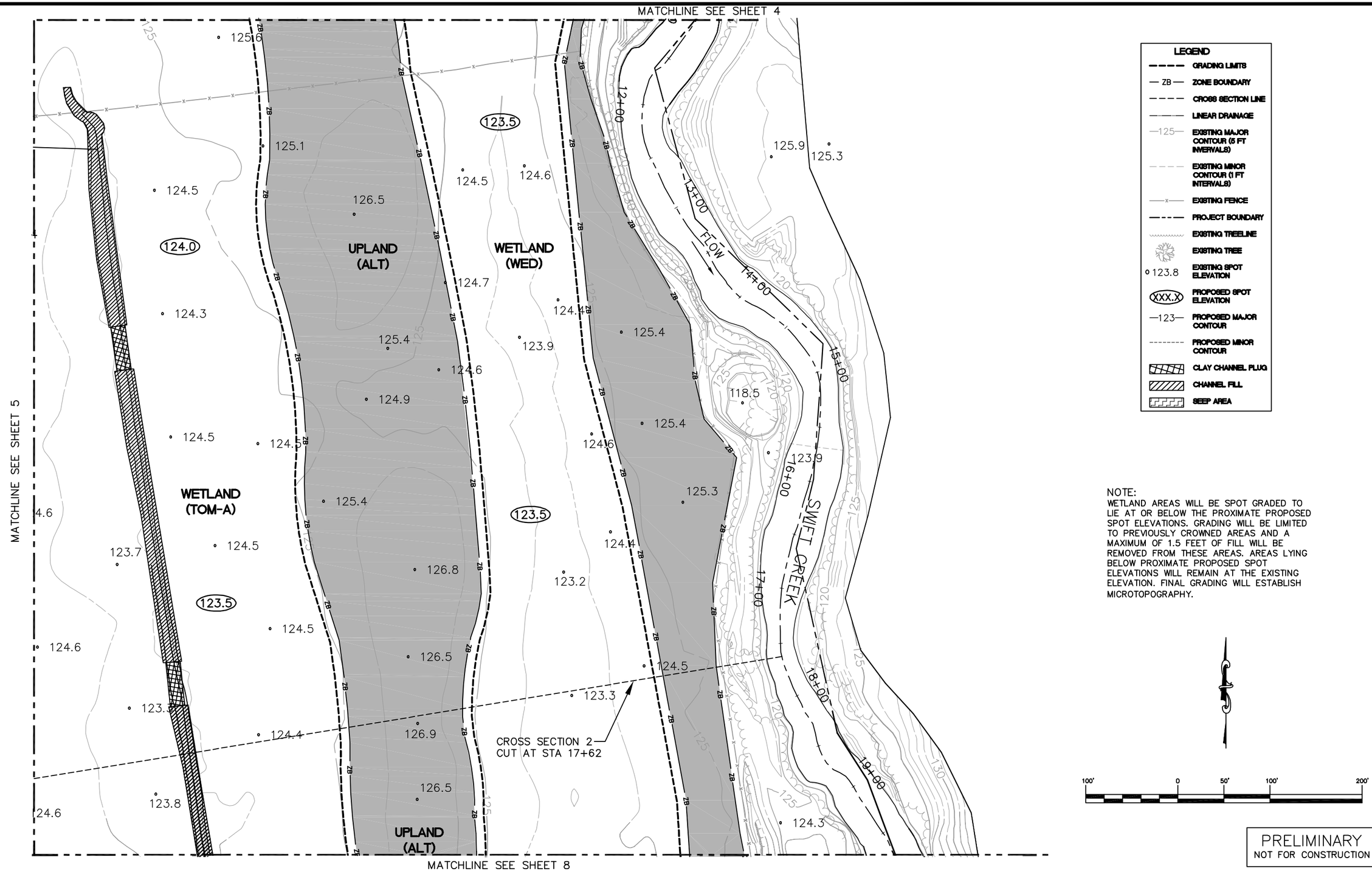
DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

ATTACHED REFERENCE FILES:

JOB NUMBER: 011795023

SHEET NUMBER: 5 OF 14



LEGEND

- GRADING LIMITS
- ZB — ZONE BOUNDARY
- CROSS SECTION LINE
- LINEAR DRAINAGE
- 125 — EXISTING MAJOR CONTOUR (5 FT INVERVALS)
- EXISTING MINOR CONTOUR (1 FT INTERVALS)
- EXISTING FENCE
- PROJECT BOUNDARY
- EXISTING TREELINE
- EXISTING TREE
- 123.8 — EXISTING SPOT ELEVATION
- XXX.X — PROPOSED SPOT ELEVATION
- 123 — PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- CLAY CHANNEL PLUG
- CHANNEL FILL
- SEEP AREA

