Tarlton Stream and Wetland Restoration Project

Contract #:	D05013-1
County:	Cumberland
Cataloging Unit:	Cape Fear 03030004
Monitoring Firm POC:	Mid-Atlantic Mitigation, LLC
	Rich Mogensen (704) 782-4133
	Kimley-Horn Associates, Inc.
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Prepared For:	EEP Project Manager, Guy Pearce

Year 1(2006) Monitoring Report

Kimley-Horn
and Associates, Inc.

Mid-Atlantic
Mitigation, LLC
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1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

On behalf of the North Carolina Ecosystem Enhancement Program (NCEEP), Mid-Atlantic Mitigation, LLC (MAM) with technical assistance from Kimley-Horn and Associates (KHA) restored, enhanced and preserved 4,402 linear feet of stream, restored 6.6 acres of riverine wetlands and enhanced 2.7 acres of riverine wetlands. Construction of the project began in November 2005 with beaver dam removal and grade-control structure installation, continued into March 2006 with final planting completed in June 2006. The Tarlton Stream and Wetland Restoration Project (Project) will provide NCEEP with 3,930 Stream Mitigation Units (SMUs) and 8.0 Wetland Mitigation Units (WMUs).

The objective of the restoration approach is to plan, design, and construct a dynamically stable stream/riparian floodplain and bottomland hardwood riverine wetland community providing an ecological improvement for the entire site and watershed. This project is designed to provide a stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport the surface water and sediment load. Also, the Project aims to reestablish the primary stream and wetland functions associated with nutrient removal and transport, sediment retention, wildlife (both aquatic and terrestrial) habitat, and to provide restoration of riparian zones that have been historically an impounded lakebed. The restoration approach, due to the existing condition (fluctuating open water levels caused by Beaver activity) and varied historical conditions of the site (lake, dry lake bed, beaver impoundments, etc.), involved an “adaptive” management phased process.

The project was constructed in two phases. The restoration approach established a stable grade control stream section, which maintains the elevation of the entire stream thalweg and the floodplain by controlling the downstream end of the project area. The floodplain elevation below the dam was set by installing several rock-cross vanes and a constructed riffle to hold the grade of the existing lake bottom area which is now the floodplain area above the dam. This design provides both secondary water quality and primary flood storage benefits. The Project (both streams and wetlands) underwent a natural adjustment to a more stable aquatic ecosystem. The streams continued to re-establish natural channel function. This adaptive management approach allowed the streams to naturally seek equilibrium and appropriate dimension, pattern, and profile as the Project stabilizes. The primary restoration approach is to determine whether the stream adjustments trend towards the design criteria and restoration goals based on up-stream reference morphology and vegetation communities.

The riverine wetland and buffer vegetation community will transition as the system seeks hydrologic and biologic equilibrium. The sediments were unconsolidated and mucky with saturation. It was anticipated that settling and subsidence would occur throughout the initial growing season, first through evaporation and then through transpiration as the herbaceous cover (seeded and natural propagation) established. This did occur and continues to progress. Areas that were not saturated/ponded (i.e. fringe areas and/or

headwater wetlands) were intially planted with bare root seedlings and containerized plants to establish a bottomland hardwood riparian wetland community. Later as the site dewatered, thousands of containerized, bottomland hardwood trees & shrubs were planted throughout the stream and wetland areas.

The stream(s) will be monitored for stability of dimension, pattern, and profile using standard practices including permanent cross sections, riffle-run-pool analysis, and pebble counts. Wetland hydrology and vegetation success will be monitored using self-reading ground water monitoring gages and standardized, randomly placed permanent vegetation plots which will be monitored for species diversity and survival. Monitoring data will be analyzed to determine what remedial actions if any are required and any remedial actions proposed will be detailed in the annual monitoring reports.

The first year monitoring was completed on October 19th, 2006. There is some active channel evolution and adjustment occurring in the mid to upper reaches on both stream channels. This will be monitored closely and MAM may want to do some low-intrusive hand channel work this winter. Any minor channel work will be documented in the 2nd Annual monitoring report. The vegetation in all of the plots currently meets and/or exceeds the requirements.

2.0 PROJECT BACKGROUND

2.1 LOCATION AND SETTING

The Project is located in the City of Fayetteville, Cumberland County, North Carolina on the corner of Clearwater Drive and US 401 Bypass (Country Club Drive). A location map is included in Figure 1. The project site is located in the Upper Cape Fear River Watershed (USGS 8-digit Hydrologic Unit 03030004, and NCDWQ River Basin 03-06-15), and is within the NC Ecosystem Enhancement Program (EEP) Cross Creek Targeted Local Watershed (00050). The project site was historically impounded by a dam built in the 1970s, creating Country Club Lake by impounding about 4,500 feet of two perennial prongs of a tributary to Cross Creek. The project drainage area is approximately 2.6 sq. mi. flowing into Cross Creek, a 303(d)-listed stream for impaired biological activity. The eastern prong of the project which is named UT to Cross Creek East has a drainage area of 1.0 square miles. The western prong named UT to Cross Creek West has a drainage area of 1.6 square miles. The project area conservation easement consists of 17.8 acres. The restoration project is being managed and monitored by Mid-Atlantic Mitigation, LLC but the property is owned by the Greg and Patricia Tarlton and the conservation easement is held by the State of North Carolina.

