

**Armstrong Property
Wetland Restoration
June 2007
Restoration Plan**

Albemarle Restoration LLC

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Armstrong Property Wetland Mitigation

1.0 Introduction

The North Carolina Department of Environment and Natural Resources Ecosystem Enhancement Program has selected 25 acres of the property owned by Bobby Armstrong and Lou M. Armstrong for wetland/stream restoration to fulfill a portion of the Request for Proposals (RFP): Full Delivery Project Tar Pamlico River Basin, RFP 16-D06012. An option for an easement purchase by Albemarle Restorations, LLC was signed by the landowners on November 17, 2005 for this full delivery contract. The purpose of the RFP and subsequent contract(s) awarded by EEP is to provide compensatory stream, wetland and/or buffer mitigation within the Tar-Pamlico River Basin Cataloging Unit 03020104. Albemarle Restorations, LLC entered into a contract with the State of North Carolina on April 5, 2006 to deliver 20 wetland mitigation units and 2,000 stream units on the Armstrong project site, Contract No. D06012-A. An easement was recorded on the 25 acres encompassing this project on March 12, 2006 and is provided in **Appendix B**.

Albemarle Restorations, LLC proposes to restore 20 acres of riverine wetlands (20 Wetland Mitigation Units) and 2,000 linear feet of stream restoration (2,000 Stream Units) on the Armstrong Property, located on Route 45 near Ponzer, in Hyde County, North Carolina. The Armstrong Property is in the Pungo River watershed (USGS Cataloging Unit 03020104090010), which is currently listed as “impaired” as noted in the 2004 Tar-Pamlico River Basinwide Water Quality Plan. As designed, the site is within required 5-year floodprone area.

The site has been chosen in part because of its location in a targeted watershed and because it provides the opportunity to add contiguous diverse wetland habitat to a high quality cypress-dominated riverine wetland system directly adjacent to the project area. The project’s location in the Pamlico River Sub-basin (Sub-basin 03-03-07) allows the 25 acres placed in a conservation easement to join the existing wetland system and nearby forested areas in close proximity. This project site has been selected because of the soils present and a very shallow depth to groundwater (indicated by extensive past ditching). Previous site visits have revealed high water marks from frequent overbank flooding of the existing ditches and widespread wet soil conditions. These factors indicate that minimal grading will be necessary, and that the desired hydrophytic vegetation to be planted will thrive.

The +/- 132-acre Armstrong Property is currently in agricultural production, and is adjacent to a high quality cypress swamp surrounding Clark Mill Creek, a small tributary to the Pungo River. The conversion of this site from agricultural use to established riverine wetlands with restored swamp runs and a bottomland hardwood riparian

community will restore an extensive wetland buffer along the entire stream within the project and easement area, making this a practical and environmentally beneficial restoration project.

2.0 Project Goals and Objectives

The restoration plans have been developed based on reference wetlands and utilizing the 50 years of combined wetland restoration experience brought forth by the principals of Albemarle Restorations, LLC. The baseline goals of the project are to restore wetland hydrology and establish a viable community of wetland vegetation throughout the project area. Beyond that, the goals and objectives are as follows:

- 1) Provide floodflow attenuation.
- 2) Improve water quality through sediment, toxicant, and nutrient retention and reduction.
- 3) Alleviate downstream flooding issues by lessening the effect of pulse or flashy flows.
- 4) Provide shading through long-term forest cover to reduce algae growth and associated low dissolved oxygen levels in surface water moving through the site.
- 5) Produce and export food sources for a wide range of wildlife.
- 6) Restore wildlife habitat and recreational opportunities.

3.0 Site Location

The 25-acre project site is located in the central east portion of the Armstrong property, in the Pungo River watershed (USGS Cataloging Unit 03020104090010), which is currently listed as “impaired” as noted in the 2004 Tar-Pamlico River Basinwide Water Quality Plan. The restoration site lies adjacent to a cypress swamp surrounding Clark Mill Creek, a tributary to the Pungo River. The site is accessed from Route 45, southeast of Ponzer, via an existing farm lane. A vicinity map is provided and is labeled as **Figure 1** in **Appendix A**. Downstream from the site, the tributary runs almost entirely through wooded areas containing extensive wetlands before joining the Pungo River. The tributary and the proximity of the site to nearby forested areas on the most recent available GIS aerial photos of the area are shown on **Figure 2** in **Appendix A**.

4.0 General Watershed Description

The project site is located in Targeted Local Watershed 03020104090010, Pungo River, which lies in the Tar-Pamlico River Sub-basin 03-03-07, the Pamlico River. The following information was extrapolated from the *Tar-Pamlico Basinwide Water Quality Management Plan, 1999*. Forest/wetlands constitute 55% of the land in Sub-basin 03-03-07, while 25% is agricultural, and 18% is surface water in this 1,192 square mile area. In 1990 the population in this sub-basin was estimated at 37,658 people. The Pungo River

is the largest tributary to the Pamlico River and was considered partially supporting its uses in 1994.

5.0 Existing Site Conditions

The Armstrong farm consists of approximately 132 +/- acres, 25 of which are designated for this project site. The project site is located within the central east portion of the farm, and is presently intersected by 4 drainage ditches that are aligned north to south from the property boundary to Route 45. The ditch located on the western most portion of the project site is the channelized and re-routed tributary to Clark Mill Creek. The stream restoration component of the project involves restoring headwater swamp run hydrology to the tributary. The majority of the project area is currently bordered by agricultural fields to the north, south, southeast, and west. The eastern portion of the project area is currently bordered by timberland. Degradation to the channels and surrounding areas by past agricultural activities, including channel straightening and planting of row crops up to the channel edges, has allowed excessive nutrient and sediment accumulation in the channels. These past activities have also served to dramatically reduce the flood flow attenuation capabilities of the channels. **Appendix C** contains photographs taken during a recent site visit, showing the degradation of the channel and the proximity of tilled ground. The site is not located within a FEMA regulated floodplain, therefore floodplain requirements are not addressed in this restoration plan.

5.1 Soils

Soils examined at several locations throughout the project site in spring of 2005 exhibited strong hydric indicators, including sulfitic odor and deep gray color. The majority of the site soils are mapped Yonges loam and Acredale silt loam, with areas of Chapanoke silt loam and Yeopim silt loam. The Yonges and Acredale series underlay approximately 80% of the Armstrong tract. The Acredale series is derived from marine and fluvial sediment parent material. The Yonges loam and Acredale silt loam mapped on the site are classified as hydric with a seasonally high water table and low hydraulic conductivity which allows surface and subsurface water to be retained for long periods during the growing season. The Hydric Code for all four soils is 2B3, meaning it is poorly to very poorly drained and the water table is at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 inches per hour in any layer within 20 inches.

5.2 Hydrology

The above mentioned tributary and other natural drainage courses that existed prior to clearing and draining for agriculture have been drastically altered to facilitate large scale row crop farming. Based on historical accounts from the property owner(s), the project area was wetland prior to being cleared and

ditched, and in some years farming is not possible due to continually saturated soils and the high water table. Because of the high water table and excessively slow permeability of the soils on the site, and historical accounts that the site was formerly a cypress dominated swamp run surrounded by wetlands, the desired wetland hydrology should be achieved quickly after the site grading is completed.

5.3 Adjoining Land Uses

The topography of the project site is extremely flat, with slightly lower elevations on the eastern and southern sides. Elevations of the project area vary from 2.0' to 4.0' at the bottom of the ditches to 7.5' at the highest points of the project area. Surrounding properties that are within the project site's drainage area are mapped as either agricultural fields or timberland.

5.4 Threatened/Endangered Species and Existing Vegetation

On May 15, 2006 letters (see **Appendix B**) were sent by Albemarle Restorations, LLC to the U.S. Fish and Wildlife Service Ecological Services Office and the North Carolina Wildlife Resources Commission requesting a project review for coordination under the Endangered Species Act, the Fish and Wildlife Coordination Act, and the Migratory Bird Treaty Act. Albemarle Restorations, LLC received no response to either letter. A review of Hyde County's Threatened and Endangered Species list shows seven threatened and seven endangered species exist in the county. Five of these threatened or endangered species are sea turtles which would not inhabit the project site due to the shallow water depth and lack of water salinity. Three bird species, the piping plover (*Charadrius melodus*), the bald eagle (*Haliaeetus leucocephalus*), and the red-cockaded woodpecker (*Picoides borealis*) are listed as threatened/endangered in the county. None of these three species, or their habitat, is currently found on the project site. The shortnose sturgeon (*Acipenser brevirostrum*) and the West Indian manatee (*Trichechus brevirostrum*) are both listed as endangered in the county. The American alligator (*Alligator mississippiensis*) is "threatened due to similarity" in the county, making it exempt from Section 7 consultation. There is currently an experimental population of red wolves (*Canus rufus*) in the county, however, they are confined to the Alligator River National Wildlife Refuge. The sensitive joint-vetch (*Aeschynomene virginica*) is a threatened plant species that occurs on only one site in the county, and the threatened seabeach amaranth (*Amaranthus pumilus*) occurs only on the sand dunes of barrier islands.

The only existing vegetation within the project area consists of soybeans and corn grown for agricultural purposes. Native vegetation is absent within the project area at a scale sufficient to sustain natural wildlife habitat. Soft rush (*Juncus effuses*), and cattail (*Typha latifolia*) have colonized the main ditches in the restoration area.

5.5 Jurisdictional Wetlands

According to the property owner, Mr. Armstrong, the property has been in his family for the last 15 years and has always been used since that time for agricultural purposes. He also indicated that the farm was previously forested and logged prior to the land being sold to him. The extensive ditching and soils on site indicate that the project area was wetland at some point in the past. As with other similar projects, an application will be made to the COE and the North Carolina Division of Water Quality when the Restoration Plan has been approved by EEP. Impacts to the stream/ditches is considered transition of wetland type from waters to vegetated wetlands. Normally this conversion and relocation of Waters is authorized under Nationwide Permit #27, Stream and Wetland Restoration Activities.

5.6 Historic Preservation

On June 7, 2006 Ecotone, Inc. received a letter (**see Appendix B**) from the North Carolina Department of Cultural Resources State Historic Preservation Office concerning the subject site. The letter states that the above agency has “no concerns regarding cultural resources within the project area.”

6.0 Reference Wetlands

A tributary to Clark Mill Creek, located on the northeast corner of the Armstrong property, approximately 200 yards from the project area, was selected as a reference site. The reference site was chosen because it contains a headwater swamp run and extensive riparian wetlands very similar to the proposed conditions of the project site. The site was sampled January 10, 2007 within the swamp run and the wetlands adjacent to it. This is a wetland site typical of a cypress dominated wetland that would be found throughout the coastal plain in Hyde County, North Carolina.

6.1 Hydrological Characterization

The hydrology of the site is seasonally or semi-permanently inundated or saturated during the growing season. During the January, 2007 site visit, most of the site was under 1-6 inches of water within the swamp run and the adjacent wetlands were saturated within 1 inch of the ground surface. The robust hydrology is derived from a combination of a high groundwater table, slow permeability, and overbank flooding. Microtopography variations restore soil conditions at both sites ranging from inundation up to 18 inches to saturation at a depth of ten inches.

6.2 Soil Characterization

The soils at the reference site were mapped Dorovan muck, 0-1 percent slopes, and Yonges loam, slopes less than 2 percent. Field observations confirmed this mapped type. A profile of the soils at the site produced the following: Horizon O was found from a depth of 0-4 inches and was of an organic nature with a matrix color of 10YR 2/1. Horizon A was found from a depth of 4-8 inches and was sandy/clay in nature with a matrix color of 10YR 4/1. Horizon B occurred from a depth of 8-16 inches and was of a sandy/clay nature and matrix color of 10YR 5/1. All colors described at this site are considered Munsell Moist. Photographs of the site can be found in **Appendix C**.

6.3 Plant Community Characterization

At the reference site, 100 percent of the dominant species were OBL, FACW or FAC within the swamp run, and 90 percent of the dominant species were FAC or wetter in the adjacent wetlands. Within the swamp run, the fairly open canopy was dominated by bald cypress (*Taxodium distichum*), with red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*) making up the upper layers of the understory. The lower layers of the understory and shrub layer were also moderately open, with greenbrier (*Smilax spp.*), bayberry (*Myrica heterophylla*), and highbush blueberry (*Vaccinium corymbosum*) dominant.

Willow oak (*Quercus phellos*) loblolly pine (*Pinus taeda*) and pin oak (*Quercus palustris*) dominate the canopy in the wetland areas, with red maple and black gum common in the upper layers of the understory. Lower layers of the understory contain American holly (*Ilex opaca*), bayberry, highbush blueberry, sweet pepperbush (*Clethra alnifolia*), and greenbrier (*Smilax spp.*). Herbaceous species were not identified because the site visit was conducted in January, but it was noted that there was much less evidence of herbaceous species occurring in the swamp run area than in the wetland areas. **Appendix C** contains photographs of the site.

7.0 Restoration Plan

The goal of the proposed restoration plan is to restore a continuous headwater swamp run/riverine wetland system such as those typically found in the middle to upper reaches of first or zero order tributary systems. The width of the swamp run will be a minimum of 100 feet. Within the swamp run, flow will be through a broad series of intertwined sinuous channels. The majority of water flowing through the site under normal climactic conditions will be concentrated within the swamp run by leaving the elevation at an average of .5 feet below the surrounding riverine wetlands. The target plant community is a varied wetland forest surrounding a cypress-dominated swamp with elevated hummocks to promote cypress growth to provide a continuous forested and diverse

greenway along the tributary. Any invasive or exotic species found on the site while earth work is being completed will be removed through physical or chemical means.

7.1 Hydrologic Modifications

The primary goal of the project is to restore to a natural state the channelized and straightened tributary on the western portion of the project site. The existing ditches through the project area will be graded out, and ditches in surrounding agricultural fields will be re-routed so that much of the surrounding area (+/- 65 acres) will drain into the 25 acre project site. The ditch on the western edge of the site is to be re-routed through the project area and graded into a swamp run with a gradient of less than 0.5 percent slope and multiple sinuous interconnected channels. Adjacent to the swamp run on both banks will be riverine wetlands at an elevation between 0.5 and one foot above the mean elevation of the swamp run. Periodic flooding from the swamp run (see **Appendix D** for the HEC-RAS analysis of the site), the seasonally high water table and the extremely slow permeability of the soils will provide the necessary wetland hydrology for the adjacent wetlands. The five-year storm discharge will raise the flood elevation to 6.60 feet, inundating the entire project site.

To add to the retention time of flooding events in the wetland area and increase the direct relationship between the swamp run and the surrounding wetlands, microtopography will be used to create hummocks and depressions utilizing the current as well as proposed changes in elevation. The grading plan allows for deviations of up to one foot (1') for creating hummocks and depressional areas. A low berm structure has been designed at the lower end of the system extending around the perimeter of the project area to assist in water retention and prevent any increase in flooding potential outside of the project/easement area. The outfall from the system is adjacent to the existing access lane at the downstream portion of the berm structure, and will channel flood flows through a wide outfall into the existing swamp run that drains into Clark Mill Creek.

7.2 Soil Restoration

Soils found in the project area currently exhibit hydric characteristics and will remain. In small areas where grading of more than one and one-half feet is proposed, soil from the upper horizon will be stockpiled and redistributed prior to establishing final grade. Because sufficient organic material appears to be present to a significant depth, no amendments are specified. Large woody debris encountered within the project area will be placed throughout the restored wetlands to add variety to soil conditions and encourage diversity of volunteer species.

7.3 Plant Community Restoration

The plant species chosen for the project are native to the area, with an emphasis on species that will provide habitat and a viable, yearlong food source for a wide range of animal and plant species. Surrounding areas are home to bear, whitetail deer, raccoon, squirrel, fox, migrating waterfowl, and a wide variety of amphibian and reptile species. One of the intentions of the project is to provide food and habitat to complement and enhance the existing ecosystem. Hydrophytic species shown on the planting plan were selected to restore a diverse wetland/swamp run community. Invasive and exotic species will not be planted on the site. Any invasive or exotic species found on the site will be removed through physical or chemical means during the planting phase. In selecting vegetation, we have considered reference riverine wetland areas adjacent to the site and “Dominant Plants for Major Wetland Types” published by the North Carolina Department of Environment Water Quality Section. **Sheet P-2** of the Restoration Design Plan Sheets contains detailed planting and seeding schedules for the site.

7.4 Plant Material

7.4.1 Planting Specifications

1. Planting material will conform to the current issue of the "American Standards for Nursery Stock", published by the "American Association of Nurserymen".
2. The root system of plant material shall be well-developed and undamaged, and the plant size must conform to the size specified. Plants not meeting these criteria will be rejected.
3. Foliage of non-dormant plants shall appear healthy, with no leaf spots, damage, discoloration, or wilting, and no evidence of insects on the plant. Plants not meeting these criteria will be rejected.
4. Planting materials may be substituted upon written approval from Albemarle Restorations, LLC.

7.4.2 Storage and Delivery

1. Seed shall be delivered in containers having labels reporting the origin, purity, and germination percentage of the seed, and the date of germination testing of the seed.
2. All bare root plants shall be clearly and correctly labeled to allow confirmation of species and quantities. At least 25% of each species in every shipment shall have legible labels securely attached prior to delivery to the site.

3. All plants delivered to the project site must have thoroughly moist soil/root masses. Dry or light-weight plants shall be rejected.
4. All rejected material shall be immediately removed from the project site.
5. All plants delivered to the project site shall be stored in a cool, shaded location, and watered regularly so that roots are kept moist until time of planting.

7.4.3 Products

1. Planting Schedules specifying quantity, species, size, condition, and spacing can be found on **Sheet P-2** of the Restoration Design Plan Sheets.
2. Straw shall be from small grain species such as wheat or barley, and shall be free of rot, mildew, and noxious weed seeds.

7.4.4 Planting Procedures

1. Planting shall be performed in accordance with the current edition of the Landscape Contractors Association "Landscape Specification Guidelines" and as specified below.
2. Plants shall be randomly installed within the planting area, using the plant spacing specified in the plant schedule as a guide.
3. Bare root stock shall be planted during the period of February 1 - April 30. Planting outside of these specified dates is not permissible without approval from Albemarle Restorations, LLC.
4. Planting shall not occur during periods of sub-freezing temperatures, when the ground is frozen or excessively wet or dry, or when other conditions not generally accepted as suitable for planting persist.
5. Bare root stock shall be planted within two days of shipment.
6. Bare root seedlings and whips shall be minimum 1/4" to 1/2" caliper.
7. Bare root seedlings and whips shall be planted in accordance with the detail provided on Sheet P-2 of the Restoration Design Plan Sheets unless otherwise approved by Albemarle Restorations, LLC.
8. All woody material must be planted erect. Plants leaning greater than 10 degrees from perpendicular must be straightened or replanted by the Contractor.

7.4.5 Maintenance and Guarantee

1. Plant material shall be maintained by the Contractor for one full year from the date of final inspection and acceptance by Albemarle Restorations, LLC. Maintenance shall include the removal and one-time replacement of all dead or diseased woody vegetation.

2. The Contractor shall guarantee an 80% survival of all plants for the one year period stated above, except in the case of damage by fire, animal damage, vandalism, or other events beyond the Contractors ability to control.
3. Plants which are 25% dead or more shall be considered dead.
4. Replacement plants shall be of the same type, size, and variety as the plants specified herein, or substitutions approved by Albemarle Restorations, LLC. Replacement plants shall be provided and installed subject to the requirements of these plans and specifications.

7.5 Seeding

7.5.1 Final Grading

1. Prior to seeding, remove any mounds or surface irregularities not in conformance with grading plan. Areas that have experienced washing out, rilling, or sediment deposition shall be reconstructed and grades re-established by the Contractor in accordance with the plan or as otherwise directed by Albemarle Restorations, LLC.
2. After bringing the wetland creation area to final grades, loosen soil by discing or scarifying to a depth of at least 3 inches.
3. Prior to seeding, remove all trash, debris and large objects such as stones that might interfere with the seeding operation.
4. Seeding of wetland areas is to be according to the Wetland Seed Mix detail on **Sheet P-2** of the Restoration Design Plan Sheets. Seed shall be spread with a broadcast spreader and may be mixed with dry sand to facilitate even spreading.

7.5.2 Soil Amendments

1. Soil tests must be performed to determine if lime and/or fertilizer are required within seeding areas. Soil analysis may be performed by the N.C. Department of Agriculture and Consumer Services Agronomic Division or a recognized commercial laboratory.
2. Amend soil as needed based on N.C. Department of Agriculture and Consumer Services Agronomic Division recommendations.

7.5.3 Seedbed Preparation

1. Seedbed preparation shall consist of loosening soil to a depth of 3-5" by means of suitable agricultural or construction equipment such as disc harrows or chisel plows or rippers mounted in construction equipment. After the soil is loosened it should not be rolled or dragged smooth but left in the roughened condition. Sloped areas (Exceeding 3:1) should be

tracked leaving an irregular surface with ridges running parallel to the contour of the slope.

2. Apply fertilizer and lime if required.
3. If required, incorporate lime and fertilizer into the top 3-5" of soil by disking or other suitable means.

7.5.4 Seed Specification

All seed shall be free of noxious weeds. All seed shall be subject to re-testing by a recognized seed laboratory. All seed shall have been tested within the 6 months immediately preceding the date of sowing such materials on this job. Seed tags shall be made available to the inspector to verify type and rate of seed used.

7.5.5 Methods of Seeding

1. Dry seeding: This includes use of conventional drop or broadcast spreaders.
 - a) Seed spread dry shall be incorporated into the subsoil at the rates prescribed on the temporary or permanent seeding summaries or tables 25 or 26. The seeded areas shall then be rolled with a weighted roller to provide good seed to soil contact.
 - b) Where practical, seed should be applied in two directions perpendicular to each other. Apply half the seeding rate in each direction.
2. Drill or cultipacker seeding: Mechanized seeders that apply and cover seed with soil.
 - a) Cultipacking seeders are required to bury the seed in such a fashion as to provide at least 1/4 inch of soil covering. Seedbed must be firm after planting.
 - b) Where practical, seed should be applied in two directions perpendicular to each other. Apply half the seeding rate in each direction.