NOTE:
WETLAND AREAS WILL BE SPOT GRADED TO LIE AT OR BELOW THE PROXIMATE PROPOSED SPOT ELEVATIONS. GRADING WILL BE LIMITED TO PREVIOUSLY CROWNED AREAS AND A MAXIMUM OF 1.5 FEET OF FILL WILL BE REMOVED FROM THESE AREAS. AREAS LYING BELOW PROXIMATE PROPOSED SPOT ELEVATIONS WILL REMAIN AT THE EXISTING ELEVATION. FINAL GRADING WILL ESTABLISH MICROTOPOGRAPHY.

100' 0 50' 100' 200'

PRELIMINARY
NOT FOR CONSTRUCTION

REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
P.O. BOX 33068 - RALEIGH, NORTH CAROLINA 27636-3068
PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

TITLE: GRADING PLAN

SEAL:

DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

ATTACHED REFERENCE FILES:

JOB NUMBER: 011795023

SHEET NUMBER: 6 OF 14

MATCHLINE SEE SHEET 5

100' 0 50' 100' 200'

UPLAND

WETLAND (TOM-A)

CROSS SECTION 2 CUT AT STA 17+62

CLAY CHANNEL BLOCK (TYP.) (SEE DETAIL SHEET 2)

REMOVE EXISTING CULVERT

MATCH TO SURROUNDING GRADE

REMOVE EXISTING CULVERTS

REMOVE EXISTING CULVERT AND REPLACE WITH RIP RAP SPILLWAY INV. EL.=123.5

MATCHLINE SEE SHEET 8

NOTE:
WETLAND AREAS WILL BE SPOT GRADED TO LIE AT OR BELOW THE PROXIMATE PROPOSED SPOT ELEVATIONS. GRADING WILL BE LIMITED TO PREVIOUSLY CROWNED AREAS AND A MAXIMUM OF 1.5 FEET OF FILL WILL BE REMOVED FROM THESE AREAS. AREAS LYING BELOW PROXIMATE PROPOSED SPOT ELEVATIONS WILL REMAIN AT THE EXISTING ELEVATION. FINAL GRADING WILL ESTABLISH MICROTOPOGRAPHY.

LEGEND

- GRADING LIMITS
- ZB — ZONE BOUNDARY
- CROSS SECTION LINE
- LINEAR DRAINAGE
- 125 — EXISTING MAJOR CONTOUR (5 FT INVERVALS)
- EXISTING MINOR CONTOUR (1 FT INTERVALS)
- EXISTING FENCE
- PROJECT BOUNDARY
- EXISTING TREELINE
- EXISTING TREE
- 123.8 EXISTING SPOT ELEVATION
- XXX.X PROPOSED SPOT ELEVATION
- 123 — PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- CLAY CHANNEL PLUG
- CHANNEL FILL
- SEEP AREA

PRELIMINARY
NOT FOR CONSTRUCTION

REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
P.O. BOX 33068 - RALEIGH, NORTH CAROLINA 27636-3068
PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