2.2 STRUCTURE AND OBJECTIVES

The goals and objectives of the Project are to restore a naturally stable stream and riparian wetland community; to restore a bottomland hardwood wetland community; and to provide stormwater management for downstream development. In addition, water quality will be improved, flood storage will be increased, wildlife and aquatic habitat will be restored and the threat of flooding of downstream areas will be significantly reduced.

Phase I (completed Fall 2005): A beaver management plan was implemented to remove all the beavers from the project site. The removal of the old dam debris and spillway was completed in November and December 2005 making it more difficult for the beavers to re-establish a dam at its existing location. A beaver control program which includes regular site visits to the former dam area has been implemented and will continue throughout the monitoring period. In mid-November 2005, the lake water level was lowered over a 3-5 day period slowly releasing the water downstream to prevent flooding and erosion. In conjunction with removing the beaver dams, the stream section through the area of the historical dam and beaver dams was restored. The channel in this section (approximately 175 feet) was restored using a Priority I (Rosgen) restoration approach. The stream restoration included establishing a bankfull channel and active floodway through the relic spillway/dam and providing a variety of in-stream structures (rock vanes, constructed riffle, and step pool structures) to provide grade control, stability, and improve aquatic habitat diversity. The natural channel design was based on the upstream reference reach. The restoration project was transitioned through and under an existing aerial sanitary sewer crossing that is just beyond the easement limit. In addition to the stream restoration, a BMP (level spreader / pre-formed scour hole) was constructed in this area at the outlet of a stormwater drainage pipe. This restoration establishes a stable grade control, which maintains the elevation of the entire stream thalweg and the floodplain by controlling downstream end of the project area. The floodplain elevation below the dam was set to hold the grade of the existing lake bottom which is now the floodplain area above the dam. This also prevented any sediment that was in the old lake from being washed downstream and to provide a natural “pinch-point” corresponding with existing topography. This pinch-point will help re-establish and control natural hydrology in the proposed riparian wetland during events above bankfull and act as a large detention area.

Phase II (completed in July 2006): Once the beavers, beaver dams, and impounded water were removed, and the downstream grade control established, the Project (both streams and wetlands) underwent a natural adjustment to a more stable aquatic ecosystem. The stream segments found their hydrologic equilibrium and re-established bed and bank features. In addition, the site soils gradually dewatered allowing the deposited sediments to consolidate and subside. During the first growing season the Project soils stabilized through evapotranspiration and subsidence processes. The streams continued to re-establish natural channel function, and were evaluated for necessary adjustments. This adaptive management approach allowed the streams to naturally seek equilibrium and appropriate dimension, pattern, and profile as compared to the upstream reference reach. The primary restoration approach is to determine whether the stream adjustments trend

towards the design criteria and restoration goals based on reference morphology and vegetation communities. The eastern and western prongs are designed as Rosgen C5->E5 channels. During each monitoring year, where the channel slope and/or dimension are found to be unstable, structures such as rock cross vanes, log cross vanes, log vanes, log sills, and constructed riffles may be utilized to help maintain the channel compared to the reference morphology.

The riparian wetland and buffer vegetation community will transition and stabilize as the system seeks hydrologic equilibrium. The initial planting/seeding of the site was completed in March-April 2006 to establish herbaceous cover of exposed bare soils with the expectation that the initial growing season would allow for evapotranspiration to dewater lake bottom sediments. These sediments were initially unconsolidated and mucky with saturation. It was anticipated that settling and subsidence would occur throughout the initial growing season, first through evaporation and then through transpiration as the herbaceous cover (seeded and natural propagation) established. This has occurred as proposed. Areas that are not saturated/ponded (i.e. fringe areas and/or headwater wetlands) were planted with bare root seedlings and containerized plants to establish a bottomland hardwood riparian wetland community. Additional plantings may occur as needed, as the site continues to consolidate and settle.

In order to stabilize the newly constructed stream channel and flood plain areas both temporary and permanent grass seed as well as wetland herbaceous seed were applied to all restored areas. The types of seeds used were: *Leersia oryzoides* (Rice Cut grass); *Panicum clandestinum* (Deertongue grass); *Panicum virgatum* (Switchgrass): *Trisacum dactyloides* (Gama grass), and *Secale cereale* (Annual rye). Also, a Southeast Wildflower mix was applied throughout the project. Five hardwood planting zones were established as follows: Zone 1 – Stream Channel, Zone 2- Stream Bank, Zone 3 – Bottomland Hardwood wetland, Zone 4 – Swamp Wetland, and Zone 5- Upland fringe. Livestakes were installed along the newly constructed channel (approx. 175') within Zone 2. They were planted randomly spaced approximately 3 feet apart and differed in sizes ranging from .25" to 2" in diameter and 2' to 3' in length. Further livestaking may be necessary as the new stream channels stabilize. Zone 3 –5 consists of bareroot seedlings and 1 gallon containerized plants, which were planted randomly 3' to 12' apart throughout the project.