8.0 Monitoring

Monitoring plots will be installed and permanently monumented upon completion of plant installation. A minimum of one sampling quadrant will be located within each proposed vegetative community. Because the restoration plan requires the site to be hummocked, it is likely that sampling quadrants will include more than one vegetation community and multiple hydrologic regimes. Piezometers will be installed at the project site to measure subsurface water levels during the five-year monitoring period. Following construction, a Mitigation Plan and As Built Drawings will be prepared for the site and submitted to EEP. The Mitigation Plan will include the monitoring plan and protocol, as well as an invasive and exotic species management plan. The management

plan will identify potential invasive species as defined in the “*North Carolina Noxious Weed List*”, identify site constraints, and provide for a two-part control plan. The first part of the two-part plan will suppress the establishment of noxious plants through eradication of existing species seen on site and installation of sufficient densities of native woody and herbaceous species. The second part will be to implement an early detection and rapid response program, to identify and remove invasive species before they become established.

Monitoring will be completed using random permanent sampling quadrants as outlined in the Mitigation Plan for a minimum five-year period, or until success of the project can be validated. Monitoring Reports will be submitted to EEP by December 31 of the year in which the monitoring was conducted. In the unlikely event that success criteria outlined below are not achieved by the end of the five-year minimum monitoring period, with permission from EEP corrective measures including regrading, replanting, removal of certain species, etc. will be performed. If areas are deemed to be severely deficient in meeting the success criteria, Albemarle Restoration, LLC may opt to ask the Department to allow corrective measures prior to the end of the five-year period.

9.0 Success Criteria:

Success of the project will go beyond the establishment of wetland hydrology and a predominance of hydrophytic vegetation. Because the goals of the project are to restore a diverse wetland system, the success criteria will be tied directly to those goals. The intent of the project is to restore a diverse swamp run and wetland forest, interspersed with small areas of emergent wetlands, shallow open water, and hummocks. For each wetland type, the target hydrologic regime will be slightly different. The target regime for the emergent areas will be inundation greater than three inches for the majority of the growing season in the lowest areas and will be interspersed with higher hummocks which will be seasonally saturated for the majority of the growing season. Areas planted with shrubs will be seasonally inundated, zero to six inches, to saturated, with water levels to six inches below the surface during drier periods, especially late in the growing season, and up to 6 inches of inundation during wetter periods and in spring. Stems will be planted on hummocks to maximize initial survival rates. Areas planted in trees and shrubs will be seasonally saturated with water levels zero to twelve inches below the surface with periods of inundation following overbank flooding events and during wetter periods. Overall, we expect the project site to be inundated and/or saturated within 12 inches of the surface for a minimum of six (6) weeks during the growing season. A more detailed description of the hydrologic types and inundation periods for each type will be provided in the mitigation plan, to be submitted with the as-built construction drawings. As described in Section 8.0, piezometers will monitor both inundation and saturation in all restored wetland types. We believe that the creation of this diverse system is necessary to provide the range of intended functions and values. The primary indicators of success will therefore be the establishment of a range of wetland hydrology including inundated, saturated, seasonally saturated, and upland hummock areas. The site will be deemed successful if a range of wetland hydrologic regimes exist during

normal climatic conditions, and emergent, shrub/scrub, forested wetland plant communities are established. Site hydrology during years of excessive rainfall or extreme drought will be assessed with climatic conditions in mind. Data collected at the reference site will be provided in all post-construction monitoring reports.

At the request of EEP, Albemarle Restorations, LLC will install a monitoring plot at the reference wetland site adjacent to the project site.

10.0 References

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United States Department of Agriculture, Soil Conservation Service, Technical Guide, Section II-A-2, Hydric Soils, Hyde County, North Carolina, October 1992.

United States Fish and Wildlife Service. “Hyde County Endangered Species, Threatened Species, and Federal Species of Concern.” <http://nc-es.fws.gov/es/cntylist/hyde.html>. May 2007.

North Carolina Department of Environment and Natural Resources. “Tar-Pamlico Basinwide Water Quality Management Plan.” http://h2o.enr.state.nc.us/basinwide/tarpamlico_chapter_2.html. May 2007.

11.0 Restoration Design Plan Sheets

GENERAL NOTES:

1. This wetland restoration plan has been prepared for the North Carolina Ecosystem Enhancement Program for the purpose of restoring approximately 20.0 acres of riverine wetlands and 2,000 linear feet of stream restoration on the Armstrong property, located within the Tar-Pamlico River Basin.
3. Existing 0.5 foot topography within the project areas was prepared by True Line Surveying. Other base information was derived from Hyde County GIS data as amended and corrected by Albemarle Restorations, LLC based on field observations and ground surveys.
4. The Contractor shall notify Albemarle Restorations, LLC and the landowner's representative at least two (2) weeks prior to start of grading operations within the project area.
5. The Contractor is responsible for the location of all underground utilities prior to the start of construction. Any damages to utilities as a result of grading or other activities will be the sole responsibility of the Contractor and shall be repaired at the Contractors expense.
6. Access to the wetland restoration areas shall be from Route 45 via existing farm lanes as indicated hereon.
7. The Contractor will be responsible for any damage to private property, including but not limited to fences and private roads resulting from the execution of this contract. Repairs for any such damage will be made at the Contractors expense to the satisfaction of the private property owner and Albemarle Restorations, LLC.
8. All machinery, equipment and supplies for the project shall be stored in an upland location so as not to disturb any environmentally sensitive areas or agricultural uses on the site.
9. All rough and finish grading work will be started at the lowest proposed elevation of the wetland restoration area and proceed up-slope to minimize soil compaction.
10. All topsoil removed during grading will be stockpiled and returned once grading is completed.
11. A Nationwide 27 Permit, 40I Water Quality Permit, and approval of the Sediment and Erosion Control Plan from the Hyde County Soil Conservation District will be obtained prior to the start of construction.

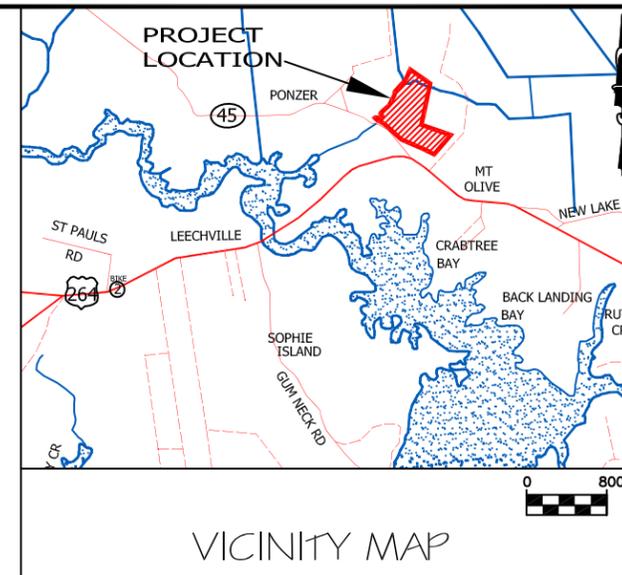
SEEDING NOTES:

1. Prior to seeding, remove any mounds or surface irregularities not in conformance with grading plan. Areas that have experienced washing out, rilling, or sediment deposition shall be reconstructed and grades re-established by the Contractor in accordance with the plan or as otherwise directed by Albemarle Restorations, LLC.
2. After bringing the wetland creation area to final grades, loosen soil by discing or scarifying to a depth of at least 3 inches.
3. Prior to seeding, remove all trash, debris and large objects such as stones that might interfere with the seeding operation.
4. Seeding of wetland areas is to be according to the Wetland Seed Mix provided on sheet P-2 of this set. Seed shall be spread with a broadcast spreader and may be mixed with dry sand to facilitate even spreading.

WETLAND MITIGATION PROJECT
ALBERMARLE RESTORATIONS, INC.
ARMSTRONG SITE

HYDE COUNTY, NC

LOCATION: OFF STATE ROUTE 45, NEAR PONZER, NC
TYPE OF WORK: MITIGATION



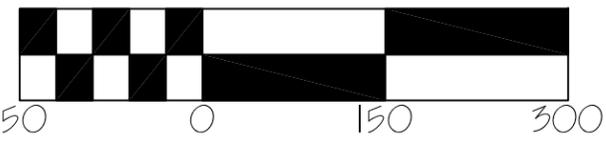
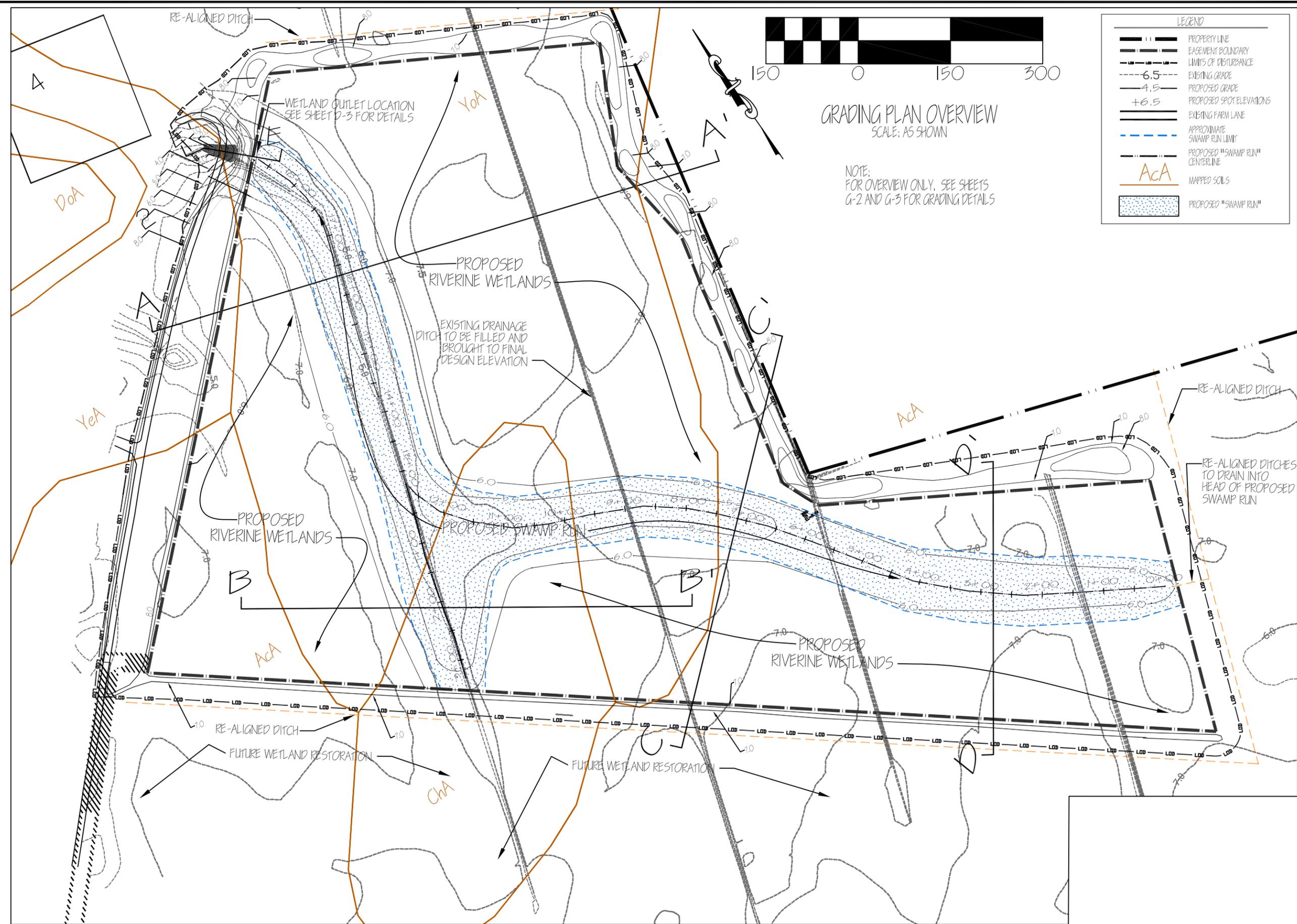
INDEX OF SHEETS

T-1	.....	TITLE SHEET
G-1	.....	GRADING OVERVIEW
G-2	.....	GRADING
G-3	.....	GRADING
D-1	.....	GRADING SECTIONS
D-2	.....	DETAILS AND SECTIONS
D-3	.....	OUTFALL DETAILS
P-1	.....	PLANTING
P-2	.....	PLANTING DETAILS

MAPPED SOILS	
AcA	Acredale silt loam, slopes less than 2%
ChA	Chapanoke silt loam, slopes less than 2%
DoA	Dorovan muck, slopes less than 1%
YeA	Yeopim silt loam, slopes less than 3%
YoA	Yonques loam, slopes less than 2%



TITLE SHEET JUNE 1, 2007	
ARMSTRONG PROPERTY RIVERINE WETLAND MITIGATION: 20.0 ACRES STREAM RESTORATION: 2,200 LINEAR FEET HYDE COUNTY, NORTH CAROLINA EEP CONTRACT #: 106012-A	
PLANNED BY: ALBERMARLE RESTORATIONS, LLC	ENVIRONMENTAL CONSULTING, PERMITTING & DESIGN, FORESTRY, CREATION & STREAM RESTORATION. P.O. Box 5 • 1204 BALDWIN MILL ROAD • JARRIETTEVILLE, MARYLAND 21084 (410) 692-7500 • FAX (410) 692-7503 • EMAIL INFO@ECOTONE.COM
WETLAND RESTORATION, STREAM RESTORATION, & WILDLIFE HABITAT CREATION 404 COURT STREET • GATESVILLE, NC 27938 (252) 353-0249 • FAX (252) 357-4892	SHEET T-1



GRADING PLAN OVERVIEW
SCALE: AS SHOWN

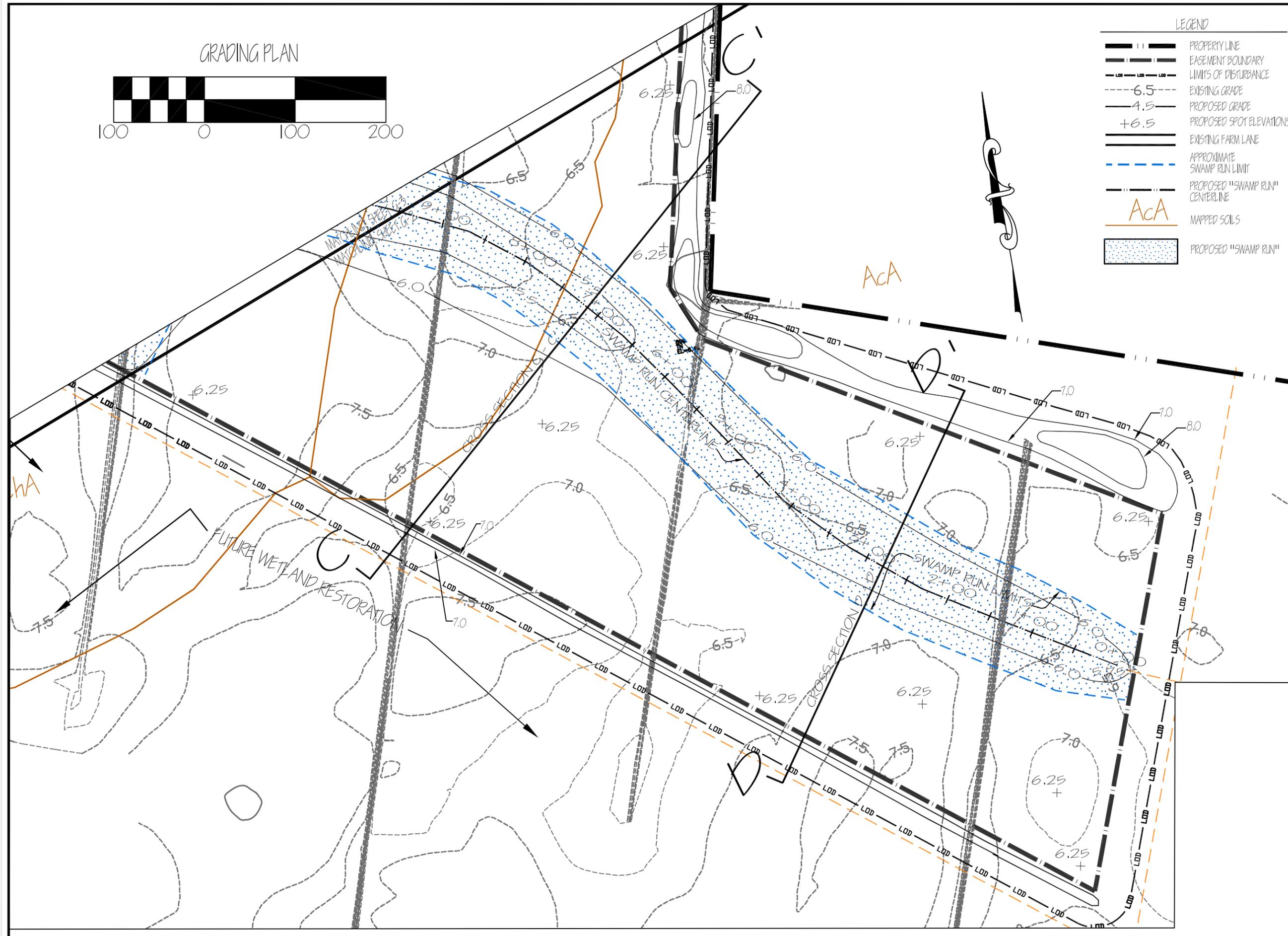
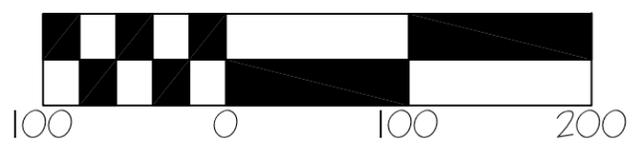
NOTE:
FOR OVERVIEW ONLY, SEE SHEETS
G-2 AND G-3 FOR GRADING DETAILS

LEGEND

	PROPERTY LINE
	EASEMENT BOUNDARY
	LIMITS OF DISTURBANCE
	EXISTING GRADE
	PROPOSED GRADE
	PROPOSED SPOT ELEVATIONS
	EXISTING FARM LANE
	APPROXIMATE SWAMP RUN LIMIT
	PROPOSED "SWAMP RUN" CENTERLINE
	MAPPED SOILS
	PROPOSED "SWAMP RUN"

GRADING PLAN OVERVIEW MAY 10, 2007	
ARMSTRONG PROPERTY RIVERINE WETLAND MITIGATION: 20.0 ACRES STREAM RESTORATION: 2,200 LINEAR FEET HAYE COUNTY, NORTH CAROLINA EEP CONTRACT #: P066012-A	
<p>ECOTONE, INC. ENVIRONMENTAL CONSULTING, PERMITTING & DESIGN, FOREST & WETLAND CREATION & STREAM RESTORATION. P.O. Box 5 • 1204 BALDWIN MILL ROAD • JARRETTSVILLE, MARYLAND 21084 (410) 692-7500 • FAX (410) 692-7503 • EMAIL: INFO@ECOTONEINC.COM</p>	<p>PLAN PREPARED BY: ALBERMARLE RESTORATIONS, LLC WETLAND RESTORATION, STREAM RESTORATION, & WILDLIFE HABITAT CREATION 404 COURT STREET • GATESVILLE, NC 27338 (852) 333-0249 • FAX (852) 357-4892</p>
SHEET G-1	

GRADING PLAN



LEGEND

- PROPERTY LINE
- EASEMENT BOUNDARY
- LIMITS OF DISTURBANCE
- 6.5- - EXISTING GRADE
- 4.5- - PROPOSED GRADE
- +6.5 PROPOSED SPOT ELEVATIONS
- EXISTING FARM LANE
- APPROXIMATE SWAMP RUN LIMIT
- PROPOSED "SWAMP RUN" CENTERLINE
- ACA MAPPED SOILS
- PROPOSED "SWAMP RUN"