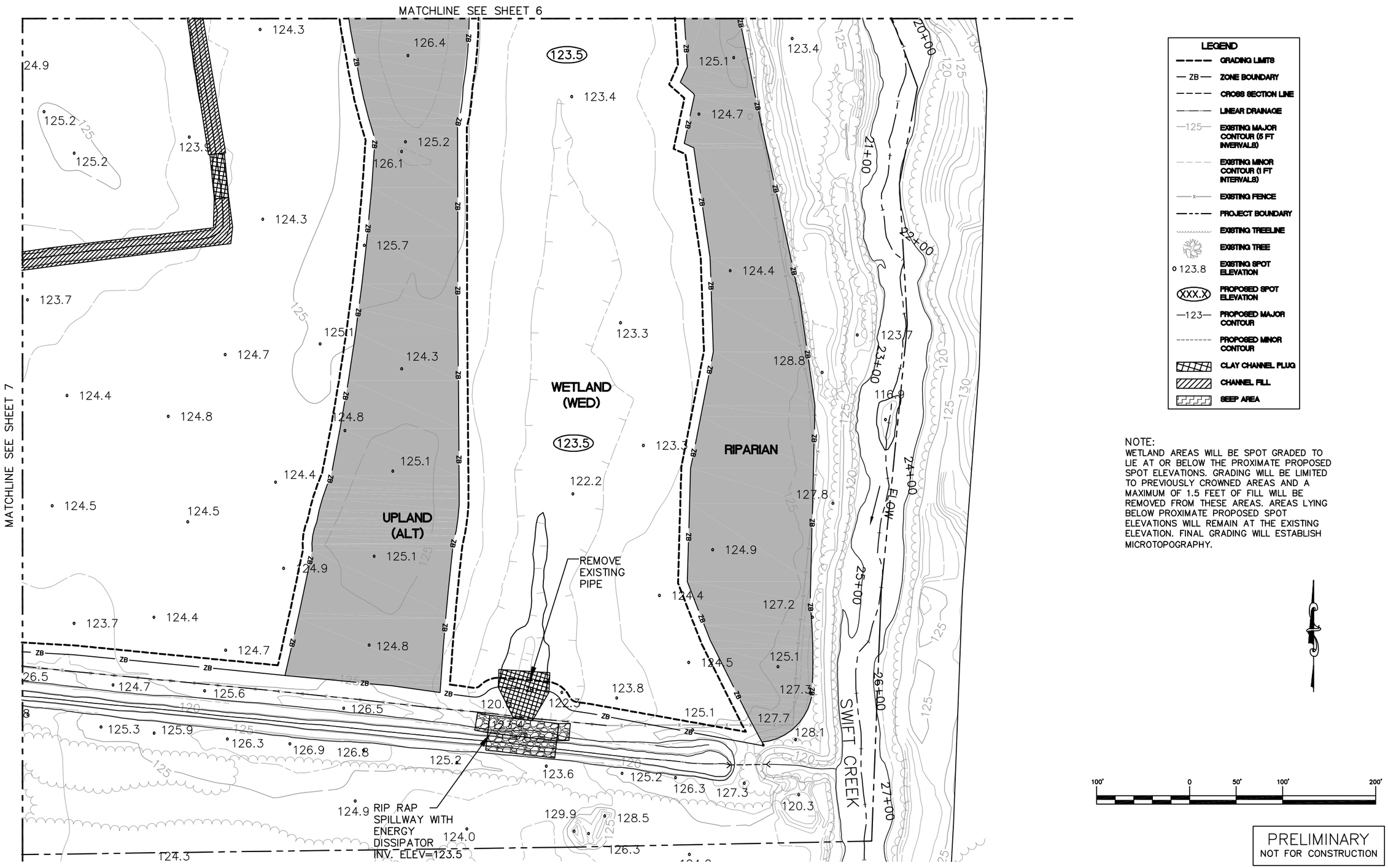
TITLE: GRADING PLAN

SEAL:

DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

ATTACHED REFERENCE FILES:
JOB NUMBER: 011795023
SHEET NUMBER: 7 OF 14



LEGEND

- GRADING LIMITS
- ZB — ZONE BOUNDARY
- CROSS SECTION LINE
- LINEAR DRAINAGE
- —125— EXISTING MAJOR CONTOUR (5 FT INVERVALS)
- EXISTING MINOR CONTOUR (1 FT INTERVALS)
- EXISTING FENCE
- PROJECT BOUNDARY
- EXISTING TREELINE
- EXISTING TREE
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- SEEP AREA

NOTE:
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100' 0 50' 100' 200'