Table I. Project Mitigation Structure and Objectives Table

Project Segment	Mitigation Type	Approach	Linear Footage or Acerage	Stationing	Comment
Stream W Prong	P	-	341	10 + 00 - 14 + 00	Western Prong as it enters the site
Stream W Prong	E1		596	14 + 00 - 19 + 00	Western Prong between Preservation Area and Restoration Area
Stream	R	P1	3465		Remainder of Site is Restoration (88%)
Wetland	R	-	6.6		Project is 83% restoration
Wetland	E	-	2.7		Stream Enhancement Area is bordered by Wetland Enhancement, Several other enhancement areas exist

Table II. Project Activity and Reporting History

Activity or Report	Calendar Year of Completion or Planned Completion	Actual Completion Date
Restoration Plan	October 2005	March 2006
Construction	October 2006	March 2006
Temporary /Permanent seeding	October 2006	March 2006
Bareroot Plantings	November 2006	March 2006
Containerized Plantings	November 2006	June 2006
Mitigation Plan	December 2006	August 2006
Year 1 Monitoring	December 2007	October 2006
Year 2 Monitoring	December 2008	October 2007
Year 3 Monitoring	December 2009	October 2008
Year 4 Monitoring	December 2010	October 2009
Year 5 Monitoring	December 2011	October 2010

Table III. Project Contacts

Project Manager Mid-Atlantic Mitigation, LLC	9301 Aviation Blvd., Suite CE1 Concord, NC 28027 Rich Mogensen (704) 782-4133
Designer Kimley-Horn and Associates Inc.	4651 Charlotte Park Dr Suite 300 Charlotte, NC 28217 Will Wilhelm (704) 333-5131
Construction Contractor Earthwork Inc.	343 Chapman Drive Sanford, NC 27330 Dan Wood (919) 718-6812
Planting & Seeding Contractor Carolina Silvics Seed mixes provided by IKEX Nursery Stock provided by Native Roots Nursery (Formerly Southern Shade)	908 Indian Trail Road Edenton, North Carolina 27932 Dwight McKinney (252) 482-8491
Monitoring Performers Mid-Atlantic Mitigation, LLC	9301 Aviation Blvd., Suite CE1 Concord, North Carolina 28027 Christine Cook (704) 782-4140

Table IV. Project Background

Project Background Table	
Project County	Cumberland
Drainage Area	2.6 square miles
Drainage Cover Estimate (%)	10%
Physiographic Region	Coastal Plain
Ecoregion	45a Southern Inner Piedmont
Wetland Type	Palustrine, Forested, Broad-leaved Deciduous
Cowardin Classification	PFO1Fh
Dominant soil types	Johnston Loam
Reference site ID	UT to Cross Creek
USGS HUC for Project and Reference	03030004
NCDWQ Sub-basin for Project and Reference	03-06-15
% of project easement fenced	0 – Urban site surrounded by private residence

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 VEGETATION ASSESSMENT

3.1.1 Soil Data

Table V. Preliminary Soil Data

Series	Max Depth (in)	% Clay on Surface	K	T	OM %
Johnston Loam	80	25 - 49	.20 - .17	5	3 - 8

3.1.2 Vegetative Problem Areas

At this time, no vegetative problem areas have been noted or invasive species problems. The site has been stabilized and vegetated with native woody and herbaceous species

3.1.3 Stem Counts

Zones 1 – 3 of the five planting zones were sampled in three 75 ft by 75 ft plots. The prevalent vegetation should consist of macrophytes that typically are adapted for life in saturated soil conditions. These species should have the ability to grow, compete, reproduce, and persist in anaerobic soil conditions. A reduction in the percentage of nuisance vegetation in wetlands areas with existing vegetation to less than 15% will indicate enhancement of wetland vegetation. For the restoration areas, study plots showing that the composition and density of vegetation in the restoration areas that compares closely to the reference areas will indicate restoration success for vegetation. The initial success of riparian and wetland vegetation planting will be evaluated based on herbaceous cover as the site is stabilized in the initial growing season. After the year-two growing season, success will be gauged by stem counts of planted species and desirable volunteer species. Stem counts of over 320 trees per acre after 3 years, 288 trees per acre after 4 years, and 260 trees per acre after 5 year will be considered successful. Photos taken at established photo points should indicate maturation of riparian vegetation community.

On October 19, 2006, the first year-vegetative monitoring was performed on the established vegetative plots.

Exhibit Table VI: Stem Counts for Each Species Arranged by Plot						
Species	Plots			Initial Totals	Year 1 Totals	Survival %
	1	2	3			
Shrubs						
Alnus serrulata	3		5	3	8	> 100
Cephalanthus occidentalis	1	2		3	3	100
Cornus ammomum	4	1	4	10	9	90
Totals	**8**	**3**	**9**	**16**	**20**	**> 100**
Trees						
Betula nigra	5	12	1	18	18	100
Chamaecyparis thyoides	1	1		8	2	25
Fraxinus pennsylvanica	20	1	14	35	35	100
Liriodendron tulipifera				1	0	0
Nyssa aquatica	5	1		6	6	100
Nyssa biflora	6		2	8	8	100
Nyssa slyvantica	5	4	1	10	10	100
Quercus falcata var. pagodafolia				0	0	0
Quercus michauxii				0	0	0
Quercus nigra				2	0	0
Quercus phellos			1	1	1	100
Quercus shumardii			1	1	1	100
Salix nigra			1	0	1	>100
Taxodium distichium	7	8	6	25	21	84
Totals	**49**	**27**	**27**	**115**	**103**	**90**

*Year 1 Totals include planted material and native volunteers

3.1.4 Vegetation Assessment Summary

Vegetation success will be defined as tree survival to meet 320 stems per acre after 3 years and 260 stems per acre after 5 years inside the permanent vegetative plots and herbaceous cover evaluated with photos showing 75% coverage, after 5 years.