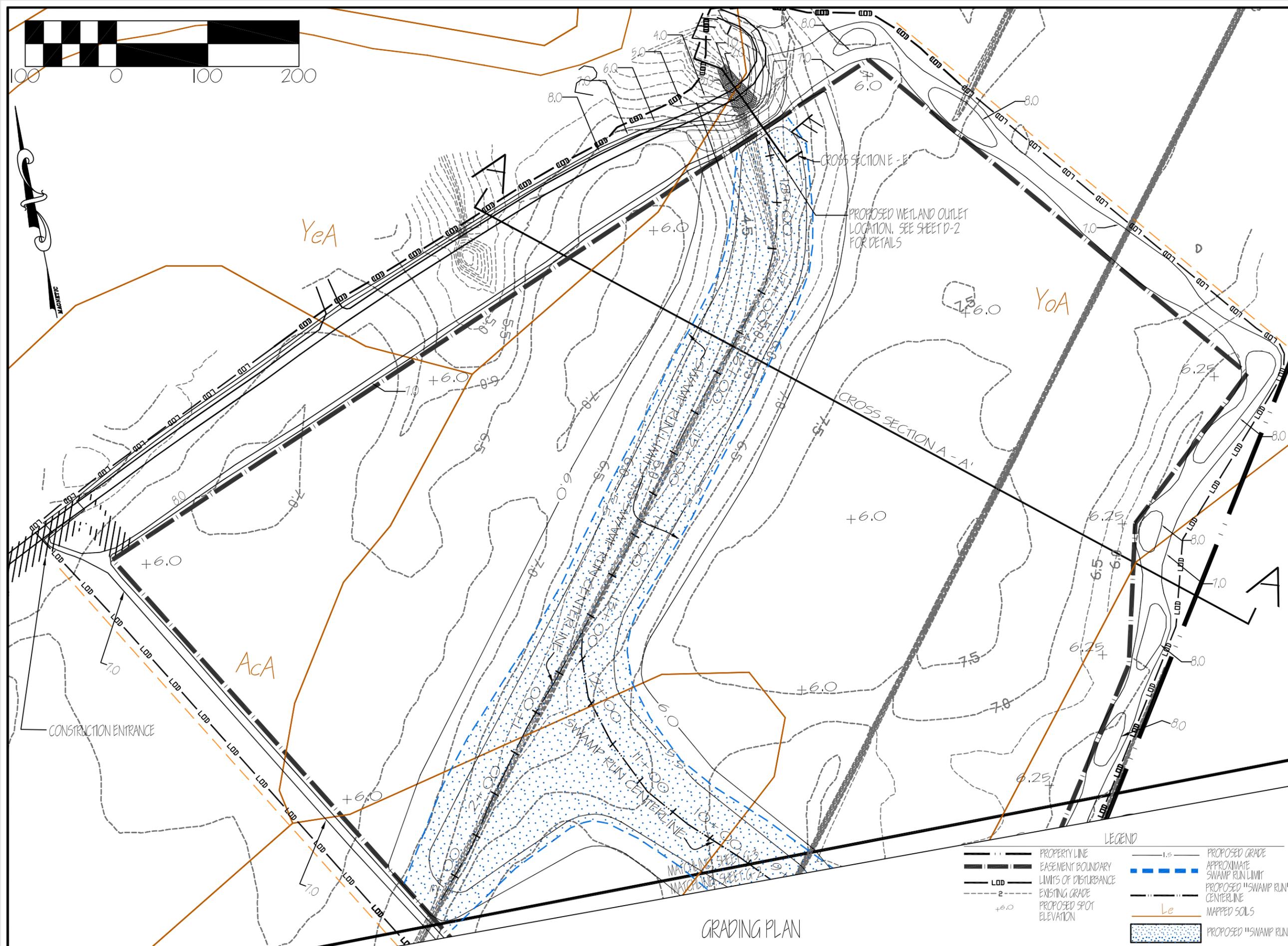
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SCALE:	SCALE:
PROJECT:	PROJECT:
DESIGNER:	DESIGNER:
CHECKER:	CHECKER:
DATE:	DATE:

ARMSTRONG PROPERTY
 RIVERINE WETLAND MITIGATION: 20.0 ACRES
 STREAM RESTORATION: 2,200 LINEAR FEET
 HAYES COUNTY, NORTH CAROLINA
 EEP CONTRACT #: D06012-A



PLAN PREPARED BY:
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 (410) 692-7500 • FAX (410) 692-7503 • EMAIL: INFO@ECOTONEINC.COM

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 WETLAND RESTORATION,
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 404 COURT STREET • GATESVILLE, NC 27938
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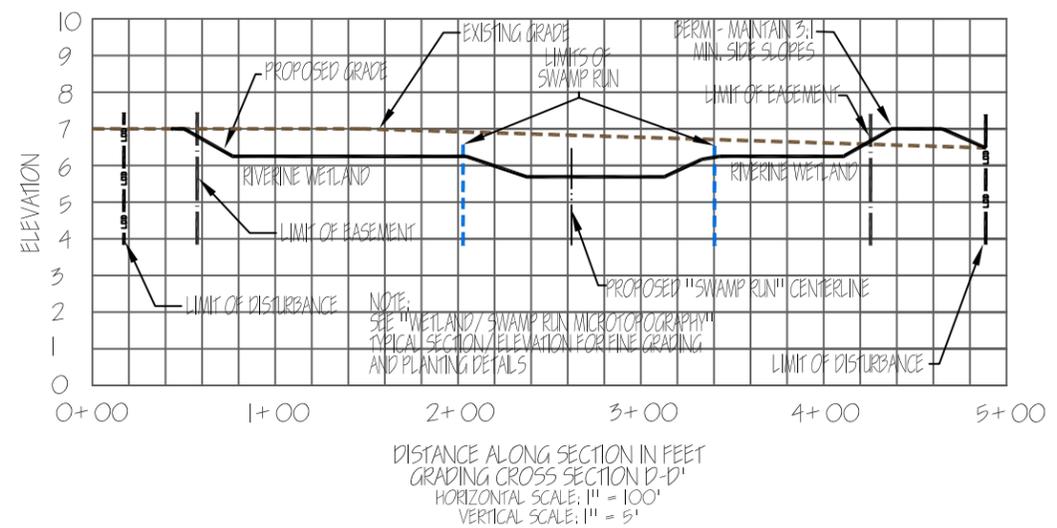
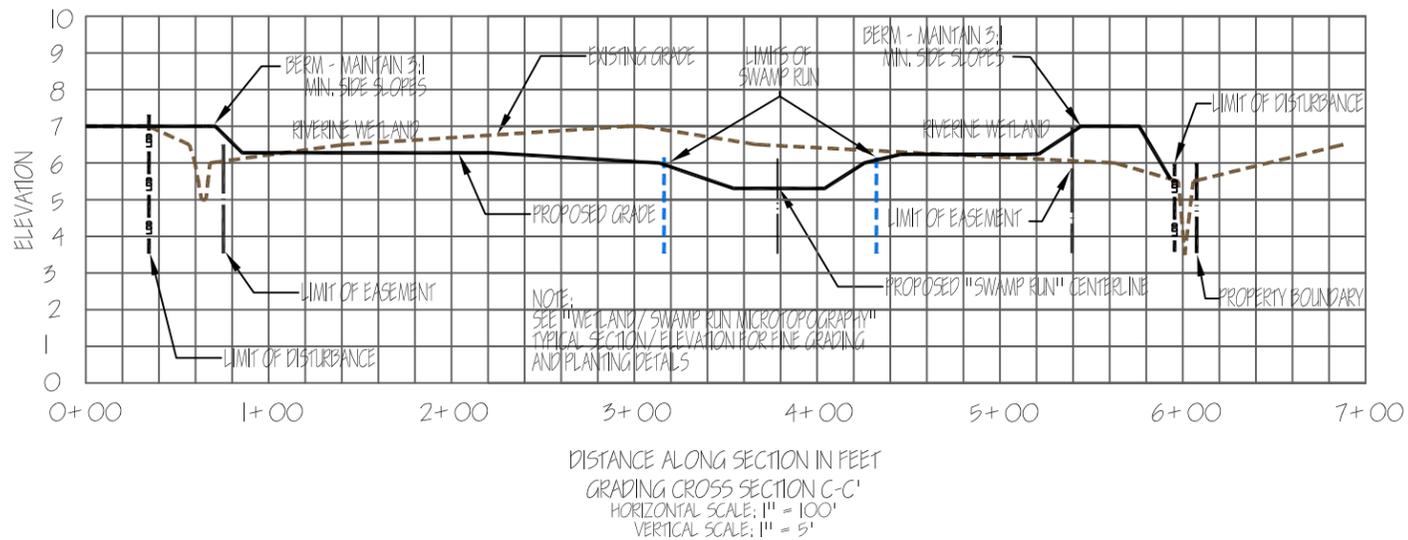
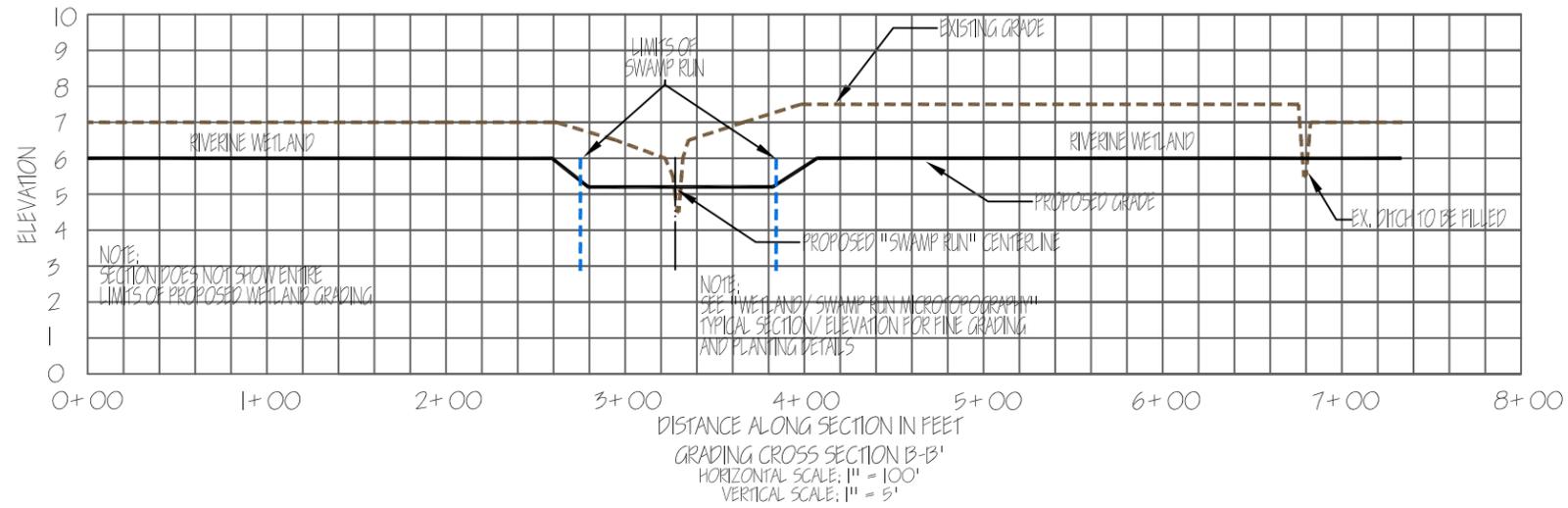
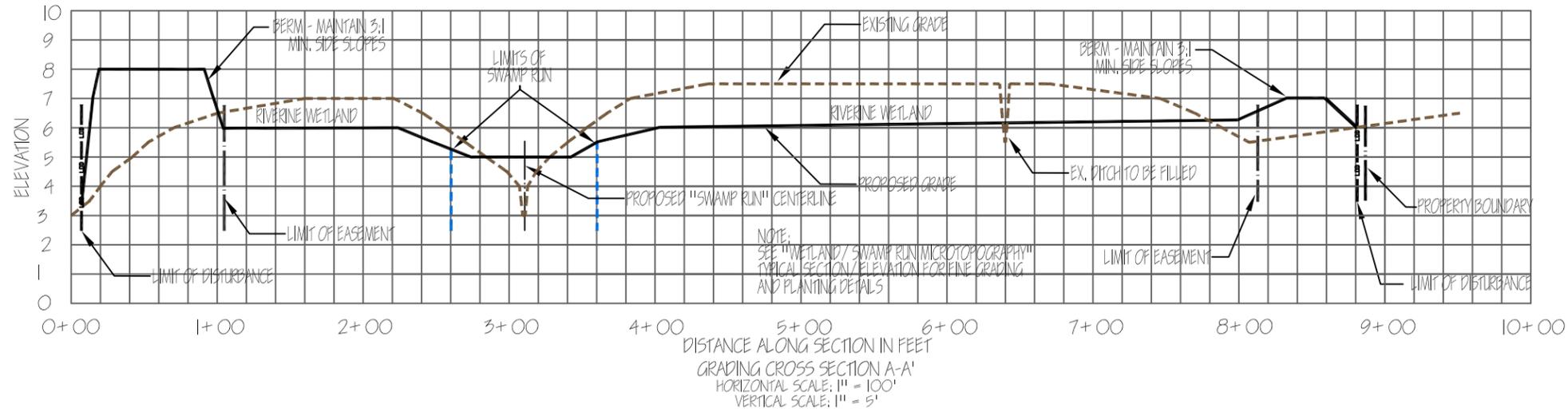


LEGEND

	PROPERTY LINE		PROPOSED GRADE
	EASEMENT BOUNDARY		APPROXIMATE SWAMP RUN LIMIT
	LIMITS OF DISTURBANCE		PROPOSED "SWAMP RUN" CENTERLINE
	EXISTING GRADE		MAPPED SOILS
	PROPOSED SPOT ELEVATION		PROPOSED "SWAMP RUN"

GRADING PLAN

<p>GRADING PLAN MAY 10, 2007</p>	
<p>ARMSTRONG PROPERTY RIVERINE WETLAND MITIGATION: 20.0 ACRES STREAM RESTORATION: 2,200 LINEAR FEET HYDE COUNTY NORTH CAROLINA EEP CONTRACT #: D06012-A</p>	
<p>PREPARED BY: ECOTONE, INC. ENVIRONMENTAL CONSULTING, PERMITTING & DESIGN, FOUNDATION & STREAM RESTORATION P.O. Box 5 • 1204 BALDWIN HILL ROAD • JARRETTVILLE, MARYLAND 21084 (410) 692-7500 • FAX (410) 692-7503 • EMAIL: INFO@ECOTONEINC.COM</p>	
<p>WETLAND RESTORATION, FOUNDATION & WILDLIFE HABITAT CREATION 404 COURT STREET • GATESVILLE, NC 27938 (659) 333-0249 • FAX (659) 337-4892</p>	
<p>SHEET G-3</p>	



GRADING SECTIONS
MAY 10, 2007

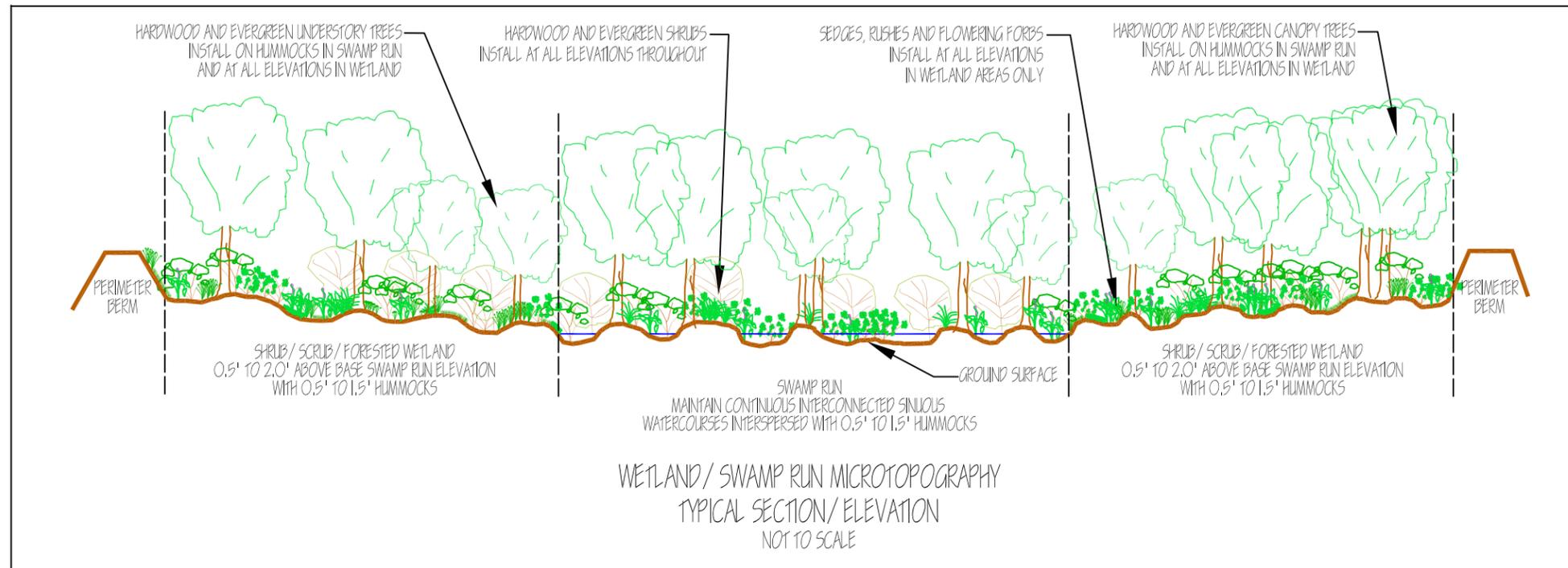
REVISIONS	DATE	BY

ARMSTRONG PROPERTY
 RIVERINE WETLAND MITIGATION: 20.0 ACRES
 STREAM RESTORATION: 2,200 LINEAR FEET
 HYPE COUNTY, NORTH CAROLINA
 EEP CONTRACT #: D0602-A



PLAN PREPARED BY:
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 (852) 333-0249 • FAX (852) 357-4892



SITE INFORMATION (not for bidding purposes)

Total Area of Wetlands	25.0	Acres
Area Disturbed	31.4	Acres
Area to be Roofed or Paved	0	Acres
Total Cut	27,800	Cu. Yds.
Total Fill	11,200	Cu. Yds.
Offsite Waste/ Borrow Area Location	16,600	Cu. Yds.

(Armstrong Farm)

UTILITY NOTIFICATION

"Ecotone, Inc. makes no representation as to the existence or non-existence of any utilities at the construction site. Shown on these construction drawings are those utilities which have been identified. It is the responsibility of the landowners or operators and contractors to assure themselves that no hazard exists or damage will occur to utilities. It is suggested that NC One-Call Center be contacted at: 1-800-632-4949."

DETAILS AND SECTIONS

MAY 10, 2007

DATE:	
BY:	
SCALE:	

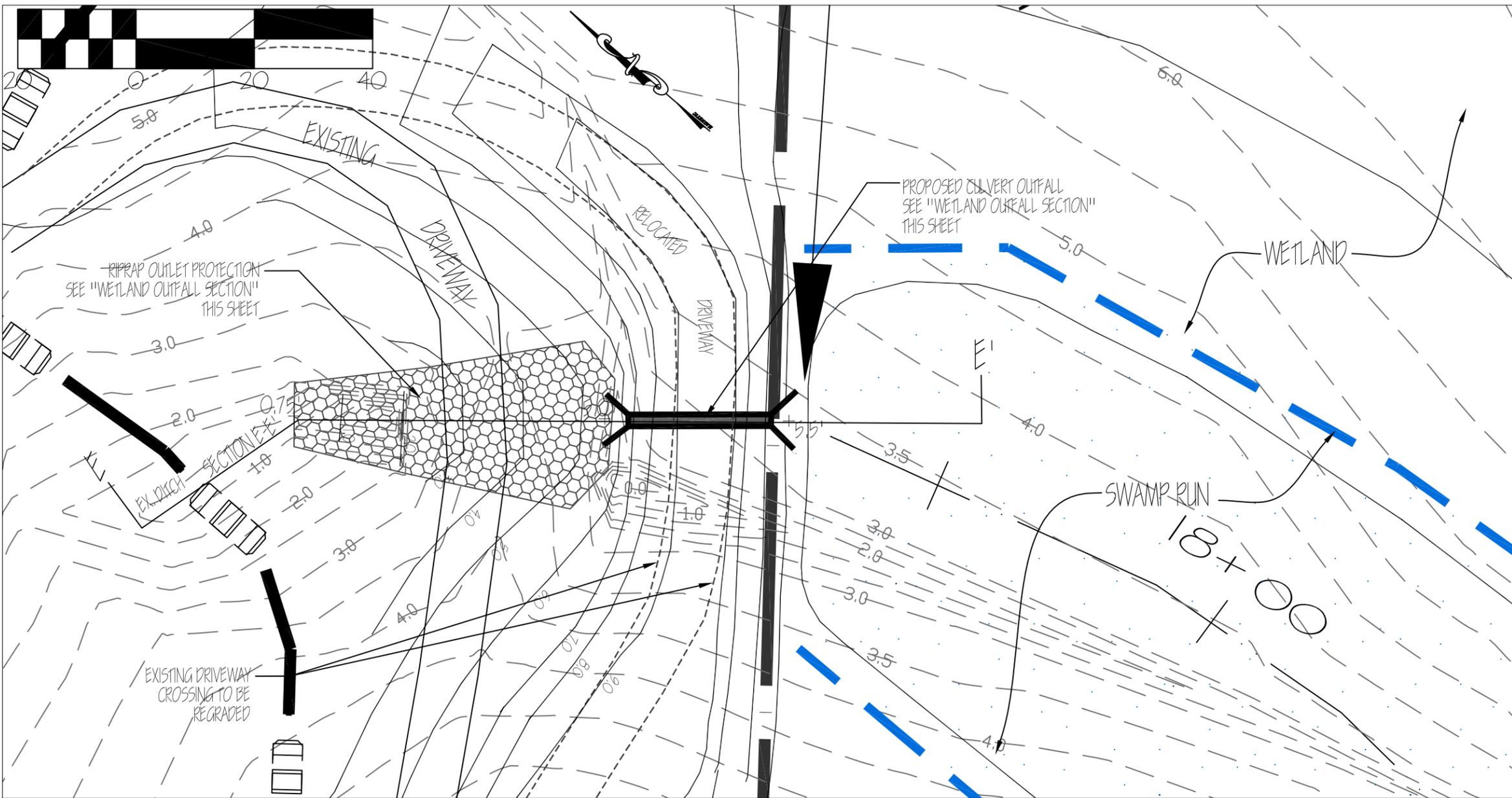
ARMSTRONG PROPERTY
RIVERINE WETLAND MITIGATION: 20.0 ACRES
STREAM RESTORATION: 2,200 LINEAR FEET
HIDE COUNTY, NORTH CAROLINA
PEP CONTRACT #: 1D06012-A