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DRAWN BY: JIK
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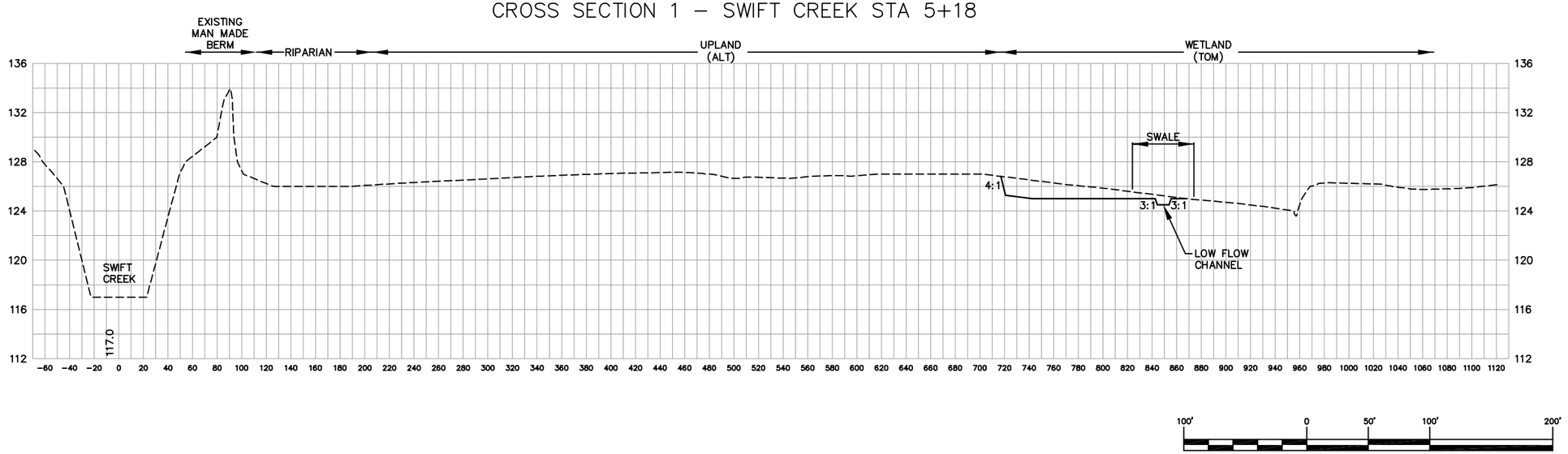
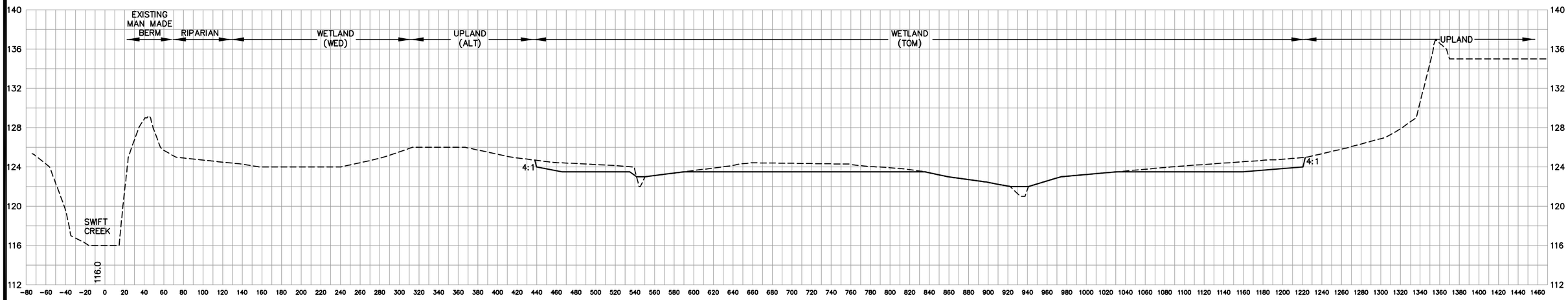
ATTACHED REFERENCE FILES:
JOB NUMBER: 011795023
SHEET NUMBER: 8 OF 14

CROSS SECTION 1 – SWIFT CREEK STA 5+18



CROSS SECTION 2 – SWIFT CREEK STA 17+62



LEGEND

EXISTING GROUND

PROPOSED GRADE

PRELIMINARY
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PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

TITLE: CROSS SECTIONS

SEAL:

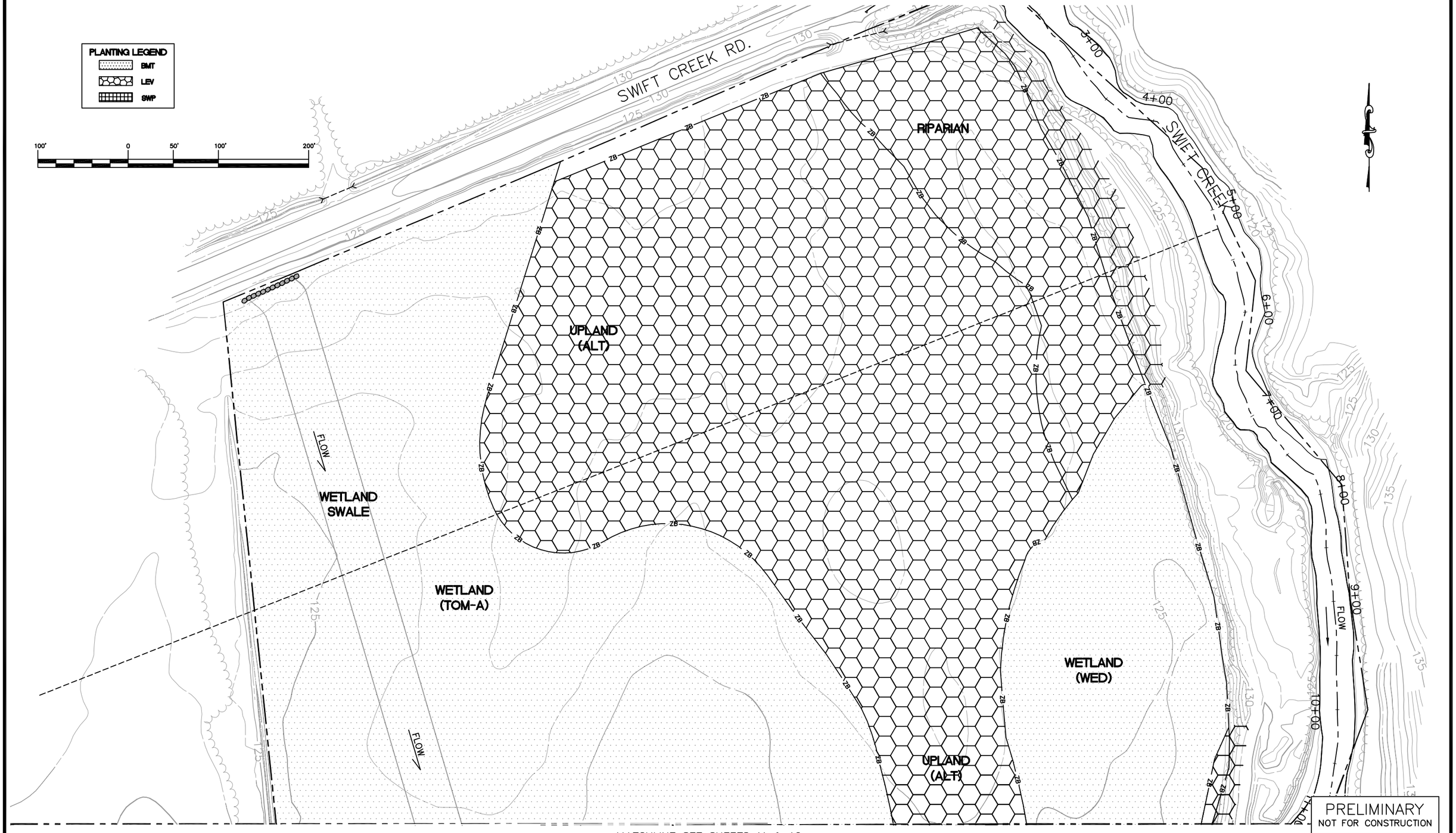
DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

ATTACHED REFERENCE FILES:

JOB NUMBER: 011795023

SHEET NUMBER: 9 OF 14



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MATCHLINE SEE SHEETS 11 & 12

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PHONE: (919) 677-2000 FAX: (919) 677-2050

CLIENT: STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE: PLANTING PLAN

SEAL:

DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

ATTACHED REFERENCE FILES:

JOB NUMBER: 011795023

SHEET NUMBER: 10 OF 14

MATCHLINE SEE SHEET 10

HOUSE WITH BASE ELEVATION 127.0

125

SEEP AREA

FLOW

WETLAND (TOM-A)

WETLAND (TOM-B)

UPLAND

UPLAND

ZB

130

135

MATCHLINE SEE SHEET 12

MATCHLINE SEE SHEET 13

PLANTING LEGEND

- BMT
- LEV
- SWP

100' 0 50' 100' 200'

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CLIENT: STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

TITLE: PLANTING PLAN

SEAL:

DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY WETLAND RESTORATION

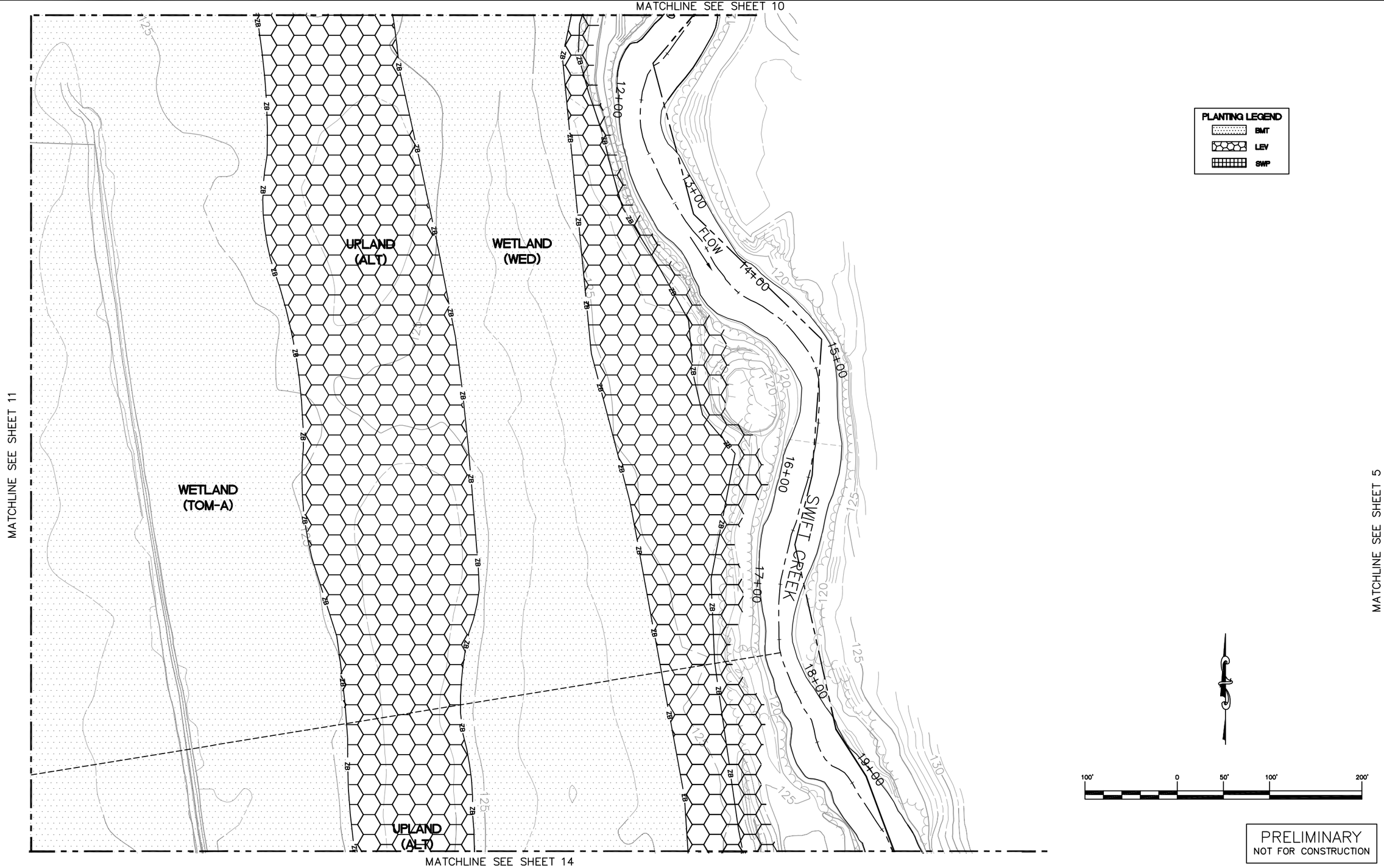
ATTACHED REFERENCE FILES:
JOB NUMBER: 011795023
SHEET NUMBER: 11 OF 14

MATCHLINE SEE SHEET 10

MATCHLINE SEE SHEET 11

MATCHLINE SEE SHEET 5

MATCHLINE SEE SHEET 14



PLANTING LEGEND

- BMT
- LEV
- SWP

100' 0 50' 100' 200'

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CLIENT: STATE OF NORTH CAROLINA
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TITLE: PLANTING PLAN

SEAL:

DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY
WETLAND RESTORATION

ATTACHED REFERENCE FILES:
JOB NUMBER: 011795023
SHEET NUMBER: 12 OF 14

PRELIMINARY
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REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