All three plots showed excellent survival percentages. The site as a whole shows an average of 317 stems per acre and demonstrates 94 percent survival. The community is diverse and rich with healthy volunteers. Volunteer numbers of *Alnus serrulata* and *Salix nigra* have increased since the plots were installed and initial counts done in June of 2006. It is expected that desirable species such as these will continue to colonize the site and that planted species will continue to have a low mortality rate, therefore stem counts should maintain or continue to rise slightly over the next few years as the site progresses.

In Appendix A, the vegetative survey data tables show the actual counts of each species found per plot, severely stressed but not dead plants were noted. The herbaceous cover plant community was monitored in a 1 m by 1 m square at one corner of each plot. Each herbaceous quadrant showed at least 75% cover and all were or at close to 100%.

3.2 CHANNEL STABILITY ASSESSMENT

3.2.1 Cross Sections

The site has shown no significant change since as-built documents were submitted. The Cross Section plots are located in Appendix B. Cross Sections 1 and 2 show the only constructed pool and riffle, respectively, on the site at this time. There appears to be some minor settling occurring on the left bank of the run between Cross Sections 1 and 2. Much of this area was constructed with usable debris from the dam removal and this bank is composed mostly of stone. The vegetation is slow in taking hold on this section of bank because of the stone composition. The stream channels at Cross Sections 3 through 10 are less defined then Cross Sections 1 and 2. MAM and KHA tried to select deep still areas for pools and chose shallower areas of swift running water for the riffle cross sections.

3.2.2 Bank Full Events

The upstream reference gage has only registered minor peaks exceeding bank full elevation. There is no evidence on site that there have been any significant bank full events. A crest stage gage was proposed to be installed at the end of the site in the location of the old dam. MAM and KHA have decided to install both an automated stream gage with data logger and a crest stage gage as planned. However, neither device has yet to be installed at this time. Going into year-two monitoring KHA will install the data logger near the top of the Western Prong at the top of the beginning of the project and MAM will install the crest stage gage as planned. Both installations should be done within the next two months.

3.2.3 Longitudinal Profiles

There is currently only one constructed riffle on the project, which is located at the site of the original dam and corresponds with Cross Section 2. This riffle was constructed with large cobbles and small boulders found on site. A pebble count was done which demonstrates the substantial size of the bed material. There is currently no smaller bed material present and only a small representative sample was taken. The peeble count data is presented in Appendix C. The site has shown no significant change since as-built documents were submitted. Currently, the site is in a very early stage of development and MAM will be watching and remediating the stream work as needed through out the next year. At least one significant bank full event will need to be observed in order to identify sections of the stream that may need additional work. While several obvious pools (shown on the profile graphs in Appendix C) have formed, very little definition in the riffle areas has been observed. Although in low-gradient coastal plain systems the current stream morphology is common and stable.

3.2.4 Wetland Assessment

Seven ground water gages are distributed around the project along with one reference gage off site, but not far upstream on the Western Prong. Detailed descriptions of each gage along with graphs showing the 2006 data have been prepared. These graphs along with the rain gage data graphs are presented in Appendix E. Each gage on site indicates jurisdictional hydrology. At this stage of development demonstrating jurisdictional hydrology is not a problem. Some areas of the site, as evidenced by Gage 6 still remain somewhat over saturated and standing water is observed. As the site progresses towards hydrologic equilibrium, some areas may develop small open water features, but for the most part is predicted that the site will continue to dry out over the coming years.

3.2.5 Site Stability Assessment Summary

Overall, the stream channel has developed and stabilized well. The herbaceous vegetative cover has also developed a healthy and diverse community. The planted trees and shrubs have also done very well and are supplemented by a robust existing buffer community which provides seed source for volunteers well suited to the current site conditions. Ground water wells demonstrate favorable trends and jurisdictional wetland hydrology.

APPENDIX A: Vegetation Raw Data

APPENDIX B: Cross Sections

APPENDIX C: Profile Survey and Pebble Count Data

APPENDIX D: Photo Log

Photo Point 1 – Storm Water BMP

Photo Point 3 – Structures 1 & 2

Problem Area 1 – Rocks and bank under matting have settled. Vegetation hasn't taken root due to rock under matting, area will be live staked this winter.

Photo Point 8 – Site overview from Monument

Photo Point 9 – Eastern Prong from top of dam

Photo Point 12 – VP2

VP 2 Herbaceous Plot

Photo Point 14 – VP 1

VP 1 Herbaceous Plot

Photo Point 20 – VP3

VP 3 Herbaceous Plot

Photo Point 13 – Western Prong from Utility Line, downstream

Photo Point 15 – Western Prong from Utility Line, upstream

Photo Point 31 – Enhancement Area

APPENDIX E: Ground and Surface Water Data

Kimley-Horn and Associates, Inc.