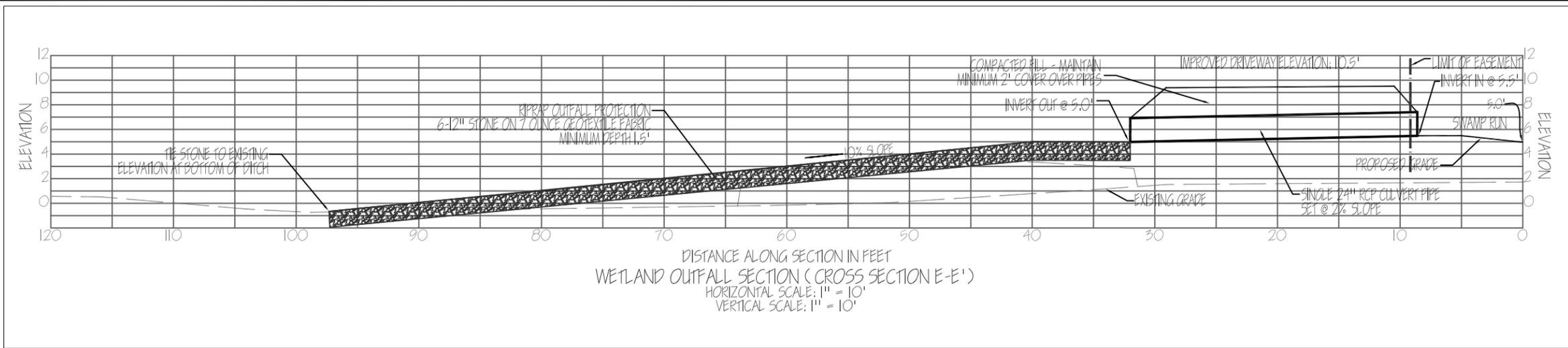
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STREAM RESTORATION

P.O. Box 9 • 1204 BALDWIN MILL ROAD • JARRRETTVILLE, MARYLAND 21084
(410) 692-7500 • FAX (410) 692-7503 • E-MAIL: INFO@ECOTONEINC.COM

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WETLAND RESTORATION,
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WETLAND OUTFALL DETAIL
SCALE: 1" = 20'



WETLAND OUTFALL SECTION (CROSS SECTION E-E')
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 10'

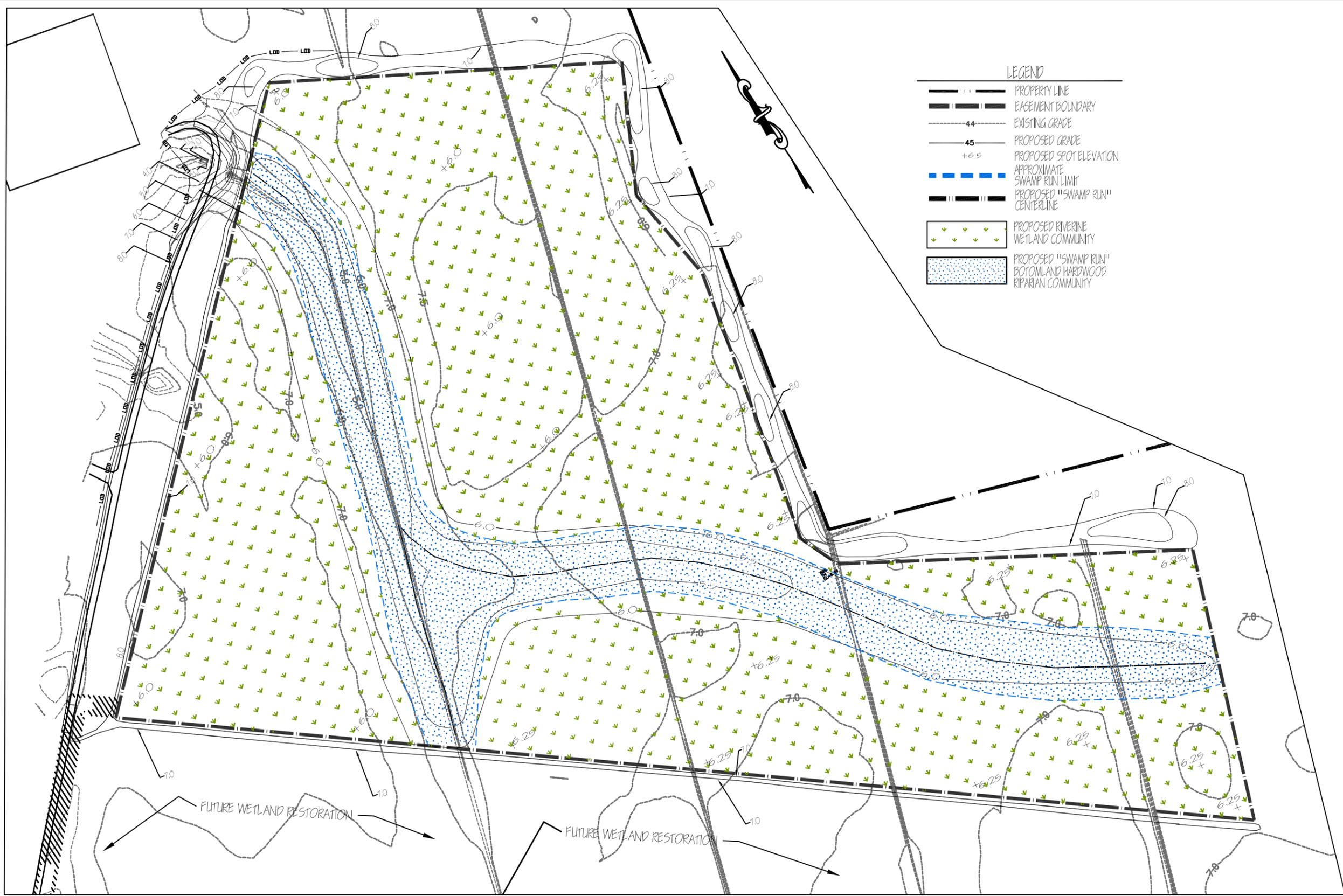


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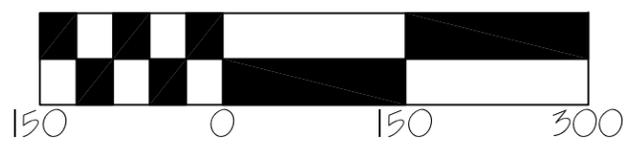
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(252) 333-0249 • FAX (252) 357-4892

DETAILS AND SECTIONS
JUNE 1, 2007

ARMSTRONG PROPERTY
RIVERINE WETLAND MITIGATION: 20.0 ACRES
STREAM RESTORATION: 2,200 LINEAR FEET
HYDE COUNTY, NORTH CAROLINA
EPP CONTRACT #: 106012-A



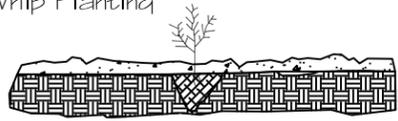
- LEGEND**
- PROPERTY LINE
 - EASEMENT BOUNDARY
 - EXISTING GRADE
 - PROPOSED GRADE
 - PROPOSED SPOT ELEVATION
 - APPROXIMATE SWAMP RUN LIMIT
 - PROPOSED "SWAMP RUN" CENTERLINE
 - PROPOSED RIVERINE WETLAND COMMUNITY
 - PROPOSED "SWAMP RUN" BOTOMLAND HARDWOOD RIPARIAN COMMUNITY



PLANTING PLAN

<p>PLAN PREPARED BY:</p> <p>ECOTONE, INC.</p> <p>ENVIRONMENTAL CONSULTING, PERMITTING & DESIGN, FOREST RESTORATION, STREAM RESTORATION.</p> <p>P.O. Box 5 • 1204 BALDWIN HILL ROAD • JANNETTSVILLE, MARYLAND 21084 (410) 692-7500 • FAX (410) 692-7503 • EMAIL: INFO@ECOTONEINC.COM</p>	<p>ARMSTRONG PROPERTY RIVERINE WETLAND MITIGATION: 20.0 ACRES STREAM RESTORATION: 2,200 LINEAR FEET HAYDE COUNTY, NORTH CAROLINA EEP CONTRACT #: D06012-A</p>	<p>PLANNING PLAN MAY 10, 2007</p>
<p>ALBERMARLE RESTORATIONS, LLC</p> <p>WETLAND RESTORATION, STREAM RESTORATION, & WILDLIFE HABITAT CREATION</p> <p>404 COURT STREET • GATESVILLE, NC 27938 (850) 333-0248 • FAX (850) 357-4892</p>		<p>SHEET P-1</p>

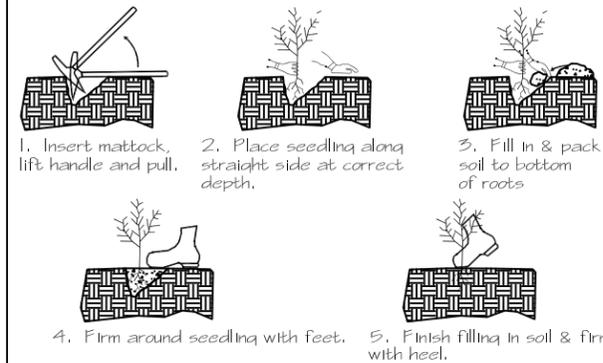
Seedling and Whip Planting



Correct and Incorrect Planting Depth



Mattock Planting



Note: Mulching newly planted seedlings helps the soil retain water and protects the seedling from compaction and stem injuries.

Source: Adapted from Forest Conservation Manual, 1991

Seedling and Whip Planting Techniques

PERMANENT WETLAND SEED MIX: 20.0 ACRES

Botanical Name	Common Name	Min. % Purity	Min. % Germ.	% of Mix by weight	Seeding Rate (lbs/ac)
<i>Lolium multiflorum</i>	Annual Ryegrass	90	85	48	4.80
<i>Agrostis alba</i>	Redtop	90	85	7.5	0.75
<i>Panicum virgatum</i>	Switch Grass	90	85	7.5	0.75
<i>Agrostis stolonifera</i>	Creeping Bentgrass	90	85	7.5	0.75
<i>Elymus virginiana</i>	Wild Rye Grass	90	85	7.5	0.75
<i>Peltandra virginica</i>	Arrow Arum	90	85	3	0.30
<i>Setaria geniculata</i>	Foxtail Grass	90	85	3	0.30
<i>Tripsacum dactyloides</i>	Eastern Gamma Grass	90	85	2	0.20
<i>Echinochloa muricata</i>	Barnyard Grass	90	85	2	0.20
<i>Zizania aquatica</i>	Wild Rice	90	85	2	0.20
<i>Carex vulpinoidea</i>	Fox Sedge	90	85	2	0.20
<i>Polygonum pensylvanicum</i>	Penn. Smartweed	90	85	2	0.20
<i>Sparganium americanum</i>	Eastern Bur Reed	90	85	2	0.20
<i>Scirpus americana</i>	3-Square Bulrush	90	85	0.5	0.05
<i>Scirpus validus</i>	Soft Stem Bulrush	90	85	0.5	0.05
<i>Pontederia cordata</i>	Pickerel Weed	90	85	0.5	0.05
<i>Eleocharis obtusa</i>	Blunt Spike Rush	90	85	0.5	0.05
<i>Carex lurida</i>	Lurid (Shallow) Sedge	90	85	0.5	0.05
<i>Juncus effusus</i>	Soft Rush	90	85	0.5	0.05
<i>Scirpus cyperinus</i>	Wool Grass	90	85	0.5	0.05
<i>Leersia oryzoides</i>	Rice Cutgrass	90	85	0.5	0.05
				Total 100%	10 lbs/ac

PLANTING DETAILS
MAY 10, 2007

ARMSTRONG PROPERTY
RIVERINE WETLAND MITIGATION: 20.0 ACRES
STREAM RESTORATION: 2,200 LINEAR FEET
HAYE COUNTY, NORTH CAROLINA
EEP CONTRACT #: P06012-A



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P.O. Box 5 • 1204 BALDWIN MILL ROAD • JARRETTSVILLE, MARYLAND 21084
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(852) 333-0249 • FAX (852) 357-4892

Key: "SWAMP RUN" BOTTOMLAND HARDWOOD RIPARIAN COMMUNITY
PLANTING SCHEDULE - 5.0 Acres

	Quantity	Botanical Name	Common Name	Size	Condition	Spacing
Trees:	186	<i>Taxodium distichum</i>	Bald Cypress	2-5'	Bare Root	12' Random Spacing
	186	<i>Acer rubrum</i>	Red Maple	2-5'	Bare Root	11' Random Spacing
	186	<i>Nyssa aquatica</i>	Water Tupelo	2-5'	Bare Root	12' Random Spacing
	186	<i>Nyssa biflora</i>	Swamp Black Gum	2-5'	Bare Root	12' Random Spacing
	186	<i>Quercus phellos</i>	Willow Oak	2-5'	Bare Root	12' Random Spacing
	186	<i>Quercus bicolor</i>	Swamp White Oak	2-5'	Bare Root	12' Random Spacing
	186	<i>Quercus nigra</i>	Water Oak	2-5'	Bare Root	12' Random Spacing
Total:	1302					
Shrubs:	109	<i>Vaccinium corymbosum</i>	Highbush Blueberry	1/4" caliper	Bare Root	12' Random Spacing
	109	<i>Lyonia lucida</i>	Fetterbush	1/4" caliper	Bare Root	12' Random Spacing
	109	<i>Itea virginica</i>	Virginia Sweetspire	1/4" caliper	Bare Root	12' Random Spacing
	109	<i>Cephalanthus occidentalis</i>	Buttonbush	1/4" caliper	Bare Root	12' Random Spacing
Total:	436					

Key: RIVERINE WETLAND PLANTING SCHEDULE - 20.0 Acres

	Quantity	Botanical Name	Common Name	Size	Condition	Spacing
Trees:	752	<i>Taxodium distichum</i>	Bald Cypress	2-5'	Bare Root	12' Random Spacing
	752	<i>Acer rubrum</i>	Red Maple	2-5'	Bare Root	11' Random Spacing
	752	<i>Quercus michauxii</i>	Swamp Chestnut Oak	2-5'	Bare Root	12' Random Spacing
	752	<i>Nyssa biflora</i>	Swamp Black Gum	2-5'	Bare Root	12' Random Spacing
	751	<i>Quercus phellos</i>	Willow Oak	2-5'	Bare Root	12' Random Spacing
	751	<i>Liquidambar styraciflua</i>	Sweet Gum	2-5'	Bare Root	12' Random Spacing
	751	<i>Quercus palustris</i>	Pin Oak	2-5'	Bare Root	12' Random Spacing
Total:	5261					
Shrubs:	347	<i>Myrica cerifera</i>	Wax Myrtle	1/4" caliper	Bare Root	12' Random Spacing
	347	<i>Magnolia virginiana</i>	Sweetbay	1/4" caliper	Bare Root	12' Random Spacing
	347	<i>Baccharis halimifolia</i>	High Tide Bush	1/4" caliper	Bare Root	12' Random Spacing
	347	<i>Itea virginica</i>	Virginia Sweetspire	1/4" caliper	Bare Root	12' Random Spacing
	348	<i>Cephalanthus occidentalis</i>	Buttonbush	1/4" caliper	Bare Root	12' Random Spacing
Total:	1736					

APPENDIX A

-Figures-

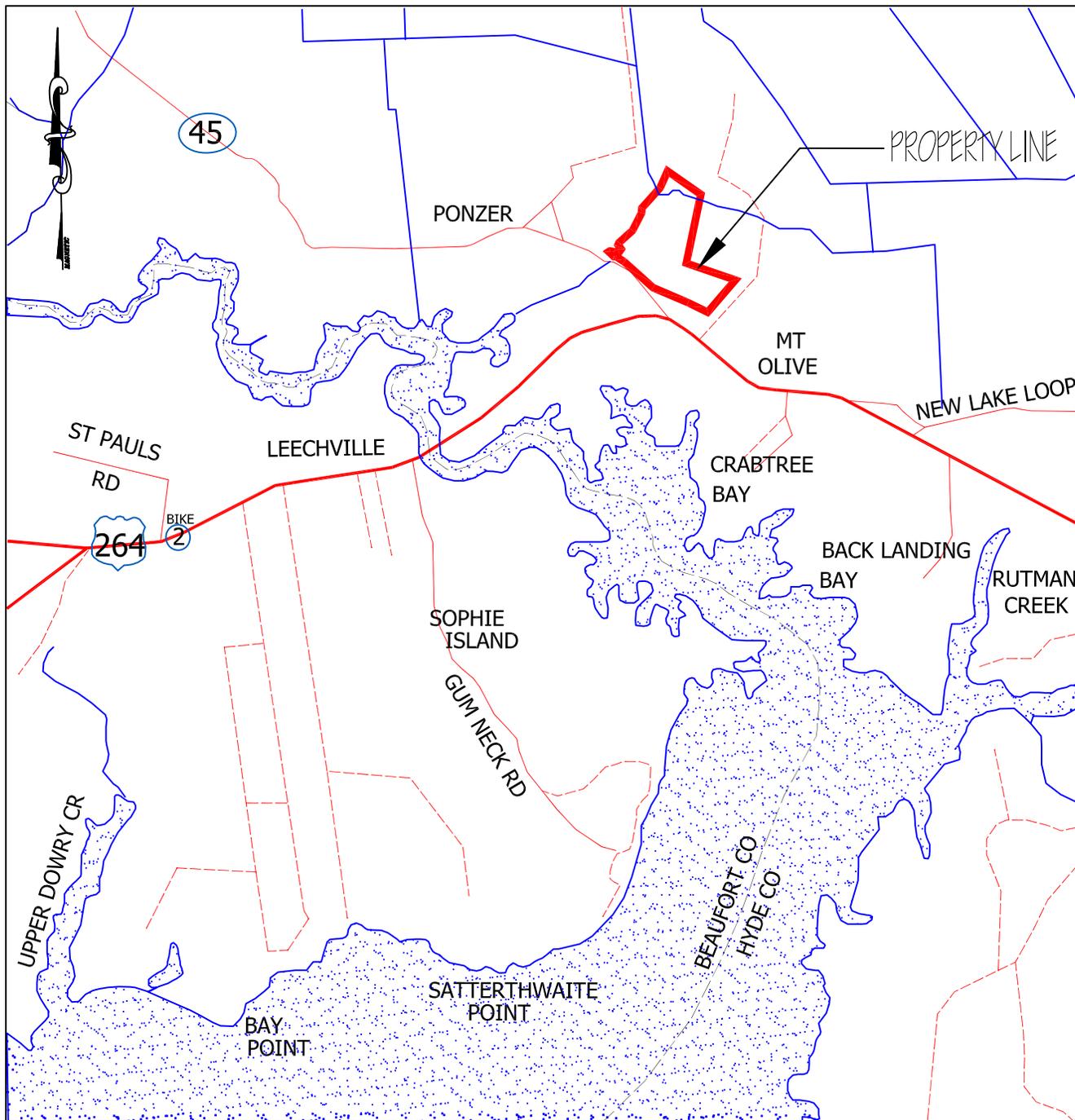
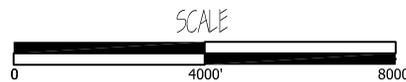


FIGURE I
VICINITY MAP



Scale: 1" = 4000'

5/2007

Drawn By: LMS

PREPARED BY:

ECOTONE, INC.

ENVIRONMENTAL CONSULTING, PERMITTING & DESIGN,
FOREST & WETLAND CREATION &
STREAM RESTORATION.

P.O. Box 5 • 1204 BALDWIN MILL ROAD • JARRETTSVILLE, MARYLAND 21084
(410) 692-7500 • FAX (410) 692-7503 • E-MAIL INFO@ECOTONEINC.COM

PREPARED FOR:

ALBERMARLE RESTORATIONS, LLC

WETLAND RESTORATION,
STREAM RESTORATION,
& WILDLIFE HABITAT CREATION

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(252) 333-0249 • FAX (252) 357-4892



ARMSTRONG PROPERTY
RIVERINE WETLAND MITIGATION
20.0 ACRES
STREAM MITIGATION
2,000 LINEAR FEET
HYDE COUNTY, NORTH CAROLINA
ESP CONTRACT #.: D06012-A

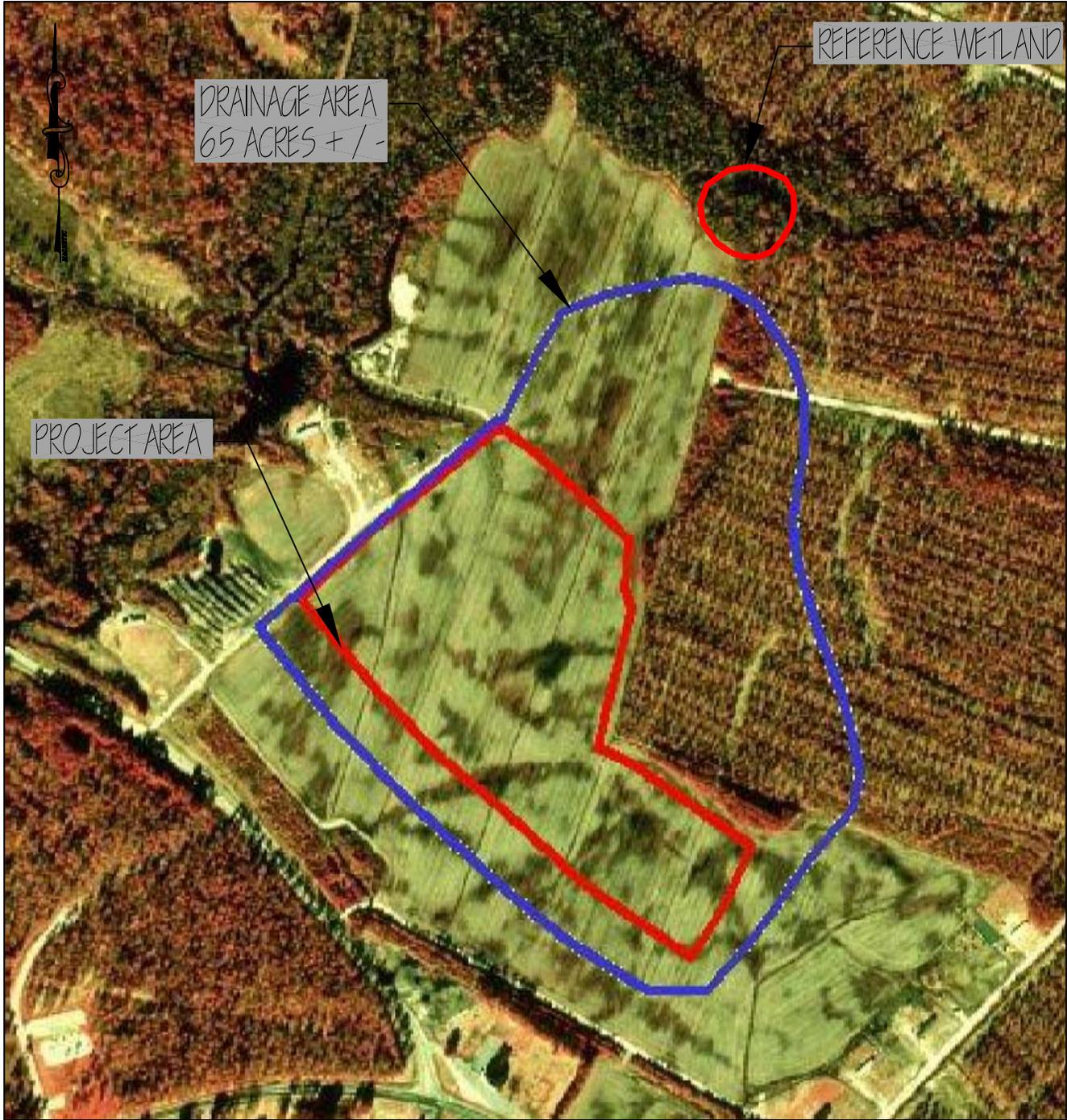
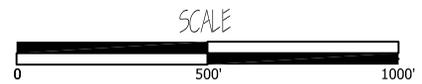


FIGURE 2
DRAINAGE AREA



Scale: 1" = 500'

5/2007

Drawn By: LMS

PREPARED BY:

ECOTONE, INC.