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CLIENT: STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

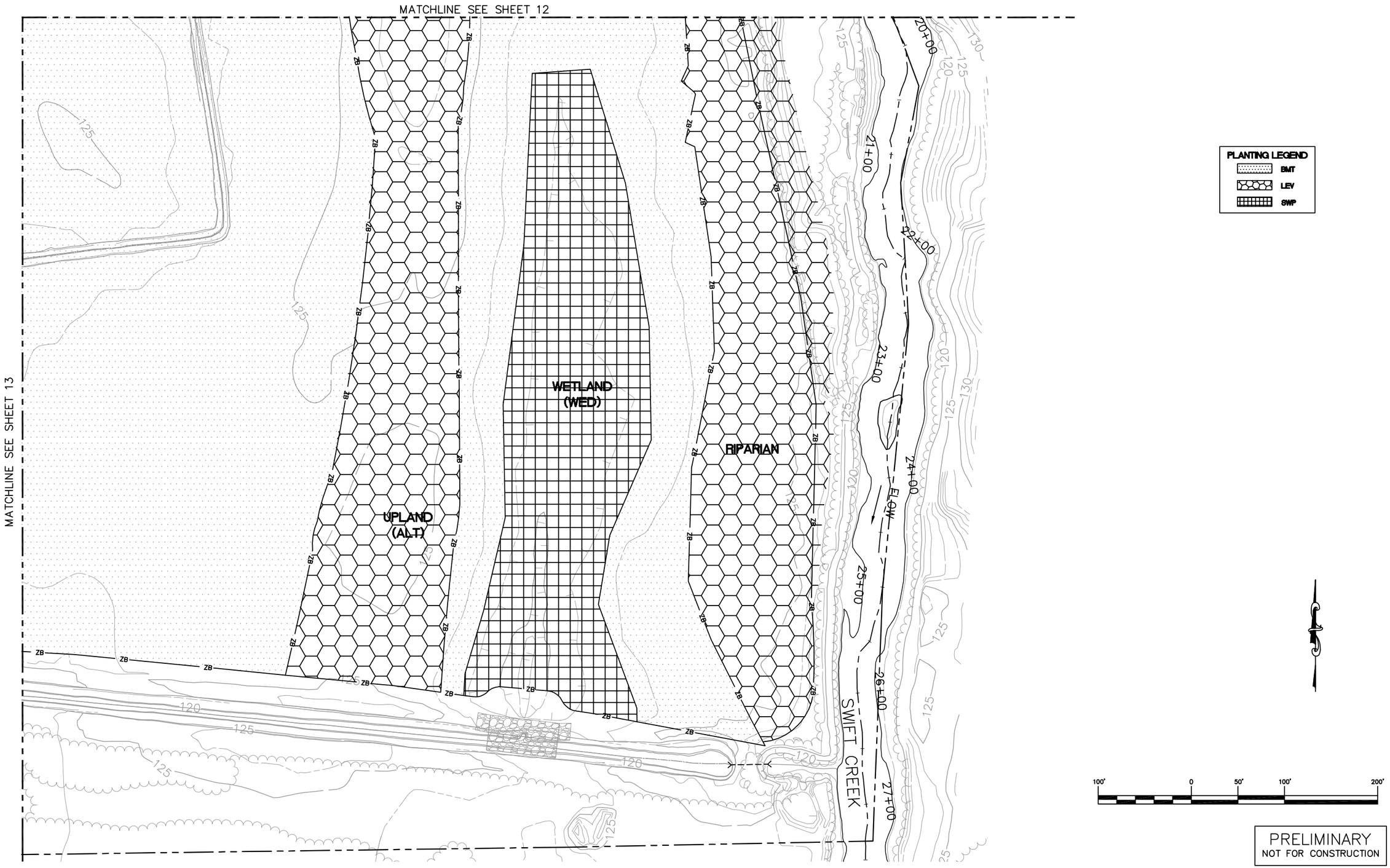
TITLE: PLANTING PLAN

SEAL:

DATE: 08/16/07
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: DMP

PROJECT: MOORE PROPERTY
WETLAND RESTORATION

ATTACHED REFERENCE FILES:
JOB NUMBER: 011795023
SHEET NUMBER: 13 OF 14



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WETLAND RESTORATION

ATTACHED REFERENCE FILES:
JOB NUMBER: 011795023
SHEET NUMBER: 14 OF 14