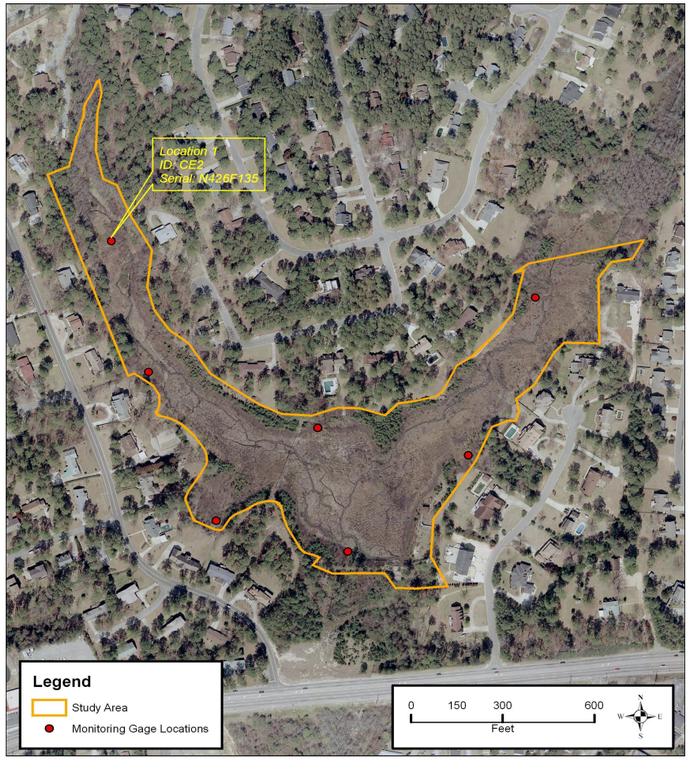
Project:	**Tarlton Site (Cumberland County, NC)**		
Installed:	1/17/2006	**Inspected:**	10/19/2006
By:	CWE, TBC	**By:**	CWE, JD

GAGE DESCRIPTION:

Location: 1
Type: Free water surface, water table
ID: CE2
Serial #: N426F135

INSTALLATION SITE DESCRIPTION: The gage is located in the upstream area of the western prong within the restoration site. The gage is approximately 60 feet from the top of bank of the stream channel and approximately 45 feet from the toe-of-slope and project boundary. The gage is located within the area of the historic lake, but upslope from the beaver impoundment open water prior to restoration downstream grade control and removal of the beaver dam. The stream channel is incised, however, the floodplain appears to be frequently flooded. **Soil Profile**: 0-3" 10 YR 2/1 Loam; 3-8" 10 YR 4/1 Loam w/10 YR 4/6 mottles (25%); 8-15" 10 YR 4/1 Sandy Clay; 15-24"10 YR 2/1 Loam. **Vegetation**: *Microstegium, Juncus effusus, Scirpus spp., Carex spp., Alnus serrulata, Pinus taeda, Platanus occidentalis, Acer rubrum.* **Hydrology:** Soil is saturated at the surface with pockets of ponded water in depressions around the gage.

Observation Date:	10/19/2006
Climate/recent rainfall:	75 deg.F, heavy rain w/in last 48 hours.




1/17/2006 (west view)