ENVIRONMENTAL CONSULTING, PERMITTING & DESIGN,
FOREST & WETLAND CREATION &
STREAM RESTORATION.

P.O. Box 5 • 1204 BALDWIN MILL ROAD • JARRETSVILLE, MARYLAND 21084
(410) 692-7500 • FAX (410) 692-7503 • E-MAIL INFO@ECOTONEINC.COM

PREPARED FOR:

ALBERMARLE RESTORATIONS, LLC

WETLAND RESTORATION,
STREAM RESTORATION,
& WILDLIFE HABITAT CREATION

404 COURT STREET • GATESVILLE, NC 27938
(252) 333-0249 • FAX (252) 357-4892

**Ecosystem
Enhancement
PROGRAM**

ARMSTRONG PROPERTY
RIVERINE WETLAND MITIGATION
20.0 ACRES
STREAM MITIGATION
2,000 LINEAR FEET
HYDE COUNTY, NORTH CAROLINA
EEP CONTRACT #: DO6012-A

APPENDIX B

-Supporting Documents-

**Recorded Easement
Categorical Exclusion Approval
Farmland Conversion Impact Rating
Historic Preservation
Threatened/Endangered Species**

STATE OF NORTH CAROLINA

CONSERVATION EASEMENT
PROVIDED PURSUANT TO
FULL DELIVERY
MITIGATION CONTRACT

HYDE COUNTY

SPO File Number 48-ZE

Prepared by: Office of the Attorney General

Property Control Section

Return to: Blane Rice, State Property Office

1321 Mail Service Center

Raleigh, NC 27699-1321

THIS CONSERVATION EASEMENT DEED, made this 12th day of March, 2006, by Bobby and Lou Armstrong, ("**Grantor**"), whose mailing address is P.O. Box 96, Pantego, NC 27860 to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Ecosystem Enhancement Program (formerly known as the Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between Albemarle Restorations, LLC, whose mailing address is P.O. Box 204, Gatesville, NC 27938, and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources Purchase and Services Contract Number D06012-A.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003. This MOA recognizes that the Ecosystem Enhancement Program is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Ecosystem Enhancement Program in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and Council of the State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real property situated, lying, and being in Currituck Township, Hyde County, North Carolina (the "**Property**"), and being more particularly described as that certain parcel of land containing approximately 115 acres and being conveyed to the Grantor by deed as recorded in Deed Book 196 at Pages 484-486 of the Hyde County Registry, North Carolina; and

WHEREAS, Grantor is willing to grant a Conservation Easement over the herein described areas of the Property, thereby restricting and limiting the use of the included areas of the Property to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept such Conservation Easement. This Conservation Easement shall be for the protection and benefit of the waters of *Clark Mill Creek, a tributary of the Pungo River*.

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement of the nature and character and to the extent hereinafter set forth, over a described area of the Property, referred to hereafter as the "**Easement Area**", for the benefit of the people of North Carolina, and being all of the tract of land as identified as the Armstrong Tract as shown on a plat of survey entitled "The State of North Carolina, Ecosystem Enhancement Program. Armstrong Project" dated August 31, 2006, certified by Curk T. Lane, and **recorded in Plat Cabinet C, Slide(s) 100 D'E**, Hyde County Registry. The Armstrong Tract being more particularly described as follows:

Commencing at a point, said point being the NCGS Monument "HYD 14" and having North Carolina grid coordinates of North 672475.3250, East 2743184.8844 and an Elevation of 10.4232. Thence from said point a bearing and distance of N59°14'04"E 6934.32 feet to a point. Said point being a NCGS Monument "Mount Olive" and having North Carolina grid coordinates of North 676022.4209, East 2749143.3108 and an Elevation of 6.3156. Thence from said point a bearing and distance of S53°12'30"E 284.15 feet to a point. Said point being an iron pipe set in the center of NC Hwy 264 and a southwestern corner of the Bobby & Lou Armstrong property as recorded in Deed Book 196 Page 484-486 in the Hyde County, N.C. registry. Thence from said point a bearing and distance of N37°49'35"E 749.81 feet to an iron pipe set and the **POINT OF BEGINNING**. Thence a bearing and distance of N51°52'19"W 1739.95 feet to an iron pipe set. Thence a bearing and distance of N46°34'31"E 30.33 feet to an iron pipe set. Thence a bearing and distance of N46°34'31"E 961.89 feet to an iron pipe set. Thence a bearing and distance of S60°24'29"E 538.28 feet to an iron pipe set. Thence a bearing and distance of S26°47'55"W 204.51 feet to an iron pipe set. Thence a bearing and distance of S07°24'53"E 154.10 feet to an iron pipe set. Thence a bearing and distance of S12°32'42"W 431.32 feet to an iron pipe set.

Thence a bearing and distance of $S22^{\circ}50'20''E$ 67.97 feet to an iron pipe set. Thence a bearing and distance of $S59^{\circ}17'11''E$ 540.67 feet to an iron pipe set. Thence a bearing and distance of $S20^{\circ}10'02''W$ 421.17 feet to an iron pipe set and the **POINT OF BEGINNING** and containing 25.008 acres according to a plat by True Line Surveying, P.C. dated August 31, 2006, entitled "Conservation Easement Survey for The State of North Carolina Ecosystem Enhancement Program, Armstrong Project"

Together with a 30' access easement which is more particularly described as follows:

Commencing at a point, said point being the NCGS Monument "HYD 14" and having North Carolina grid coordinates of North 672475.3250, East 2743184.8844 and an Elevation of 10.4232. Thence from said point a bearing and distance of $N59^{\circ}14'04''E$ 6934.32 feet to a point. Said point being a NCGS Monument "Mount Olive" and having North Carolina grid coordinates of North 676022.4209, East 2749143.3108 and an Elevation of 6.3156. Thence from said point a bearing and distance of $S53^{\circ}12'30''E$ 284.15 feet to a point. Said point being an iron pipe set in the center of NC Hwy 264 and a southwestern corner of the Bobby & Lou Armstrong property as recorded in Deed Book 196 Page 484-486 in the Hyde County, N.C. registry. Thence from said point a bearing and distance of $N37^{\circ}49'35''E$ 749.81 feet to an iron pipe set. Thence a bearing and distance of $N51^{\circ}52'19''W$ 1739.95 feet to an iron pipe set and the **POINT OF BEGINNING**. Thence a bearing and distance of $N 51^{\circ}52'19''W$ 47.53 feet to an iron pipe set. Thence a bearing and distance of $S42^{\circ}51'24''W$ 617.46 feet to a PK nail set. Thence a bearing and distance of $N55^{\circ}37'52''W$ 30.33 feet to a PK nail set. Thence a bearing and distance of $N42^{\circ}51'39''E$ 649.56 feet to an iron pipe set. Thence a bearing and distance of $S51^{\circ}52'19''E$ 79.60 feet to an iron pipe set. Thence a bearing and distance of $S46^{\circ}34'31''W$ 30.33 feet to an iron pipe set and the **POINT OF BEGINNING** and containing 0.480 acres according to a plat by True Line Surveying, P.C. dated August 31, 2006, entitled "Conservation Easement Survey for The State of North Carolina Ecosystem Enhancement Program, Armstrong Project"

The purposes of this Conservation Easement are to maintain, restore, enhance, create and preserve wetland and/or riparian resources in the Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

This Conservation Easement shall be perpetual. It is an easement in gross, runs with the land, and is enforceable by Grantee against Grantor, their personal representatives, heirs, successors, and assigns, lessees, agents, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a

compatible use herein, any activity in, or use of, the Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. The following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Easement Area for the purposes thereof. Usage of motorized vehicles in the Easement Area is prohibited, except as they are used exclusively for management, maintenance, or stewardship purposes, and on existing trails, paths or roads.

B. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Easement Area not inconsistent with this Conservation Easement, and the right of access to the Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

C. Vegetative Cutting. Except as related to the removal of non-native plants, diseased or damaged trees, and vegetation that obstructs, destabilizes or renders unsafe the Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Easement Area is prohibited.

D. Industrial, Residential and Commercial Uses. All are prohibited in the Easement Area.

E. Agricultural Use. All agricultural uses within the Easement Area including any use for cropland, waste lagoons, or pastureland are prohibited.

F. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Easement Area.

G. Roads and Trails. There shall be no construction of roads, trails, walkways, or paving in the Easement Area. Existing roads or trails located in the Easement Area may be maintained by Grantor in order to minimize runoff, sedimentation and for access to the interior of the Property for management, maintenance, stewardship purposes, or undeveloped recreational and educational uses of the Easement Area. Existing roads, trails or paths may be maintained with loose gravel or permanent vegetation to stabilize or cover the surfaces.

H. Signs. No signs shall be permitted in the Easement Area except interpretive signs describing restoration activities and the conservation values of the Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Easement Area may be allowed.

I. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances or machinery, or other material in the Easement Area is prohibited.

J. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, or drilling; no removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

K. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Easement Area may temporarily be used for good cause shown as needed for the survival of livestock and agricultural production.

L. Subdivision and Conveyance. Grantor voluntarily agrees that no subdivision, partitioning, or dividing of the underlying fee that is subject to this Easement is allowed. Unless agreed to by the Grantee in writing, any future conveyance of the Easement Area and the rights as conveyed herein shall be as a single block of property. Any future transfer of the fee simple shall be subject to this Conservation Easement. Any transfer of the fee is subject to the Grantee's right of ingress, egress, and regress over and across the Property to the Easement Area for the purposes set forth herein.

M. Development Rights. All development rights are removed from the Easement Area and shall not be transferred.

N. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is consistent with the purposes of this Conservation Easement. The Grantor shall not vary from the above restrictions without first obtaining written approval from the N.C. Ecosystem Enhancement Program, whose mailing address is 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Ingress, Egress, Regress and Inspection. The Grantee, its employees and agents, successors and assigns, receive the perpetual right of general ingress, egress, and regress to the Easement Area over the Property at reasonable times to undertake any activities to restore, manage, maintain, enhance, and monitor the wetland and riparian resources of the Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade,

fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterranean water flow.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Easement Area that is inconsistent with the purposes of this Easement and to require the restoration of such areas or features of the Easement Area that may have been damaged by such activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, their successors or assigns, that comes to the attention of the Grantee, the Grantee shall, except as provided below, notify the Grantor, their successors or assigns in writing of such breach. The Grantor shall have ninety (90) days after receipt of such notice to correct the conditions constituting such breach. If the breach remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by appropriate legal proceedings including damages, injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief if the breach of the term of this Conservation Easement is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement. The Grantor and Grantee acknowledge that under such circumstances damage to the Grantee would be irreparable and remedies at law will be inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor, their successors or assigns are complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor, their successors or assigns, for any injury or change in the Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life, damage to property or harm to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, their successors or assigns, including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. **No Waiver.** Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown above or to other address(es) as either party establishes in writing upon notification to the other.

C. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees to make any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed subject to the Conservation Easement herein created.

D. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

E. This Conservation Easement may be amended, but only in a writing signed by all parties hereto, and provided such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement.

F. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and

licensees, the right of access to the Easement Area, and the right of quiet enjoyment of the Easement Area.

TO HAVE AND TO HOLD the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes.

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same are free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

Lou M. Armstrong (SEAL)

Bobby Armstrong (SEAL)

NORTH CAROLINA

COUNTY OF Hyde

I, George Thomas Davis Jr, a Notary Public in and for the County and State aforesaid, do hereby certify that Bobby and Lou Armstrong, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 12th day of March, 2007.



George Thomas Davis Jr
Notary Public

My commission expires:

8-1-09

Albemarle Restorations, LLC

*Wetland Restoration
Stream Restoration
Wildlife Habitat*

July 19, 2006

Mr. Donnie Brew
Federal Highway Administration – NC Division
310 New Bern Avenue
Suite 410
Raleigh 27601-1418

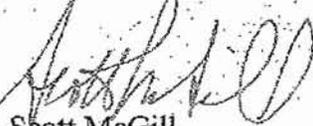
**RE: EEP Contract 16-D06012-A
Armstrong Property Wetland Restoration, Hyde County, NC**

Dear Mr. Brew:

Enclosed please find a completed Categorical Exclusion form for the above referenced contract and project. The project consists of the restoration of 25 acres of prior converted cropland to bottomland hardwood wetlands. Also enclosed are all required supporting documentation required as part of the Categorical Exclusion process. As instructed we have enclosed only the first few pages of the Phase I Environmental Assessment (40 or so pages total) per your request. If you would like a complete copy of the Phase I, we would be happy to forward one. Please call or e-mail me at (410) 692-7500 or smcgill@ecotoneinc.com if you have any questions or comments related to this matter.

Sincerely,

Ecotone, Inc.



Scott McGill
Principal

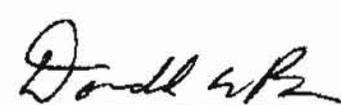
Cc: Mr Guy Pearce, NC EEP Project Manager

P.O. BOX 204
GATESVILLE, NC 27938
PHONE (252)333-0249
FAX (252)357-4892

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects Version 1.3

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1 General Project Information	
Project Name:	Armstrong Farm Wetland
County Name:	HYDE
EEP Number:	D06012-A
Project Sponsor:	Albemarle Restorations, LLC
Project Contact Name:	ED TENELLE
Project Contact Address:	PB BOX 204 Gatesville, NC 27438
Project Contact E-mail:	edtenelle@al.com
EEP Project Manager:	GUY PEARCE
Project Description	
For Official Use Only	
Reviewed By:	
7/24/06 Date	 EEP Project Manager
Conditional Approved By:	
Date	For Division Administrator FHWA
<input type="checkbox"/> Check this box if there are outstanding issues	
Final Approval By:	
7-25-06 Date	 For Division Administrator FHWA

Part 2: All Projects Regulation/Question		Response
Coastal Zone Management Act (CZMA)		
1. Is the project located in a CAMA county?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
3. Has a CAMA permit been secured?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
4. Has NCDCLM agreed that the project is consistent with the NC Coastal Management Program?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)		
1. Is this a "full-delivery" project?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
6. Is there an approved hazardous mitigation plan?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
National Historic Preservation Act (Section 106)		
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2. Does the project affect such properties and does the SHPO/THPO concur?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
3. If the effects are adverse, have they been resolved?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)		
1. Is this a "full-delivery" project?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
2. Does the project require the acquisition of real estate?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
3. Was the property acquisition completed prior to the intent to use federal funds?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A

Part 3: Ground-Disturbing Activities Regulation/Question		Response
American Indian Religious Freedom Act (AIRFA)		
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
2. Is the site of religious importance to American Indians?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
4. Have the effects of the project on this site been considered?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
Antiquities Act (AA)		
1. Is the project located on Federal lands?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
3. Will a permit from the appropriate Federal agency be required?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
4. Has a permit been obtained?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
Archaeological Resources Protection Act (ARPA)		
1. Is the project located on federal or Indian lands (reservation)?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
2. Will there be a loss or destruction of archaeological resources?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
3. Will a permit from the appropriate Federal agency be required?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
4. Has a permit been obtained?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
Endangered Species Act (ESA)		
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
2. Is Designated Critical Habitat or suitable habitat present for listed species?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
4. Is the project "likely to adversely affect" the specie and/or "likely to adversely modify" Designated Critical Habitat?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	

<u>Executive Order 13007 (Indian Sacred Sites)</u>	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
<u>Farmland Protection Policy Act (FPPA)</u>	
1. Will farmland be converted?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
2. Has NRCS determined that the project contains prime, unique, statewide or local important farmland?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
<i>Form Enclosed</i>	
<u>Fish and Wildlife Coordination Act (FWCA)</u>	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
2. Have the USFWS and the NCWRC been consulted?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
<i>Letter Enclosed</i>	
<u>Land and Water Conservation Fund Act (Section 6(f))</u>	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2. Has the NPS approved of the conversion?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
<u>Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)</u>	
1. Is the project located in an estuarine system?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2. Is suitable habitat present for EFH-protected species?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
4. Will the project adversely affect EFH?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
5. Has consultation with NOAA-Fisheries occurred?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
<u>Migratory Bird Treaty Act (MBTA)</u>	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2. Have the USFWS recommendations been incorporated?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
<u>Wilderness Act</u>	
1. Is the project in a Wilderness area?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A

Albemarle Restorations, LLC

*Wetland Restoration
Stream Restoration
Wildlife Habitat*

May 15, 2006

MR. Todd Waters
NRCS, District Conservationist
P.O. Box 264
Swan Quarter, NC 27885

Dear Mr. Waters,

Please find attached USDA Form AD-1006, Farmland Conversion Impact Rating, for your review and completion. I am requesting this project review as coordination under the Farmland Protection Policy Act. We are constructing a 25 acre wetland and stream restoration project under the NC Department of Environment and Natural Resources Ecosystem Enhancement Program (EEP) as mitigation for future NC Department of Transportation activities. This project is located on the Armstrong farm in the community of Ponzer in Hyde County. To assist in your review, I have enclosed a location map and an aerial photo showing the project site. If you have any questions or comments, please do not hesitate to contact me at 252-333-0249. Thank you for your time and attention to this matter.

Sincerely,



Edmund R. Temple, Jr.
Project Manager

Enclosures

404 COURT STREET
GATESVILLE, NC 27938
PHONE (252) 333-0249

FARMLAND CONVERSION IMPACT RATING

PART I (To be completed by Federal Agency)		Date Of Land Evaluation Request <u>5/15/06</u>			
Name Of Project <u>Armstrong Wetland Restoration</u>		Federal Agency Involved <u>Federal Highway Administration</u>			
Proposed Land Use <u>Wetland & Stream Restoration</u>		County And State <u>Hyde County, North Carolina</u>			
PART II (To be completed by NRCS)		Date Request Received By NRCS <u>5-18-06</u>			
Does the site contain prime, unique, statewide or local important farmland? (If no, the FPPA does not apply - do not complete additional parts of this form).		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Acres Irrigated <u>NONE</u>	Average Farm Size <u>716</u>
Major Crop(s) <u>CORN</u>	Farmable Land In Govt. Jurisdiction Acres: <u>22,802</u> % <u>57.0</u>	Amount Of Farmland As Defined In FPPA Acres: <u>22,745</u> % <u>56.7</u>			
Name Of Land Evaluation System Used <u>HYDE LE</u>	Name Of Local Site Assessment System <u>NONE</u>	Date Land Evaluation Returned By NRCS <u>6-25-06</u>			
PART III (To be completed by Federal Agency)		Alternative Site Rating			
		Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly		<u>25.00</u>			
B. Total Acres To Be Converted Indirectly		<u>0.00</u>			
C. Total Acres In Site		<u>25.00</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
PART IV (To be completed by NRCS) Land Evaluation Information					
A. Total Acres Prime And Unique Farmland		<u>25.00</u>			
B. Total Acres Statewide And Local Important Farmland		<u>0.00</u>			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		<u>40.0%</u>			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		<u>4.3</u>			
PART V (To be completed by NRCS) Land Evaluation Criterion Relative Value Of Farmland To Be Converted (Scale of 0 to 100 Points)		<u>86</u>	<u>0</u>	<u>0</u>	<u>0</u>
PART VI (To be completed by Federal Agency) Site Assessment Criteria (These criteria are explained in 7 CFR 658.5(b))		Maximum Points			
1. Area In Nonurban Use		<u>14</u>			
2. Perimeter In Nonurban Use		<u>9</u>			
3. Percent Of Site Being Farmed		<u>20</u>			
4. Protection Provided By State And Local Government		<u>0</u>			
5. Distance From Urban Builtup Area		<u>15</u>			
6. Distance To Urban Support Services		<u>0</u>			
7. Size Of Present Farm Unit Compared To Average		<u>0</u>			
8. Creation Of Nonfarmable Farmland		<u>0</u>			
9. Availability Of Farm Support Services		<u>4</u>			
10. On-Farm Investments		<u>0</u>			
11. Effects Of Conversion On Farm Support Services		<u>0</u>			
12. Compatibility With Existing Agricultural Use		<u>0</u>			
TOTAL SITE ASSESSMENT POINTS		<u>160</u>	<u>0</u>	<u>0</u>	<u>0</u>
PART VII (To be completed by Federal Agency)					
Relative Value Of Farmland (From Part V)		<u>100</u>	<u>86</u>	<u>0</u>	<u>0</u>
Total Site Assessment (From Part VI above or a local site assessment)		<u>160</u>	<u>62</u>	<u>0</u>	<u>0</u>
TOTAL POINTS (Total of above 2 lines)		<u>260</u>	<u>148</u>	<u>0</u>	<u>0</u>
Site Selected: <u>YES</u>	Date Of Selection <u>6/30/06</u>	Was A Local Site Assessment Used? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			

Reason For Selection:

The site scored less than 160 points, therefore under the guidelines set forth under section 658.4 (7 CFR Part 658.4) the site will not be given further considerations for protection and no additional sites need to be evaluated.