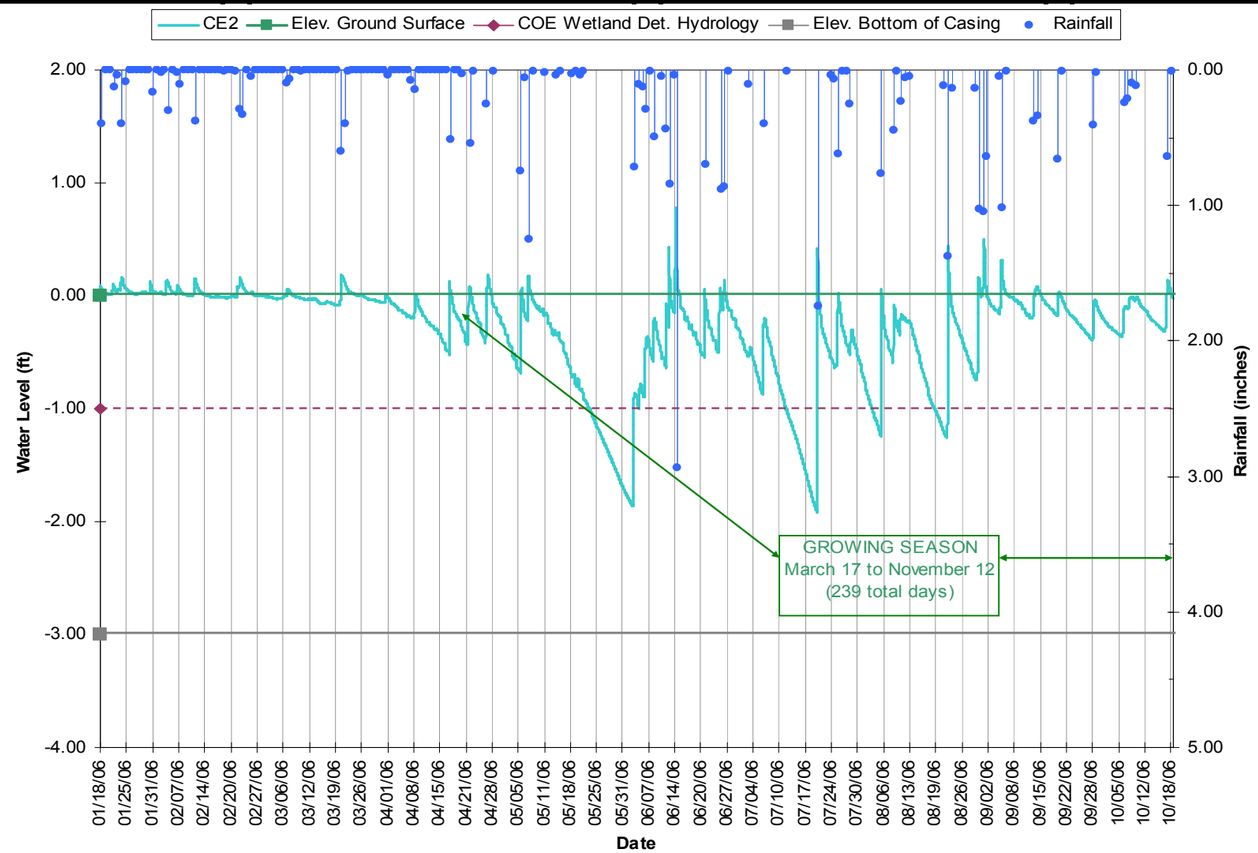

4/21/2006 (west view)


10/19/2006 (west view)


1/17/2006 (east view)


4/21/2006 (north view)


10/19/2006 (east view)



COMMENTS: 1/17/06 - soil is saturated with pockets of ponded water in depressions. **4/21/06** - area is dewatering slightly with new herbaceous growth. **10/19/06** - Herbaceous veg has done very well (see 4+ft tall *Polygonum sagitatum*). Stream downslope from gage has gone from multiple streams to single channel and may have some headcutting.

Kimley-Horn and Associates, Inc.

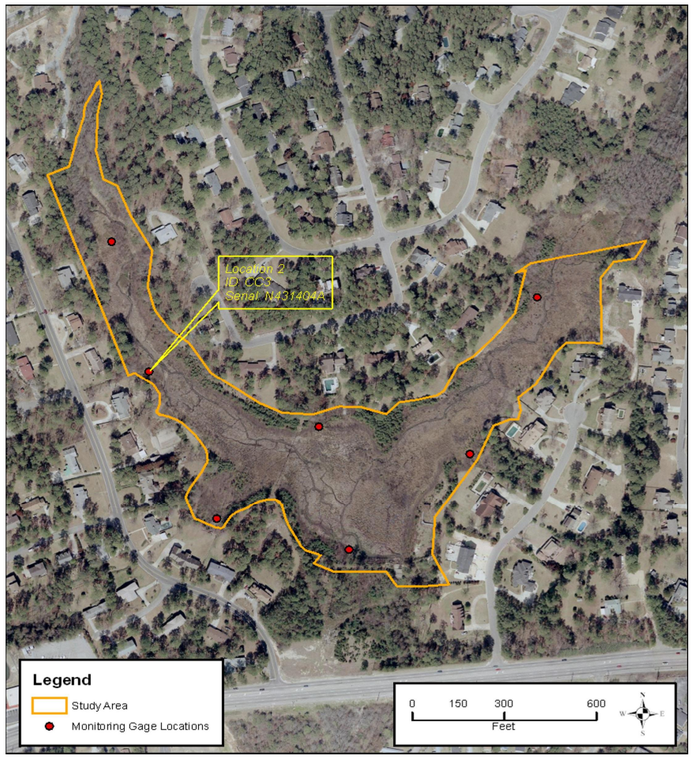
Project:	Tarlton Site (Cumberland County, NC)	
Installed: 1/17/2006	**Inspected:** 10/19/2006	OK? Yes
By: CWE, TBC	**By:** CWE, JD	

GAGE DESCRIPTION:

Location: 2
Type: Free water surface, water table
ID: CC3
Serial #: N431404A

INSTALLATION SITE DESCRIPTION: The gage is located downstream from Location 1 adjacent to the western prong within the restoration site. The gage is approximately 30 feet from the toe-of-slope and project boundary, and is just downstream from a tributary/stormwaer discharge into the stream. The location is in a forested edge between the adjacent property lawn and concrete bulkhead, and the stream. The location is within the boundary of the historic lak, but upslope from the inpounded open water area from the beaver dam prior to it's removal and stabilization of the downstream grade control. **Soil Profile:** 0-4" 10 YR 4/1 Loam, 4-14" 10 YR 4/1 Loamy sand, 14-24" 10 YR 5/2 Loamy sand. **Vegetation:** *Platanus occidentalis, Liriodendron tulipifera, Salix nigra, Acer rubrum, Alnus serrulata*. **Hydology:** the soil is saturated at the surface with areas of ponded water in depressions around the gage. The location is in the active floodplain with multiple stream channels re-establishing within the old lake bed.

Observation Date: 10/19/2006
Climate/recent rainfall: 75 deg.F, heavy rain w/in last 48 hours.




1/17/2006 (west view)