(See instructions on reverse side)

This form was electronically produced by National Production Services Staff

Form AD-1006 (10-83)



North Carolina Department of Cultural Resources
State Historic Preservation Office

Peter B. Sandbeck, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

June 7, 2006

Scott McGill
1204 Baldwin Mill Road
P.O. Box 5
Jarrettsville, Maryland 21084

Re: Armstrong Property, Ponzer, Hyde County, ER 06-1407

Dear Mr. McGill:

Thank you for your letter of May 22, 2006. We have reviewed the project referenced above and offer the following comments.

The project area is located southeast of Ponzer adjacent to Clark Mill Creek. No previously recorded archaeological sites within the boundaries of the project area are located on the site files at the Office of State Archaeology. The general area containing the proposed project boundaries was cleared for cultural resources on July 30, 2003 under ER 03-1298. Based on this information, our office has no concerns regarding cultural resources within the project area. In the event we review any permit applications connected with this project, we will not recommend a comprehensive survey of the area.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-733-4763. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Peter Sandbeck

ADMINISTRATION
RESTORATION
SURVEY & PLANNING

Location
507 N. Blount Street, Raleigh NC
515 N. Blount Street, Raleigh NC
515 N. Blount Street, Raleigh, NC

Mailing Address
4617 Mail Service Center, Raleigh NC 27699-4617
4617 Mail Service Center, Raleigh NC 27699-4617
4617 Mail Service Center, Raleigh NC 27699-4617

Telephone/Fax
(919)733-4763/733-8653
(919)733-6547/715-4801
(919)733-6545/715-4801

Albemarle Restorations, LLC

*Wetland Restoration
Stream Restoration
Wildlife Habitat*

May 15, 2006

Ms. Maria Tripp
North Carolina Wildlife Resources Commission
943 Washington Square Mall
Washington, NC 27889

Dear Ms. Tripp,

I am writing to request a project review for coordination under the Fish and Wildlife Coordination Act and the Migratory Bird Treaty Act. We are constructing a wetland and stream restoration project under the North Carolina Department of Environment and Natural Resources Ecosystem Enhancement Program (EEP) in Hyde County, North Carolina.

The project site consists of 25 acres of prior-converted (PC) cropland that are drained by several field ditches that flow into Clark Mill Creek, a tributary of the Pungo River and Pamlico Sound. The restoration project will consist of plugging drainage ditches, minor land grading to restore natural topography, reforestation using bottomland hardwoods, and constructing a low-level berm around the project to contain flooding on site. If successful, this site will increase migratory bird habitat, improve water quality, and enhance anadromous fish and shellfish habitat downstream.

To assist in your review, I have enclosed a location map and an aerial photo showing the project site. If you have any questions or comments, please do not hesitate to contact me at 252-333-0249. Thank you for your time and attention to this matter.

Sincerely,



Edmund R. Temple, Jr.
Project Manager

404 COURT STREET
GATESVILLE, NC 27938
PHONE (252)333-0249

Albemarle Restorations, LLC

*Wetland Restoration
Stream Restoration
Wildlife Habitat*

May 15, 2006

Mr. Peter Benjamin, Office Supervisor
U.S. Fish and Wildlife Service
Ecological Services Office
P.O. Box 33726
Raleigh, NC 27636

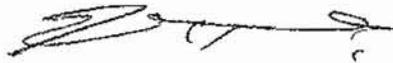
Dear Mr. Benjamin,

I am writing to request a project review for coordination under the Endangered Species Act, the Fish and Wildlife Coordination Act, and the Migratory Bird Treaty Act. We are constructing a wetland and stream restoration project under the North Carolina Department of Environment and Natural Resources Ecosystem Enhancement Program (EEP) in Hyde County, North Carolina. A review of the county's Threatened and Endangered Species list shows 6 threatened species and 5 endangered species, of which none of the species, nor their habitats, are currently found on the project site.

The project site consists of 25 acres of prior-converted (PC) cropland that are drained by several field ditches that flow into Clark Mill Creek, a tributary of the Pungo River and Pamlico Sound. The restoration project will consist of plugging drainage ditches, minor land grading to restore natural topography, reforestation using bottomland hardwoods, and constructing a low-level berm around the project to contain flooding on site. If successful, this site will increase migratory bird habitat, improve water quality, and enhance anadromous fish and shellfish habitat downstream.

To assist in your review, I have enclosed a location map and an aerial photo showing the project site. If you have any questions or comments, please do not hesitate to contact me at 252-333-0249. Thank you for your time and attention to this matter.

Sincerely,



Edmund R. Temple, Jr.
Project Manager

404 COURT STREET
GATESVILLE, NC 27938
PHONE (252) 333-0249

APPENDIX C

-Photographs and Reference Wetland Data Sheets-

Typical Views of the Armstrong Property



Photo 1: Existing stream which flows thru the area of the proposed riverine wetland restoration



Photo 2: Crop field proposed for riverine wetland restoration. Much of the area proposed for restoration was formerly cypress swamp which was cleared, drained and graded for agriculture



Photo 3: Photo of Clark Mill Creek swamp DIRECTLY adjacent to the proposed riverine wetlands.



Photo 4: Looking at straightened stream within the area proposed for riverine wetland restoration.

Reference Wetland Site Photographs



Photo 1: Typical View of Reference wetland



Photo 2: Typical View of Reference Wetland



Photo 3: Typical View of reference wetland



Photo 4: View of typical soil sample from reference wetland

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project Site: <u>Armstrong Reference Site</u>	Date: <u>1/10/2007</u>
Applicant/Owner: _____	County: <u>Hyde</u>
Investigator: <u>RBB/CEH</u>	State: <u>North Carolina</u>
Do Normal Circumstances exist on the site? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Community ID: <u>PFO</u>
Is the site significantly disturbed (Atypical Situation)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Transect ID: <u>2</u>
Is Area a Potential Problem Area? (if needed, explain on reverse) <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Plot ID: _____

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 Bald Cypress (<i>Taxodium distichum</i>)	Tree	OBL	8 Cinnamon Fern (<i>Osmunda cinnamomea</i>)	Veg	FACW+
2 Sweetgum (<i>Liquidambar styraciflua</i>)	Tree	FAC+	9 Japanese Honeysuckle (<i>Lonicera japonica</i>)	Vine	FAC-
3 Red Maple (<i>Acer rubrum</i>)	Tree	FAC			
4 Greenbrier (<i>Smilax</i> sp.)	Vine	FACW+			
5 Sweetbay Magnolia (<i>Magnolia virginiana</i>)	Shrub	FACW+			
6 Highbush Blueberry (<i>Vaccinium corymbosum</i>)	Shrub	FACW			
7 Coasati Doghobble (<i>Leucothoe axillaris</i>)	Shrub	FACW			

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-): 88.%

Remarks: Few scattered loblolly pines and holly; Herbaceous layer senescent (winter)

HYDROLOGY

<input type="checkbox"/> Recorded Data (describe in Remarks) <input type="checkbox"/> Stream, Lake, or Tide Gauge <input type="checkbox"/> Aerial Photographs <input type="checkbox"/> Other <input checked="" type="checkbox"/> No recorded data available Field Observations: Depth of Surface Water: <u>0-6</u> (In.) Depth to Free Water in Pit: <u>0</u> (In.) Depth to Saturated Soil: <u>0</u> (In.)	Wetland Hydrology Indicators: Primary Indicators: <input checked="" type="checkbox"/> Inundated <input checked="" type="checkbox"/> Saturated in Upper 12 inches <input checked="" type="checkbox"/> Water Marks <input checked="" type="checkbox"/> Drift Lines <input checked="" type="checkbox"/> Sediment Deposits <input checked="" type="checkbox"/> Drainage Patters in Wetlands Secondary Indicators (2 or more required): <input type="checkbox"/> Oxidized Root Channels in Upper 12" <input type="checkbox"/> Water-Stained Leaves <input type="checkbox"/> Local Soil Survey Data <input type="checkbox"/> FAC-Neutral Test <input type="checkbox"/> Other (explain in remarks)
Remarks: <u>Soil surface dry just below detritus despite recent heavy rains</u>	

SOILS

Map Unit Name (Series and Phase): <u>Dorovan muck, 0-1% slopes, frequently flooded</u>	Drainage Class: _____ <i>Circle</i>				
Taxonomy (Subgroup): _____	Field Observations Confirm Mapped Type? <u>yes</u>				
Yes					
Profile Description:					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-3	O/A	10yr3/2			Organic/Silty Laom
3-9	A	10yr3/1			Silty Loam
9-14	B	10yr4/1			Clayey/Silty Loam
14-20		10yr5/1			Silty -Clay
Hydric Soil Indicators:					
<input type="checkbox"/> Histosol	<input type="checkbox"/> Reducing Conditions	<input type="checkbox"/> High Organic Content in Surface Layer in Sandy Soils			
<input checked="" type="checkbox"/> Histic Epipedon	<input checked="" type="checkbox"/> Gleyed or Low-Chroma Colors	<input type="checkbox"/> Listed on National Hydric Soils List			
<input checked="" type="checkbox"/> Sulfidic Odor	<input type="checkbox"/> Concretions	<input type="checkbox"/> Listed on Local Hydric Soils List			
<input checked="" type="checkbox"/> Aquatic Moisture Regime	<input type="checkbox"/> Organic Streaking in Sandy Soils	<input type="checkbox"/> Other (explain in remarks)			
Remarks: _____					

WETLAND DETERMINATION

Hydrophytic Vegetation Present? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Is this Sampling Point Within a Wetland? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Wetland Hydrology Present? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Hydric Soils Present? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Remarks: _____	

APPENDIX D
-Hydraulic Analysis -

HYDRAULIC ANALYSIS
for
WETLAND RESTORATION AREA

ARMSTRONG FARM
@ PONGO RIVER

US HIGHWAY 45

April 11, 2007



Prepared by:

Richardson Engineering, LLC

30 E. Padonia Road
Suite 500

Timonium, Maryland 21093
410-560-1502

INTRODUCTION

The subject site is located in Ponzer, North Carolina along State Route 45. The 119.4 acre site is on the north side of State Route 45 on a tributary to the Pongo River. The site is currently utilized for agricultural purposes and is proposed to be converted to a wetland area. The information provided hereinafter shows that the site will be in an inundated condition during a 5-year storm event and adjacent properties will not be adversely impacted.

SITE DESCRIPTION

The existing site utilizes a series of swales to convey runoff through the site. The proposed grading will lower the grades within and create a berm around the perimeter of the area to create the pocket wetlands. The excavated material will be used to construct a berm along the perimeter of the site that will serve as an embankment for the runoff on the site. A 24" culvert will be incorporated under the realigned access road along the northwestern portion of the embankment. The embankment is constructed to between elevation 7 and 8 and the road crest will be set to elevation 9. The new culvert will have an invert elevation of 5.5. As a result of this, the main channel for flow through the site will remain inundated for extended periods. The remainder of the site will have periodic submergence with a significant area of the site being flat at elevation 6.25', which will make this area only 0.75' above the normal water elevation. This should subject the soils to significant wet periods even between rain events.

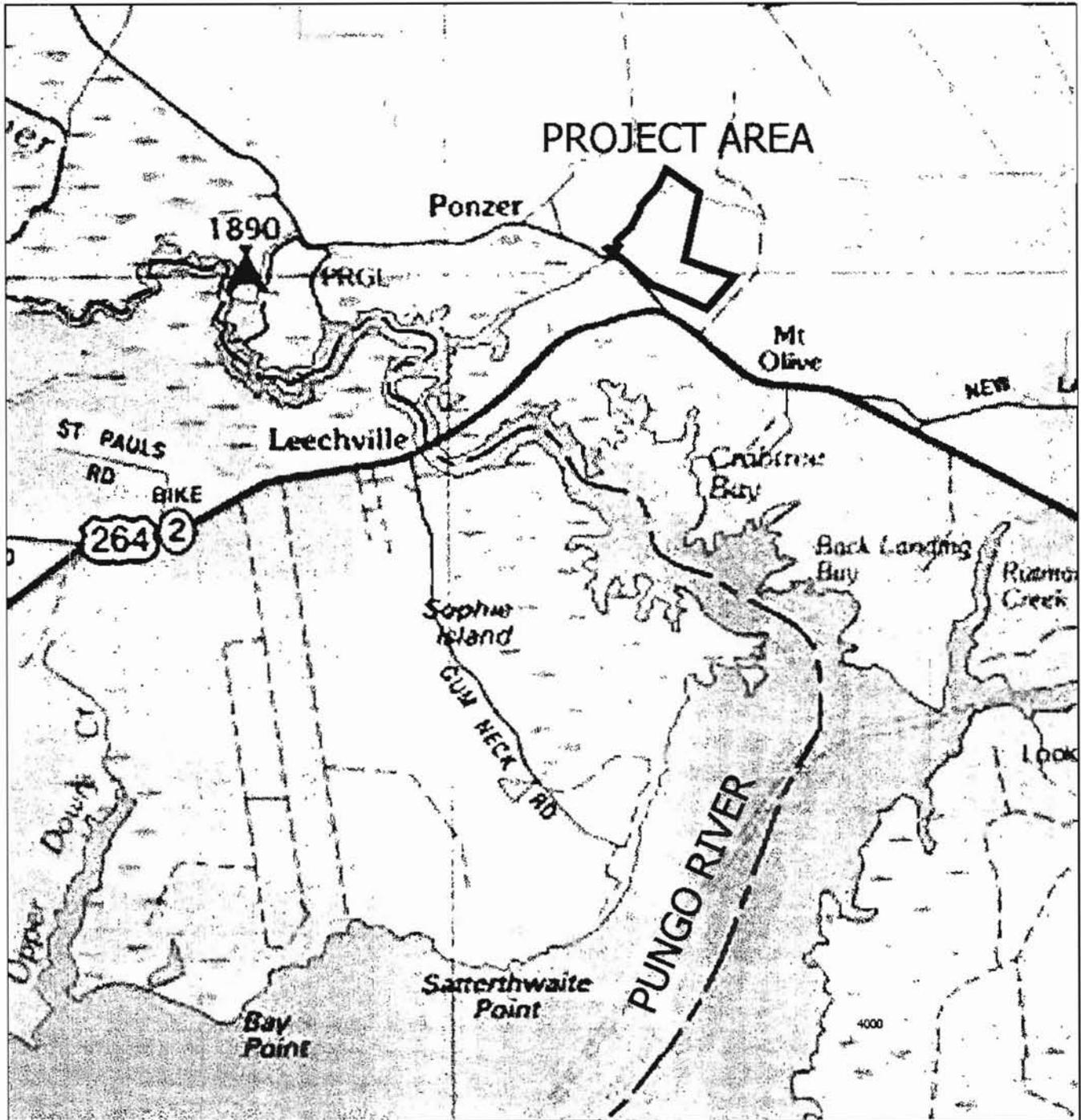
The area that is south between the embankment and State Route 45 will be raised with the excess soil from the embankment area so that this area can continue to be used for agricultural purposes, with the flow from this area being directed to the main swale going into the embankment.

METHODOLOGY

In order to determine the water surface elevation within the wetland creation area, the peak discharge was first calculated. The runoff curve number was established based on a meadow ground cover, with a 'D' hydrologic soil grouping due to the extensive area of hydric soils within the drainage area. The time of concentration was established using figure 5.F.1 in the "North Carolina Stormwater Management Guidance Manual". Upon establishment of the flow characteristics, the peak discharge from the area using the weir equation was used to solve for the head on a known length weir for a given discharge. This information was used in a TR-20 calculation to determine the peak elevations for the ponded area. The calculated water surface results in the inundation of the entire wetland creation area in the 5 year storm and a safe passage of the 100 year storm through the site.

CONCLUSIONS

The provided study indicates that the proposed wetland creation area will be inundated during a 5-year storm event and that there will be no adverse impact to adjoining properties. The excavation for the restoration of the wetlands and the installation of the berm will intuitively decrease the volume of runoff flowing onto adjacent sites since the release rate from the area is less than the inflow rate and the site will be capable of storing more runoff than existing conditions with a safe passage of the 100 year storm.



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Richardson Engineering, LLC
ECOTONE, INC.
 Environmental Consulting, Permitting & Design,
 Forest & Wetland Creation &
 Stream Restoration.

EXHIBIT A

Vicinity Map
 ARMSTRONG PROPERTY

RIVERINE WETLAND RESTORATION (35 WMU's)

P.O. Box 5 1204 Baldwin Mill Road • Jarrettsville, Maryland 21084
 (410) 692-7500 Fax (410) 692-7503 e-mail info@ecotonenc.com

Scale: 1" = 4000'

12/2005

Drawn By: LMS

RUNOFF CURVE NUMBER COMPUTATION

Version 2.10

Project : ARMSTRONG FARM

User: PCR

Date:

County : HYDE

State: NC

Checked: _____

Date: _____

Subtitle: PROPOSED CONDITIONS

Subarea : 1

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Impervious Areas				
Paved parking lots, roofs, driveways	-	-	-	0.50(98)
OTHER AGRICULTURAL LANDS				
Meadow -cont. grass (non grazed) ----	-	-	-	59.5(78)
Total Area (by Hydrologic Soil Group)				<u>60</u>

SUBAREA: 1 TOTAL DRAINAGE AREA: 60 Acres WEIGHTED CURVE NUMBER: 78

TIME OF CONCENTRATION AND TRAVEL TIME

Version 2.10

Project : ARMSTRONG FARM

User: PCR

Date:

County : HYDE

State: NC

Checked: _____

Date: _____

Subtitle: PROPOSED CONDITIONS

----- Subarea #1 - 1 -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	4.5	240	.004	F					0.769
Open Channel		1800	.0005		.03	90	90		0.450

Time of Concentration = 1.22*

=====

--- Sheet Flow Surface Codes ---

A Smooth Surface

F Grass, Dense

--- Shallow Concentrated ---

B Fallow (No Res.)

G Grass, Burmuda

--- Surface Codes ---

C Cultivated < 20 % Res.

H Woods, Light

P Paved

D Cultivated > 20 % Res.

I Woods, Dense

U Unpaved

E Grass-Range, Short

J Range, Natural

* - Generated for use by TABULAR method

TABULAR HYDROGRAPH METHOD

Version 2.10

Project : ARMSTRONG FARM
 County : HYDE
 Subtitle: PROPOSED CONDITIONS

State: NC

User: PCR
 Checked: _____

Date: _____
 Date: _____

Total watershed area: 0.094 sq mi Rainfall type: II Frequency: 5 years

----- Subareas -----

1
 Area(sq mi) 0.09*
 Rainfall(in) 6.0
 Curve number 78*
 Runoff(in) 3.58
 Tc (hrs) 1.22*
 (Used) 1.25
 TimeToOutlet 0.00
 Ia/P 0.09
 (Used) 0.10

Time Total ----- Subarea Contribution to Total Flow (cfs) -----
 (hr) Flow 1

11.0	3	3
11.3	4	4
11.6	6	6
11.9	8	8
12.0	10	10
12.1	13	13
12.2	18	18
12.3	27	27
12.4	40	40
12.5	55	55
12.6	71	71
12.7	86	86
12.8	95	95
13.0	104P	104P
13.2	89	89
13.4	71	71
13.6	55	55
13.8	43	43
14.0	35	35
14.3	26	26
14.6	20	20
15.0	16	16
15.5	12	12
16.0	10	10
16.5	9	9
17.0	8	8
17.5	7	7
18.0	7	7
19.0	6	6
20.0	5	5
22.0	4	4
26.0	0	0

ARMSTRONG FARM

CULVERT FLOW FOR WETLANDS AREA

INVERT 5.5

ELEV.	DEPTH	Q
5.0		0
5.5		0
6.0	0.5	4.38
6.5	1.0	16.0
7.0	1.5	29.17
7.5	2.0	31.99

(SEE ATTACHED
FLOW COMPS)

STORAGE IN BERM

ELEV	AREA	DEPTH	VOL	TOT. VOL
5.5	213,399 sf	0.5		0
			3,2810	
6.0	358,282	0.5		3,2810
			6,7249	
6.5	813,467	0.5		10,006
			10,919	
7.0	1,089,000	0.5		20,925
			12,620	
7.5	1,110,000	0.5		33,545

Worksheet
Worksheet for Circular Channel

Project Description

Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Discharge

Input Data

Mannings Coeffic	0.013
Channel Slope	020000 ft/ft
Depth	0.50 ft
Diameter	24.0 in

Results

Discharge	4.38 cfs
Flow Area	0.6 ft ²
Wetted Perime	2.09 ft
Top Width	0.00 ft
Critical Depth	0.74 ft
Percent Full	25.0 %
Critical Slope	0.004509 ft/ft
Velocity	7.13 ft/s
Velocity Head	0.79 ft
Specific Energ	1.29 ft
Froude Numbe	2.11
Maximum Disc	34.41 cfs
Discharge Full	31.99 cfs
Slope Full	0.000375 ft/ft
Flow Type	supercritical

Worksheet

Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Discharge

Input Data	
Mannings Coeffic	0.013
Channel Slope	020000 ft/ft
Depth	1.00 ft
Diameter	24.0 in

Results	
Discharge	16.00 cfs
Flow Area	1.6 ft ²
Wetted Perime	3.14 ft
Top Width	0.00 ft
Critical Depth	1.44 ft
Percent Full	50.0 %
Critical Slope	0.006612 ft/ft
Velocity	10.18 ft/s
Velocity Head	1.61 ft
Specific Energ	2.61 ft
Froude Numbe	2.03
Maximum Disc	34.41 cfs
Discharge Full	31.99 cfs
Slope Full	0.005000 ft/ft
Flow Type	supercritical

Worksheet

Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Discharge

Input Data	
Mannings Coeff	0.013
Channel Slope	020000 ft/ft
Depth	1.50 ft
Diameter	24.0 in

Results	
Discharge	29.17 cfs
Flow Area	2.5 ft ²
Wetted Perime	4.19 ft
Top Width	0.00 ft
Critical Depth	1.85 ft
Percent Full	75.0 %
Critical Slope	0.014408 ft/ft
Velocity	11.54 ft/s
Velocity Head	2.07 ft
Specific Energ	3.57 ft
Froude Numbe	1.68
Maximum Disc	34.41 cfs
Discharge Full	31.99 cfs
Slope Full	0.016630 ft/ft
Flow Type	supercritical

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Discharge

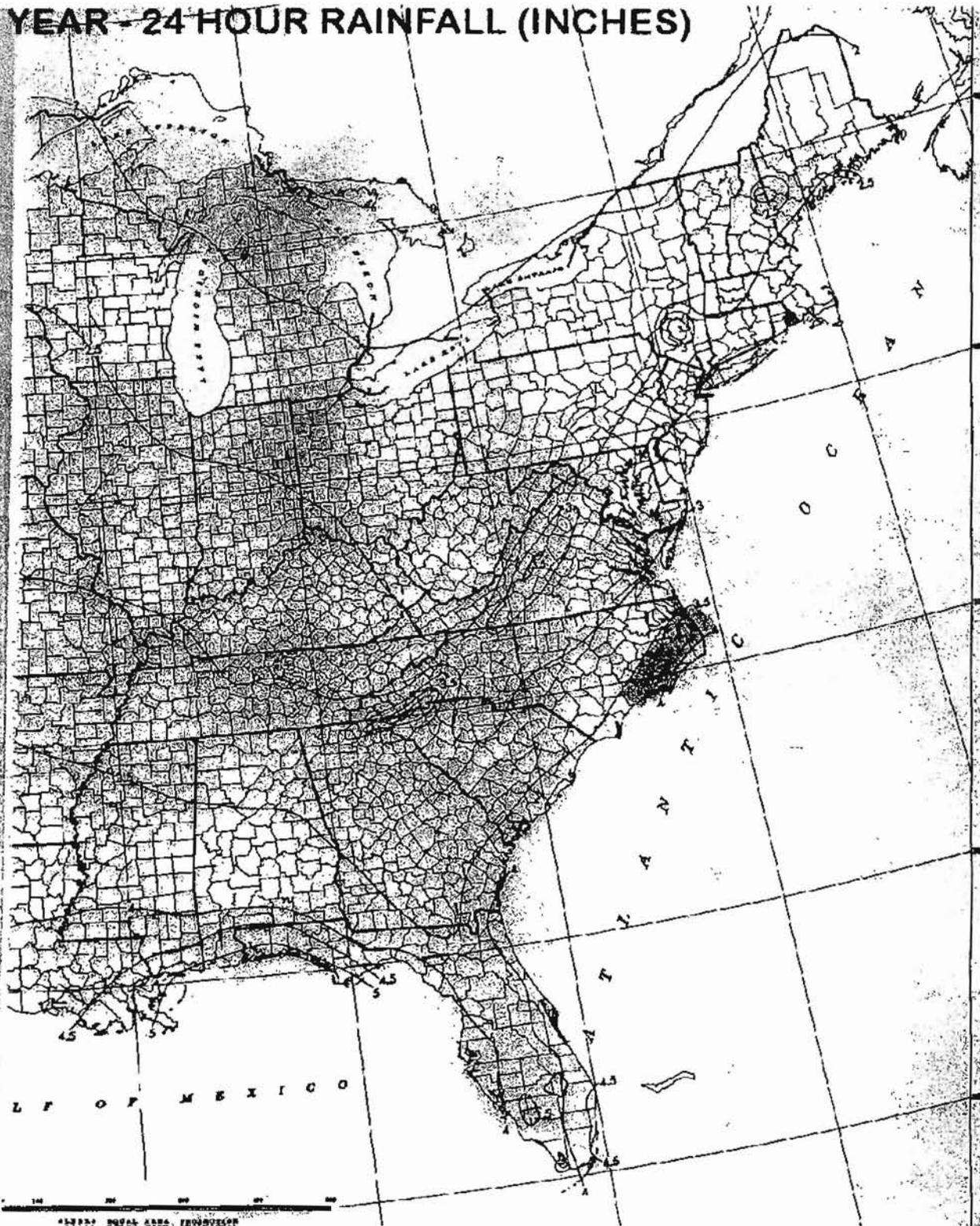
Input Data

Mannings Coeffic	0.013
Channel Slope	0.020000 ft/ft
Depth	2.00 ft
Diameter	24.0 in

Results

Discharge	31.99 cfs
Flow Area	3.1 ft ²
Wetted Perime	6.28 ft
Top Width	0.00 ft
Critical Depth	1.89 ft
Percent Full	100.0 %
Critical Slope	0.017296 ft/ft
Velocity	10.18 ft/s
Velocity Head	1.61 ft
Specific Energ	3.61 ft
Froude Numbe	0.00
Maximum Disc	34.41 cfs
Discharge Full	31.99 cfs
Slope Full	0.020000 ft/ft
Flow Type	Subcritical

1 YEAR - 24 HOUR RAINFALL (INCHES)



GULF OF MEXICO

0 100 200 300 400 500 600 700 800 900 1000

UNITED STATES GEOLOGICAL SURVEY

Section 5.0 – Engineering Methods

Table 11—Summary of Coastal Stillwater Elevations

Flooding Source	FIRM Panel Number(s)	Elevations (feet NAVD)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Atlantic Ocean/ Pamlico Sound/ Pamlico River	3720760200	4.6	6.3	7.0	8.0
	3720760400				
	3720760800				
	3720762200				
	3720762400				
	3720762600				
	3720762800				
	3720764200				
	3720764400				
	3720764600				
3720764800					
Atlantic Ocean/ Pamlico Sound	3720756800	3.9	6.1	6.6	8.1
	3720762000				
	3720762200				
	3720762400				
	3720762600				
	3720762800				
	3720764000				
	3720764200				
	3720764400				
	3720764600				
	3720764800				
	3720766000				
	3720766200				
	3720766400				
3720766600					
3720766800					
Atlantic Ocean/ Pamlico Sound	3720756800	4.2	6.2	7.0	8.4
	3720758800				
	3720766000				
	3720766200				
	3720766400				
	3720766600				
	3720768000				
3720768200					
3720768400					

Table 5.F.2 Runoff Curve Numbers (CN)

Land Use/Cover	Hydrologic Soil Group			
	A	B	C	D
	CN			
Cultivated land				
without conservation	72	81	88	91
with conservation	62	71	78	81
Pasture land				
poor condition	68	79	86	89
good condition	39	61	74	80
Meadow				
good condition	30	58	74	78
Wood or forest land				
Thin stand — poor cover, no mulch	45	66	77	83
Good stand — good cover	25	55	70	77
Open spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition:				
grass cover on 75% or more of the area	39	61	74	80
fair condition:				
grass cover on 50 to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious)	81	88	91	93
Residential: Development completed and vegetation established				
Average lot size				
Average % impervious				
1/8 acre or less	65	77	85	90
1/4 acre	38	61	75	83
1/3 acre	30	57	72	81
1/2 acre	25	54	70	80
1 acre	20	51	68	79
2 acres	15	47	66	77
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and roads paved with curbs and storm sewers	98	98	98	98
gravel	75	85	89	91
dirt	72	82	87	89
Newly graded area	81	88	93	95
Residential: Development underway and no vegetation				
Lot sizes of 1/4 acre	88	93	95	97
Lot sizes of 1/2 acre	85	91	94	96
Lot sizes of 1 acre	82	90	93	95
Lot sizes of 2 acres	81	89	92	94

¹Curve numbers are computed assuming the runoff from the house and driveway is directed toward the street.

Source: USDA-SCS

1

*****80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*****

```

JOB TR-20                FULLPRINT          SUMMARY  NOPLOTS    00000500
TITLE 003 Armstrong Wetlands restoration    00000510
TITLE 24" culvert Analysis                  00000520
3 STRUCT      01      1.0      5.00
8              5.50      0.00      0.0000
8              6.00      4.38      3.2810
8              6.50      16.0      6.7249
8              7.00      29.17     20.925
8              7.50      31.99     33.545
9 ENDTBL
6 RUNOFF 1 001      5 0.0938      78.      1.22      1 1 1
6 RESVOR 2 01 5 3 5.00
ENDATA
7 LIST
7 INCREM 6              0.10
7 COMPUT 7 001      01 0.0      4.0      1.0      2 2 01 01
  ENDCMP 1
7 COMPUT 7 001      01 0.0      6.0      1.0      2 2 05 05
  ENDCMP 1
7 COMPUT 7 001      01 0.0      8.4      1.0      2 2 99 99
  ENDCMP 1
  ENDJOB 2