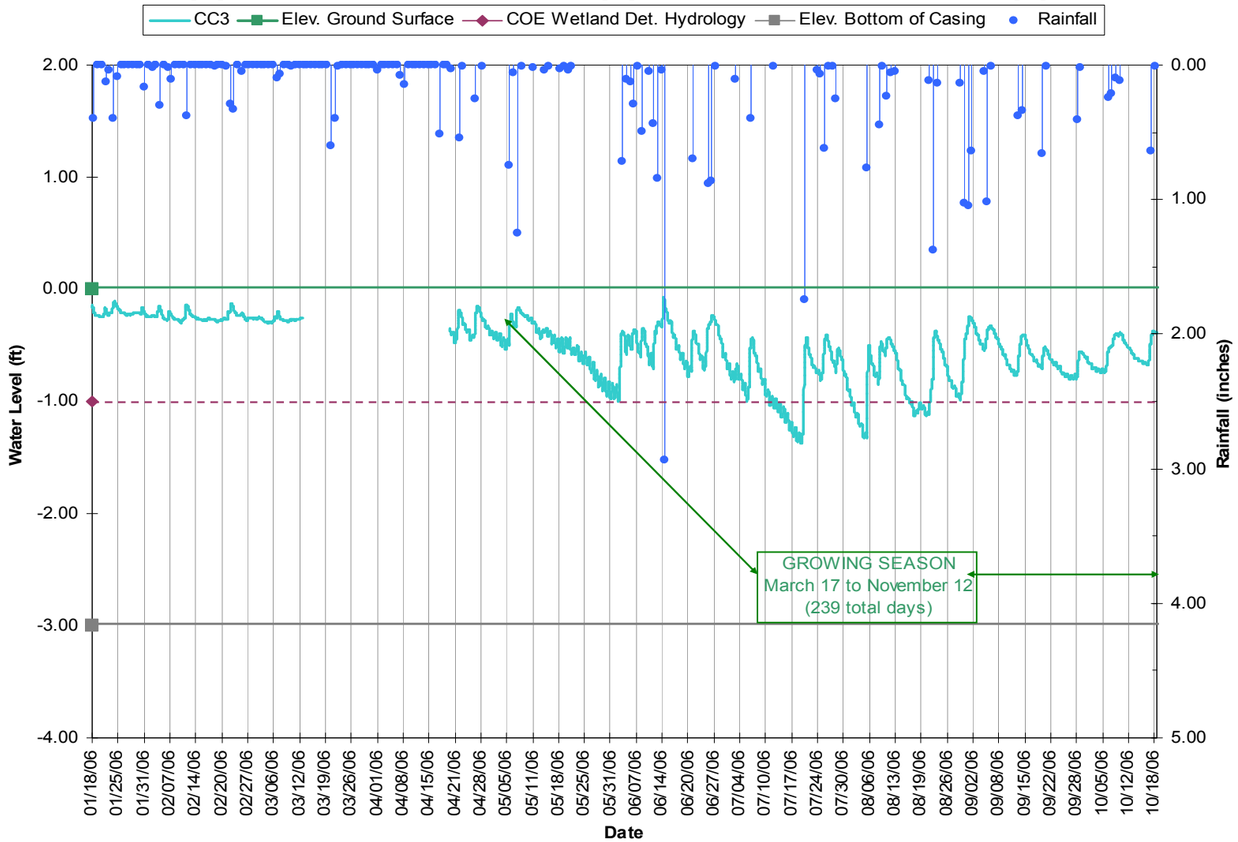

4/21/2006 (west view)


10/19/2006 (west view)


1/17/2006 (east view)


4/21/2006 (east view)


10/19/2006 (east view)



COMMENTS: 1/17/06 - soil is saturated with pockets of ponded water in depressions. **4/21/06** - soils are still saturated at the surface, however there is less evidence of ponding. Herbaceous veg and ferns (*Woodwardia areolata*) coming in. **10/19/06** - Herbaceouus veg is well established. There is some stream adjustments in the area where the primary flow is no located further from the gage. There may be some headcutting.

Kimley-Horn and Associates, Inc.

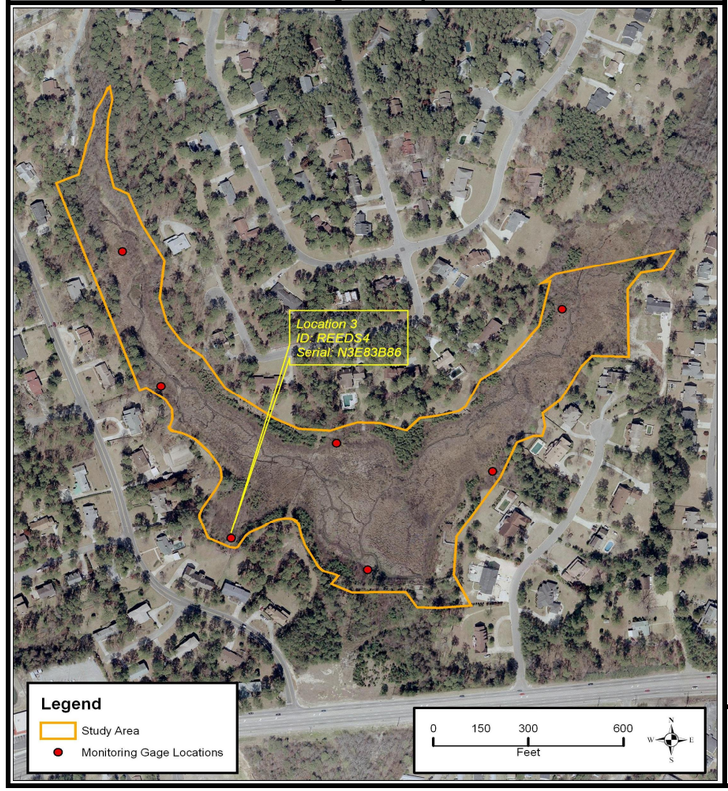
Project:	**Tarlton Site (Cumberland County, NC)**		
Installed:	1/17/2006	**Inspected:**	10/19/2006
By:	CWE, TBC	**By:**	CWE, JD