```

0*****END OF 80-80 LIST*****

1

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TR20 XEQ 06-07-07 21:55      Armstrong Wetlands restoration      00000510      JOB 1  PASS 1
  REV PC 09/83(.2)          24" culvert Analysis                00000520

```

FILE NO. 3

COMPUTER PROGRAM FOR PROJECT FORMULATION - HYDROLOGY USER NOTES

THE USERS MANUAL FOR THIS PROGRAM IS THE MAY 1983 DRAFT OF TR-20. CHANGES FROM THE 2/14/74 VERSION INCLUDE:

REACH ROUTING - THE MODIFIED ATT-KIN ROUTING PROCEDURE REPLACES THE CONVEX METHOD. INPUT DATA PREPARED FOR PREVIOUS PROGRAM VERSIONS USING CONVEX ROUTING COEFFICIENTS WILL NOT RUN ON THIS VERSION.

THE PREFERRED TYPE OF DATA ENTRY IS CROSS SECTION DATA REPRESENTATIVE OF A REACH. IT IS RECOMMENDED THAT THE OPTIONAL CROSS SECTION DISCHARGE-AREA PLOTS BE OBTAINED WHENEVER NEW CROSS SECTION DATA IS ENTERED. THE PLOTS SHOULD BE CHECKED FOR REASONABLENESS AND ADEQUACY OF INPUT DATA FOR THE COMPUTATION OF "M" VALUES USED IN THE ROUTING PROCEDURE.

GUIDELINES FOR DETERMINING OR ANALYZING REACH LENGTHS AND COEFFICIENTS (X,M) ARE AVAILABLE IN THE USERS MANUAL. SUMMARY TABLE 2 DISPLAYS REACH ROUTING RESULTS AND ROUTING PARAMETERS FOR COMPARISON AND CHECKING.

HYDROGRAPH GENERATION - THE PROCEDURE TO CALCULATE THE INTERNAL TIME INCREMENT AND PEAK TIME OF THE UNIT HYDROGRAPH HAVE BEEN IMPROVED. PEAK DISCHARGES AND TIMES MAY DIFFER FROM THE PREVIOUS VERSION. OUTPUT HYDROGRAPHS ARE STILL INTERPOLATED, PRINTED, AND ROUTED AT THE USER SELECTED MAIN TIME INCREMENT:

INTERMEDIATE PEAKS - METHOD ADDED TO PROVIDE DISCHARGES AT INTERMEDIATE POINTS WITHIN REACHES WITHOUT ROUTING.

OTHER - THIS VERSION CONTAINS SOME ADDITIONS TO THE INPUT AND NUMEROUS MODIFICATIONS TO THE OUTPUT. USER OPTIONS HAVE BEEN MODIFIED AND AUGMENTED ON THE JOB RECORD, RAINTABLES ADDED, ERROR AND WARNING MESSAGES EXPANDED, AND THE SUMMARY TABLES COMPLETELY REVISED. THE HOLDOUT OPTION IS NOT OPERATIONAL AT THIS TIME.

PROGRAM QUESTIONS OR PROBLEMS SHOULD BE DIRECTED TO HYDRAULIC ENGINEERS AT THE SCS NATIONAL TECHNICAL CENTERS:

CHESTER, PA (NORTHEAST) -- 215-499-3933, FORT WORTH, TX (SOUTH) -- 334-5242 (FTS)
LINCOLN, NE (MIDWEST) -- 541-5318 (FTS), PORTLAND, OR (WEST) -- 423-4099 (FTS)

PROGRAM CHANGES SINCE MAY 1982:

- 12/17/82 - CORRECT PEAK RATE FACTOR FOR USER ENTERED DIMHYD
CORRECT REACH ROUTING PEAK TRAVEL TIME PRINTED WITH FULLPRINT OPTION
- 5/02/83 - CORRECT COMPUTATIONS FOR ---
1. DIVISION OF BASEFLOW IN DIVERT OPERATION
 2. HYDROGRAPH VOLUME SPLIT BETWEEN BASEFLOW AND ABOVE BASEFLOW
 3. CROSS SECTION DATA PLOTTING POSITION
 4. INTERMEDIATE PEAK WHEN "FROM" AREA IS LARGER THAN "THRU" AREA
 5. STORAGE Routed REACH TRAVEL TIME FOR MULTYPEAK HYDROGRAPH
 6. ORDERING "FLOW-FREQ" FILE FROM SUMMARY TABLE #3 DATA
 7. BASEFLOW ENTERED WITH READHYD
 8. LOW FLOW SPLIT DURING DIVERT PROCEDURE #2 WHEN SECTION RATINGS START AT DIFFERENT ELEVATIONS
- ENHANCEMENTS ---
1. REPLACE USER MANUAL ERROR CODES (PAGE 4-9 TO 4-11) WITH MESSAGES
 2. LABEL OUTPUT HYDROGRAPH FILES WITH CROSS SECTION/STRUCTURE, ALTERNATE AND STORM NO'S
- 09/01/83 - CORRECT INPUT AND OUTPUT ERRORS FOR INTERMEDIATE PEAKS
CORRECT COMBINATION OF RATING TABLES FOR DIVERT
CHECK REACH ROUTING PARAMETERS FOR ACCEPTABLE LIMITS
ELIMINATE MINIMUM REACH TRAVEL TIME WHEN ATT-KIN COEFFICIENT EQUALS ONE

1

TR2C XEQ 06-07-07 21:55	Armstrong Wetlands restoration	00000510	JOB 1	PASS 1
REV PC 09/83(.2)	24" culvert Analysis	00000520		PAGE 2

EXECUTIVE CONTROL OPERATION LIST

RECORD ID

LISTING OF CURRENT DATA

	STRUCT NO.	ELEVATION	DISCHARGE	STORAGE
3 STRUCT	1			
8		5.50	.00	.00
8		6.00	4.38	3.28
8		6.50	16.00	6.72
8		7.00	29.17	20.92
8		7.50	31.99	33.54
9 ENDTBL				

	TIME INCREMENT				
4 DIMHYD		.0200			
8	.0000	.0300	.1000	.1900	.3100
8	.4700	.6600	.8200	.9300	.9900
8	1.0000	.9900	.9300	.8600	.7800
8	.6800	.5600	.4600	.3900	.3300
8	.2800	.2410	.2070	.1740	.1470
8	.1260	.1070	.0910	.0770	.0660
8	.0550	.0470	.0400	.0340	.0290
8	.0250	.0210	.0180	.0150	.0130
8	.0110	.0090	.0080	.0070	.0060
8	.0050	.0040	.0030	.0020	.0010
8	.0000	.0000	.0000	.0000	.0000
9 ENDTBL					

COMPUTED PEAK RATE FACTOR = 484.00

	TIME INCREMENT				
5 RAINFL 1		.5000			
8	.0000	.0080	.0170	.0260	.0350
8	.0450	.0550	.0650	.0760	.0870
8	.0990	.1120	.1260	.1400	.1560
8	.1740	.1940	.2190	.2540	.3030
8	.5150	.5830	.6240	.6550	.6820
8	.7060	.7280	.7480	.7660	.7830
1					

TR20 XEQ 06-07-07 21:55
REV PC 09/83(.2)

Armstrong Wetlands restoration
24" culvert Analysis

00000510
00000520

JOB 1 PASS 1
PAGE 3

8	.7990	.8150	.8300	.8440	.8570
8	.8700	.8820	.8930	.9050	.9160
8	.9260	.9360	.9460	.9560	.9650
8	.9740	.9830	.9920	1.0000	1.0000
9 ENDTBL					

	TIME INCREMENT				
5 RAINFL 2		.2500			
8	.0000	.0020	.0050	.0080	.0110
8	.0140	.0170	.0200	.0230	.0260
8	.0290	.0320	.0350	.0380	.0410
8	.0440	.0480	.0520	.0560	.0600
8	.0640	.0680	.0720	.0760	.0800
8	.0850	.0900	.0950	.1000	.1050
8	.1100	.1150	.1200	.1260	.1330

8	.1400	.1470	.1550	.1630	.1720
8	.1810	.1910	.2030	.2180	.2360
8	.2570	.2830	.3870	.6630	.7070
8	.7350	.7580	.7760	.7910	.8040
8	.8150	.8250	.8340	.8420	.8490
8	.8560	.8630	.8690	.8750	.8810
8	.8870	.8930	.8980	.9030	.9080
8	.9130	.9180	.9220	.9260	.9300
8	.9340	.9380	.9420	.9460	.9500
8	.9530	.9560	.9590	.9620	.9650
8	.9680	.9710	.9740	.9770	.9800
8	.9830	.9860	.9890	.9920	.9950
8	.9980	1.0000	1.0000	1.0000	1.0000
9	ENDTBL				

TABLE NO. TIME INCREMENT
5 RAINFL 3 .5000

8	.0000	.0100	.0220	.0360	.0510
8	.0670	.0830	.0990	.1160	.1350
8	.1560	.1790	.2040	.2330	.2680
8	.3100	.4250	.4800	.5200	.5500
8	.5770	.6010	.6230	.6440	.6640
8	.6830	.7010	.7190	.7360	.7530
8	.7690	.7850	.8000	.8150	.8300
8	.8440	.8580	.8710	.8840	.8960
8	.9080	.9200	.9320	.9440	.9560
8	.9670	.9780	.9890	1.0000	1.0000
9	ENDTBL				

1

TR20 XEQ 06-07-07 21:55
REV PC 09/83(.2)

Armstrong Wetlands restoration
24" culvert Analysis

00000510
00000520

JOB 1 PASS 1
PAGE 4

TABLE NO. TIME INCREMENT
5 RAINFL 4 .5000

8	.0000	.0040	.0080	.0120	.0160
8	.0200	.0250	.0300	.0350	.0400
8	.0450	.0500	.0550	.0600	.0650
8	.0700	.0750	.0810	.0870	.0930
8	.0990	.1050	.1110	.1180	.1250
8	.1320	.1400	.1480	.1560	.1650
8	.1740	.1840	.1950	.2070	.2200
8	.2360	.2550	.2770	.3030	.4090
8	.5150	.5490	.5830	.6050	.6240
8	.6400	.6550	.6690	.6820	.6940
8	.7050	.7160	.7270	.7380	.7480
8	.7580	.7670	.7760	.7840	.7920
8	.8000	.8080	.8160	.8230	.8300

8	.8370	.8440	.8510	.8580	.8640
8	.8700	.8760	.8820	.8880	.8940
8	.9000	.9060	.9110	.9160	.9210
8	.9260	.9310	.9360	.9410	.9460
8	.9510	.9560	.9610	.9660	.9710
8	.9760	.9800	.9840	.9880	.9920
8	.9960	1.0000	1.0000	1.0000	1.0000
9	ENDTBL				

TABLE NO. TIME INCREMENT
5 RAINFL 5 .5000

8	.0000	.0020	.0050	.0080	.0110
8	.0140	.0170	.0200	.0230	.0260
8	.0290	.0320	.0350	.0380	.0410
8	.0440	.0470	.0510	.0550	.0590
8	.0630	.0670	.0710	.0750	.0790
8	.0840	.0890	.0940	.0990	.1040
8	.1090	.1140	.1200	.1260	.1330
8	.1400	.1470	.1540	.1620	.1710
8	.1810	.1920	.2040	.2170	.2330
8	.2520	.2770	.3180	.6380	.6980
8	.7290	.7520	.7700	.7850	.7980
8	.8090	.8190	.8290	.8380	.8460
8	.8540	.8610	.8680	.8740	.8800
8	.8860	.8920	.8970	.9020	.9070
8	.9120	.9170	.9210	.9250	.9290
8	.9330	.9370	.9410	.9450	.9490
8	.9530	.9570	.9600	.9630	.9660
8	.9690	.9720	.9750	.9780	.9810

1

TR20 XEQ 06-07-07 21:55
REV PC 09/83(.2)

Armstrong Wetlands restoration
24" culvert Analysis

00000510
00000520

JOB 1 PASS 1
PAGE 5

8	.9840	.9870	.9900	.9930	.9960
8	.9980	1.0000	1.0000	1.0000	1.0000
9	ENDTBL				

TABLE NO. TIME INCREMENT
5 RAINFL 6 .0200

8	.0000	.0080	.0162	.0246	.0333
8	.0425	.0524	.0630	.0743	.0863
8	.0990	.1124	.1265	.1420	.1595
8	.1800	.2050	.2550	.3450	.4370
8	.5300	.6030	.6330	.6600	.6840
8	.7050	.7240	.7420	.7590	.7750
8	.7900	.8043	.8180	.8312	.8439

8	.8561	.8678	.8790	.8898	.9002
8	.9103	.9201	.9297	.9391	.9483
8	.9573	.9661	.9747	.9832	.9916
8	1.0000	1.0000	1.0000	1.0000	1.0000

9 ENDTBL

1

TR20 XEQ 06-07-07 21:55	Armstrong Wetlands restoration	00000510	JOB 1	PASS 1
REV PC 09/83(.2)	24" culvert Analysis	00000520		PAGE 6

0 STANDARD CONTROL INSTRUCTIONS

6 RUNOFF 1	1	5	.0938	78.0000	1.22001	1	0	1	0	1	
6 RESVOR 2	1	5	3	5.0000		1	1	0	1	0	1

ENDATA

END OF LISTING

1

TR20 XEQ 06-07-07 21:55	Armstrong Wetlands restoration	00000510	JOB 1	PASS 1
REV PC 09/83(.2)	24" culvert Analysis	00000520		PAGE 7

EXECUTIVE CONTROL OPERATION INCREM		RECORD ID
+	MAIN TIME INCREMENT = .10 HOURS	

EXECUTIVE CONTROL OPERATION COMPUT		RECORD ID
+	FROM XSECTION 1	
+	TO STRUCTURE 1	

STARTING TIME = .00	RAIN DEPTH = 4.00	RAIN DURATION = 1.00	RAIN TABLE NO. = 2	ANT. MOIST. COND = 2
ALTERNATE NO. = 1	STORM NO. = 1	MAIN TIME INCREMENT = .10 HOURS		

OPERATION RUNOFF CROSS SECTION 1

OUTPUT HYDROGRAPH = 5

AREA = .09 SQ MI INPUT RUNOFF CURVE = 78. TIME OF CONCENTRATION = 1.22 HOURS

INTERNAL HYDROGRAPH TIME INCREMENT = .1017 HOURS

PEAK TIME (HRS)	PEAK DISCHARGE (CFS)	PEAK ELEVATION (FEET)
12.69	50.87	(RUNOFF)
23.69	2.30	(RUNOFF)

TIME (HRS)	FIRST HYDROGRAPH POINT =	.00 HOURS	TIME INCREMENT =	.10 HOURS	DRAINAGE AREA =	.09 SQ.MI.
9.00	DISCHG	.00	.01	.03	.05	.07
		.00	.01	.03	.05	.07
					.10	.14
						.18

10.00	DISCHG	.23	.29	.35	.42	.50	.58	.67	.78	.91	1.06
11.00	DISCHG	1.23	1.43	1.66	1.92	2.23	2.59	3.10	3.92	5.35	7.98
12.00	DISCHG	12.40	18.48	25.92	34.16	41.76	47.19	50.16	50.85	49.61	46.87
13.00	DISCHG	43.19	38.82	34.40	30.61	27.42	24.70	22.35	20.26	18.40	16.78
14.00	DISCHG	15.36	14.10	12.99	12.02	11.16	10.41	9.74	9.14	8.60	8.11
15.00	DISCHG	7.67	7.27	6.92	6.61	6.34	6.10	5.87	5.66	5.47	5.30
16.00	DISCHG	5.15	5.03	4.92	4.83	4.75	4.69	4.63	4.58	4.53	4.48
17.00	DISCHG	4.41	4.34	4.26	4.19	4.11	4.05	3.99	3.94	3.90	3.86
18.00	DISCHG	3.82	3.78	3.72	3.66	3.58	3.51	3.43	3.36	3.30	3.25
19.00	DISCHG	3.20	3.17	3.14	3.12	3.10	3.08	3.07	3.06	3.05	3.04
20.00	DISCHG	3.02	2.99	2.95	2.89	2.83	2.76	2.69	2.63	2.57	2.51
21.00	DISCHG	2.47	2.43	2.41	2.38	2.37	2.35	2.34	2.33	2.32	2.32
22.00	DISCHG	2.31	2.31	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
23.00	DISCHG	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
24.00	DISCHG	2.28	2.25	2.19	2.10	1.97	1.80	1.61	1.41	1.20	1.01
25.00	DISCHG	.84	.69	.56	.45	.37	.30	.25	.20	.17	.13
26.00	DISCHG	.11	.09	.07	.06	.05	.04	.03	.02	.02	.02
27.00	DISCHG	.01	.01	.01	.01	.00					

RUNOFF VOLUME ABOVE BASEFLOW = 1.89 WATERSHED INCHES, 114.19 CFS-HRS, 9.44 ACRE-FEET; BASEFLOW = .00 CFS

OPERATION RESVOR STRUCTURE 1
 INPUT HYDROGRAPH= 5 OUTPUT HYDROGRAPH= 3
 SURFACE ELEVATION= 5.00

PEAK TIME(HRS) PEAK DISCHARGE(CFS) PEAK ELEVATION(FEET)
 14.53 10.24 6.25

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .09 SQ.MI.

TR20 XEQ 06-07-07 21:55 Armstrong Wetlands restoration 00000510 JOB 1 PASS 1
 REV PC 09/83(.2) 24" culvert Analysis 00000520 PAGE 8

9.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
10.00	DISCHG	.01	.01	.01	.02	.02	.03	.03	.04	.05	.06
11.00	DISCHG	.07	.09	.10	.12	.14	.17	.20	.23	.28	.35
12.00	DISCHG	.46	.62	.86	1.18	1.58	2.06	2.57	3.09	3.61	4.10
13.00	DISCHG	4.80	5.80	6.65	7.36	7.95	8.45	8.87	9.21	9.49	9.71
14.00	DISCHG	9.88	10.02	10.11	10.18	10.22	10.23	10.23	10.21	10.17	10.12
15.00	DISCHG	10.06	9.99	9.91	9.82	9.73	9.63	9.53	9.43	9.32	9.22
16.00	DISCHG	9.11	9.00	8.89	8.77	8.67	8.56	8.45	8.34	8.24	8.14
17.00	DISCHG	8.04	7.93	7.83	7.74	7.64	7.54	7.44	7.35	7.25	7.16
18.00	DISCHG	7.07	6.98	6.89	6.80	6.71	6.63	6.54	6.45	6.37	6.28
19.00	DISCHG	6.20	6.12	6.03	5.95	5.88	5.80	5.72	5.65	5.58	5.51
20.00	DISCHG	5.44	5.37	5.31	5.24	5.18	5.11	5.05	4.98	4.92	4.85
21.00	DISCHG	4.79	4.72	4.66	4.60	4.53	4.47	4.42	4.37	4.35	4.33
22.00	DISCHG	4.30	4.28	4.26	4.24	4.22	4.20	4.18	4.16	4.14	4.12

23.00	DISCHG	4.10	4.08	4.06	4.04	4.02	4.00	3.98	3.96	3.94	3.93
24.00	DISCHG	3.91	3.89	3.87	3.85	3.83	3.81	3.79	3.76	3.74	3.71
25.00	DISCHG	3.68	3.64	3.61	3.58	3.54	3.51	3.47	3.44	3.40	3.37
26.00	DISCHG	3.33	3.29	3.26	3.22	3.19	3.15	3.12	3.09	3.05	3.02
27.00	DISCHG	2.99	2.95	2.92	2.89	2.86	2.83	2.80	2.76	2.73	2.70
28.00	DISCHG	2.67	2.65	2.62	2.59	2.56	2.53	2.50	2.48	2.45	2.42
29.00	DISCHG	2.40	2.37	2.34	2.32	2.29	2.27	2.24	2.22	2.19	2.17

RUNOFF VOLUME ABOVE BASEFLOW = 1.56 WATERSHED INCHES, 94.54 CFS-HRS, 7.81 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP

RECORD ID

+ COMPUTATIONS COMPLETED FOR PASS 1

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Armstrong Wetlands restoration
24" culvert Analysis

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JOB 1 PASS 2
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EXECUTIVE CONTROL OPERATION COMPUT

RECORD ID

+ FROM XSECTION 1

TO STRUCTURE 1

STARTING TIME = .00 RAIN DEPTH = 6.00 RAIN DURATION = 1.00 RAIN TABLE NO. = 2 ANT. MOIST. COND = 2
ALTERNATE NO. = 5 STORM NO. = 5 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

OUTPUT HYDROGRAPH = 5

AREA = .09 SQ MI INPUT RUNOFF CURVE = 78. TIME OF CONCENTRATION = 1.22 HOURS

INTERNAL HYDROGRAPH TIME INCREMENT = .1017 HOURS

PEAK TIME (HRS)	PEAK DISCHARGE (CFS)	PEAK ELEVATION (FEET)
12.66	98.24	(RUNOFF)
23.67	3.84	(RUNOFF)

TIME (HRS)	FIRST HYDROGRAPH POINT =	.00 HOURS	TIME INCREMENT =	.10 HOURS	DRAINAGE AREA =	.09 SQ. MI.
7.00	DISCHG	.00	.01	.03	.06	.09
8.00	DISCHG	.24	.29	.34	.45	.59
9.00	DISCHG	.96	1.06	1.17	1.39	1.64
10.00	DISCHG	2.20	2.36	2.53	2.88	3.32
11.00	DISCHG	4.67	5.15	5.70	6.33	7.04
12.00	DISCHG	28.06	39.89	54.09	69.46	83.28
13.00	DISCHG	81.30	72.59	63.95	56.58	50.43
14.00	DISCHG	27.44	25.09	23.02	21.21	19.64
15.00	DISCHG	13.27	12.55	11.93	11.38	10.89
16.00	DISCHG	8.77	8.56	8.37	8.21	8.07
17.00	DISCHG	7.47	7.35	7.21	7.08	6.96
18.00	DISCHG	6.45	6.37	6.27	6.16	6.04
19.00	DISCHG	5.39	5.33	5.28	5.24	5.21
20.00	DISCHG	5.07	5.02	4.95	4.85	4.74
21.00	DISCHG	4.13	4.08	4.03	3.99	3.96

22.00	DISCHG	3.86	3.86	3.85	3.85	3.84	3.84	3.84	3.84	3.84	3.84
23.00	DISCHG	3.83	3.83	3.83	3.83	3.84	3.84	3.84	3.84	3.83	3.82
24.00	DISCHG	3.80	3.75	3.65	3.49	3.28	3.00	2.68	2.34	2.00	1.68
25.00	DISCHG	1.39	1.14	.93	.75	.62	.50	.41	.34	.28	.22
26.00	DISCHG	.18	.15	.12	.10	.08	.06	.05	.04	.03	.03
27.00	DISCHG	.02	.02	.01	.01	.01	.00				

RUNOFF VOLUME ABOVE BASEFLOW = 3.58 WATERSHED INCHES, 216.59 CFS-HRS, 17.90 ACRE-FEET; BASEFLOW = .00 CFS

OPERATION RESVOR STRUCTURE 1
 INPUT HYDROGRAPH= 5 OUTPUT HYDROGRAPH= 3
 SURFACE ELEVATION= 5.00

PEAK TIME(HRS) 14.47 PEAK DISCHARGE(CFS) 18.71 PEAK ELEVATION(FEET) 6.60

TIME(HRS) 7.00 DISCHG .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .01
 FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .09 SQ.MI.

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8.00	DISCHG	.01	.01	.02	.02	.02	.03	.03	.04	.05	.06
9.00	DISCHG	.07	.08	.09	.10	.11	.13	.14	.16	.18	.20
10.00	DISCHG	.22	.24	.27	.29	.32	.35	.38	.41	.45	.49
11.00	DISCHG	.53	.58	.64	.69	.76	.83	.92	1.02	1.14	1.31
12.00	DISCHG	1.55	1.91	2.40	3.06	3.86	5.39	7.86	10.33	12.70	14.88
13.00	DISCHG	16.22	16.69	17.08	17.41	17.69	17.92	18.11	18.27	18.39	18.49
14.00	DISCHG	18.57	18.63	18.67	18.70	18.71	18.71	18.71	18.69	18.66	18.63
15.00	DISCHG	18.59	18.55	18.50	18.45	18.39	18.34	18.27	18.21	18.14	18.07
16.00	DISCHG	18.00	17.93	17.86	17.79	17.71	17.64	17.57	17.49	17.42	17.34
17.00	DISCHG	17.27	17.19	17.12	17.04	16.96	16.89	16.81	16.73	16.65	16.58
18.00	DISCHG	16.50	16.42	16.35	16.27	16.19	16.11	16.03	15.84	15.56	15.28
19.00	DISCHG	15.01	14.75	14.49	14.23	13.99	13.74	13.51	13.28	13.05	12.84
20.00	DISCHG	12.62	12.41	12.21	12.01	11.81	11.61	11.42	11.23	11.04	10.85
21.00	DISCHG	10.67	10.49	10.31	10.14	9.97	9.80	9.64	9.48	9.33	9.18
22.00	DISCHG	9.03	8.89	8.75	8.62	8.49	8.36	8.24	8.11	8.00	7.88
23.00	DISCHG	7.77	7.66	7.56	7.45	7.36	7.26	7.16	7.07	6.98	6.90
24.00	DISCHG	6.81	6.73	6.65	6.56	6.47	6.38	6.28	6.18	6.07	5.95
25.00	DISCHG	5.83	5.71	5.58	5.45	5.32	5.19	5.06	4.93	4.80	4.68
26.00	DISCHG	4.55	4.43	4.35	4.31	4.26	4.21	4.17	4.12	4.08	4.03
27.00	DISCHG	3.99	3.95	3.90	3.86	3.82	3.78	3.74	3.69	3.65	3.61
28.00	DISCHG	3.57	3.53	3.50	3.46	3.42	3.38	3.35	3.31	3.27	3.24
29.00	DISCHG	3.20	3.17	3.13	3.10	3.06	3.03	3.00	2.96	2.93	2.90

RUNOFF VOLUME ABOVE BASEFLOW = 3.14 WATERSHED INCHES, 190.32 CFS-HRS, 15.73 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP

RECORD ID

+ COMPUTATIONS COMPLETED FOR PASS 2

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Armstrong Wetlands restoration
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JOB 1 PASS 3
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EXECUTIVE CONTROL OPERATION COMPUT

RECORD ID

+ FROM XSECTION 1
+ TO STRUCTURE 1

STARTING TIME = .00 RAIN DEPTH = 8.40 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 ANT. MOIST. COND= 2
ALTERNATE NO.=99 STORM NO.=99 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

OUTPUT HYDROGRAPH= 5

AREA= .09 SQ MI INPUT RUNOFF CURVE= 78. TIME OF CONCENTRATION= 1.22 HOURS

INTERNAL HYDROGRAPH TIME INCREMENT= .1017 HOURS

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
12.65	158.18	(RUNOFF)
23.65	5.66	(RUNOFF)

TIME(HRS)	FIRST HYDROGRAPH POINT =	.00 HOURS	TIME INCREMENT =	.10 HOURS	DRAINAGE AREA =	.09 SQ.MI.
5.00	DISCHG	.00	.00	.00	.02	.03
6.00	DISCHG	.08	.11	.16	.49	.58
7.00	DISCHG	.77	.86	.96	1.44	1.53
8.00	DISCHG	1.71	1.81	1.90	2.58	2.76
9.00	DISCHG	3.16	3.37	3.57	4.69	4.94
10.00	DISCHG	5.47	5.75	6.04	7.90	8.45
11.00	DISCHG	9.85	10.71	11.70	20.58	25.72
12.00	DISCHG	49.06	68.12	90.73	157.24	151.40
13.00	DISCHG	128.75	114.52	100.55	56.83	51.24
14.00	DISCHG	42.16	38.46	35.21	24.14	22.61
15.00	DISCHG	20.00	18.91	17.94	14.48	13.95
16.00	DISCHG	13.10	12.77	12.49	11.58	11.45
17.00	DISCHG	11.13	10.93	10.74	9.89	9.78
18.00	DISCHG	9.58	9.46	9.32	8.41	8.25
19.00	DISCHG	7.99	7.90	7.82	7.62	7.59
20.00	DISCHG	7.51	7.43	7.33	6.51	6.36
21.00	DISCHG	6.12	6.03	5.96	5.76	5.74
22.00	DISCHG	5.71	5.70	5.69	5.67	5.66
23.00	DISCHG	5.66	5.66	5.66	5.66	5.66
24.00	DISCHG	5.61	5.53	5.38	3.45	2.95
25.00	DISCHG	2.05	1.68	1.37	.50	.41
26.00	DISCHG	.27	.22	.18	.06	.05
27.00	DISCHG	.03	.02	.02	.01	.00

RUNOFF VOLUME ABOVE BASEFLOW = 5.76 WATERSHED INCHES, 348.71 CFS-HRS, 28.82 ACRE-FEET; BASEFLOW = .00 CFS

OPERATION RESVOR STRUCTURE 1
INPUT HYDROGRAPH= 5 OUTPUT HYDROGRAPH= 3
SURFACE ELEVATION= 5.00

PEAK TIME(HRS) PEAK DISCHARGE(CFS) PEAK ELEVATION(FEET)
14.64 25.12 6.85

1

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TIME (HRS)	FIRST HYDROGRAPH POINT =	.00 HOURS	TIME INCREMENT =	.10 HOURS	DRAINAGE AREA =	.09 SQ.MI.
6.00	DISCHG	.00 .00 .00	.01 .01 .01	.02 .02 .02	.02 .03 .03	
7.00	DISCHG	.04 .05 .06	.07 .08 .09	.11 .12 .13	.15 .16 .17	
8.00	DISCHG	.17 .18 .20	.22 .24 .26	.29 .31 .34	.36 .38 .41	
9.00	DISCHG	.39 .43 .46	.49 .53 .57	.61 .66 .70	.75 .80 .85	
10.00	DISCHG	.80 .85 .91	.96 1.03 1.09	1.16 1.23 1.30	1.39 1.47 1.55	
11.00	DISCHG	1.48 1.57 1.68	1.79 1.92 2.06	2.22 2.40 2.63	2.93 3.21 3.58	
12.00	DISCHG	3.36 3.97 5.42	8.10 11.33 14.96	16.77 17.85 18.89	19.86 21.00 22.14	
13.00	DISCHG	20.74 21.51 22.17	22.72 23.19 23.58	23.91 24.19 24.42	24.60 24.83 25.06	
14.00	DISCHG	24.75 24.87 24.96	25.03 25.08 25.10	25.12 25.12 25.10	25.08 25.08 25.08	
15.00	DISCHG	25.04 25.00 24.95	24.90 24.83 24.77	24.69 24.62 24.54	24.46 24.39 24.31	
16.00	DISCHG	24.37 24.28 24.19	24.10 24.01 23.92	23.83 23.73 23.64	23.55 23.46 23.37	
17.00	DISCHG	23.45 23.36 23.26	23.17 23.07 22.97	22.87 22.77 22.68	22.58 22.49 22.40	
18.00	DISCHG	22.48 22.38 22.28	22.18 22.08 21.98	21.88 21.78 21.67	21.57 21.47 21.37	
19.00	DISCHG	21.47 21.36 21.26	21.16 21.06 20.95	20.85 20.75 20.65	20.55 20.45 20.35	
20.00	DISCHG	20.45 20.35 20.25	20.15 20.05 19.95	19.85 19.75 19.65	19.55 19.45 19.35	
21.00	DISCHG	19.45 19.34 19.24	19.14 19.04 18.94	18.84 18.74 18.64	18.54 18.44 18.34	
22.00	DISCHG	18.44 18.35 18.25	18.15 18.06 17.96	17.87 17.78 17.68	17.59 17.49 17.39	
23.00	DISCHG	17.50 17.41 17.32	17.23 17.14 17.06	16.97 16.88 16.80	16.71 16.62 16.53	
24.00	DISCHG	16.63 16.54 16.46	16.37 16.29 16.20	16.10 16.01 15.92	15.83 15.74 15.65	
25.00	DISCHG	14.97 14.61 14.25	13.89 13.53 13.19	12.84 12.50 12.17	11.85 11.51 11.17	
26.00	DISCHG	11.53 11.22 10.92	10.62 10.33 10.05	9.78 9.51 9.25	9.00 8.73 8.47	
27.00	DISCHG	8.75 8.51 8.28	8.05 7.83 7.61	7.40 7.20 7.00	6.81 6.61 6.41	
28.00	DISCHG	6.62 6.44 6.26	6.09 5.92 5.76	5.60 5.45 5.30	5.15 5.00 4.85	
29.00	DISCHG	5.01 4.87 4.74	4.61 4.48 4.37	4.32 4.28 4.23	4.18 4.14 4.09	

RUNOFF VOLUME ABOVE BASEFLOW = 5.13 WATERSHED INCHES, 310.82 CFS-HRS, 25.69 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP

RECORD ID

COMPUTATIONS COMPLETED FOR PASS 3

EXECUTIVE CONTROL OPERATION ENDJOB

RECORD ID

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SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION			RUNOFF AMOUNT (IN)	PEAK DISCHARGE			
						BEGIN (HR)	AMOUNT (IN)	DURATION (HR)		ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSM)
ALTERNATE 1 STORM 1													
XSECTION	1 RUNOFF	.09	2	2	.10	.0	4.00	24.00	1.89	---	12.69	50.87	542.3
STRUCTURE	1 RESVOR	.09	2	2	.10	.0	4.00	24.00	1.56	6.25	14.53	10.24	109.1
ALTERNATE 5 STORM 5													
XSECTION	1 RUNOFF	.09	2	2	.10	.0	6.00	24.00	3.58	---	12.66	98.24	1047.3
STRUCTURE	1 RESVOR	.09	2	2	.10	.0	6.00	24.00	3.14	6.60	14.47	18.71	199.5
ALTERNATE 99 STORM 99													
XSECTION	1 RUNOFF	.09	2	2	.10	.0	8.40	24.00	5.76	---	12.65	158.18	1686.3
STRUCTURE	1 RESVOR	.09	2	2	.10	.0	8.40	24.00	5.13	6.85	14.64	25.12	267.8

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS.....		
		1	5	99
0 STRUCTURE 1	.09			
ALTERNATE 1		10.24	.00	.00
ALTERNATE 5		.00	18.71	.00
ALTERNATE 99		.00	.00	25.12
0 XSECTION 1	.09			
ALTERNATE 1		50.87	.00	.00
ALTERNATE 5		.00	98.24	.00
ALTERNATE 99		.00	.00	158.18

1END OF 1 JOBS IN THIS RUN