GAGE DESCRIPTION:

Location: 3
Type: Free water surface, water table
ID: REEDS4
Serial #: N3E83B86

INSTALLATION SITE DESCRIPTION: The gage is located in the SE portion of the project site adjacent culvert outlet/tributary at the boundary. The gage is located within the area of the historic lake, but upslope from the beaver impoundment open water prior to removal of the beaver dam. The tributary is a single channel downstream from the culvert and then becomes braided in the portion of the old lake bed. There may be toe-of-slope some groundwater seepage into the wetland from the adjacent property, and the area appears to periodically, but not as frequently as other gage locations within the site. **Soil Profile**: 0-3" 10 YR 2/1 Loam; 3-6" 10 YR 3/2 Sandy loam w/few mottles; 6-12" 2.5Y Sand w/10 YR 5/8 mottles (30%) Sand. **Vegetation**: *Microstegium, Vitis spp., Parthenocissus quinquefolia, Toxicodendron radicans, Saururus cernuus, Ligustrum sinense, Sambucus canadensis, Rubus spp., Alnus serrulata, Myrica cerifera, Nyssa sylvatica, Liriodendron tulipifera, Salix nigra, Acer rubrum.* **Hydrology:** evidence of seepage from toe-of-slope and evidence of ponding. Soil is saturated at the

Observation Date:	10/19/2006
Climate/recent rainfall:	75 deg.F, heavy rain w/in last 48 hours.



1/17/2006 (southwest view)

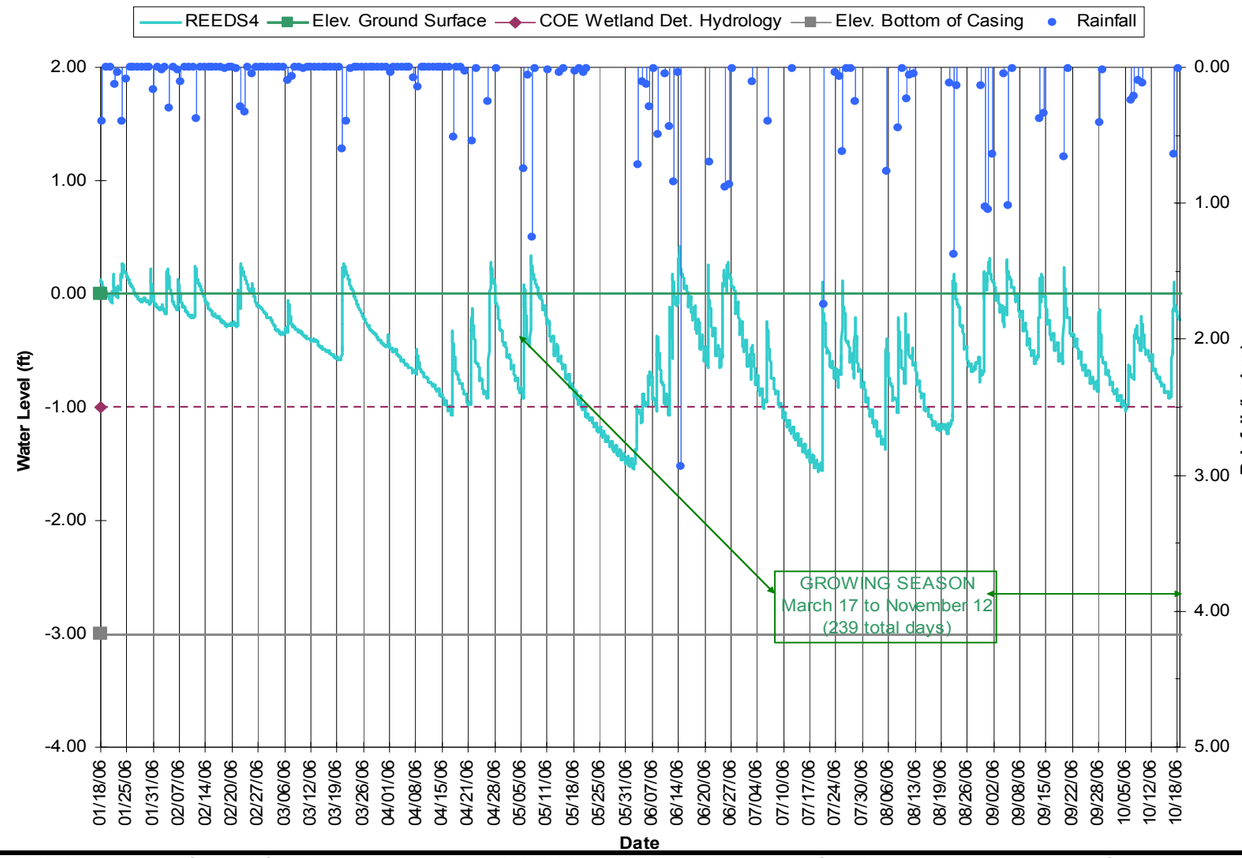
4/21/2006 (southwest view)

10/19/2006 (southwest view)

1/17/2006 (northeast view)

4/21/2006 (northeast view)

10/19/2006 (northeast view)



COMMENTS: 1/17/06 - evidence of recent flooding and inundation **10/19/06** - the stream downstream from the gage location has not formed into a single channel and continues to be braided.

Kimley-Horn and Associates, Inc.

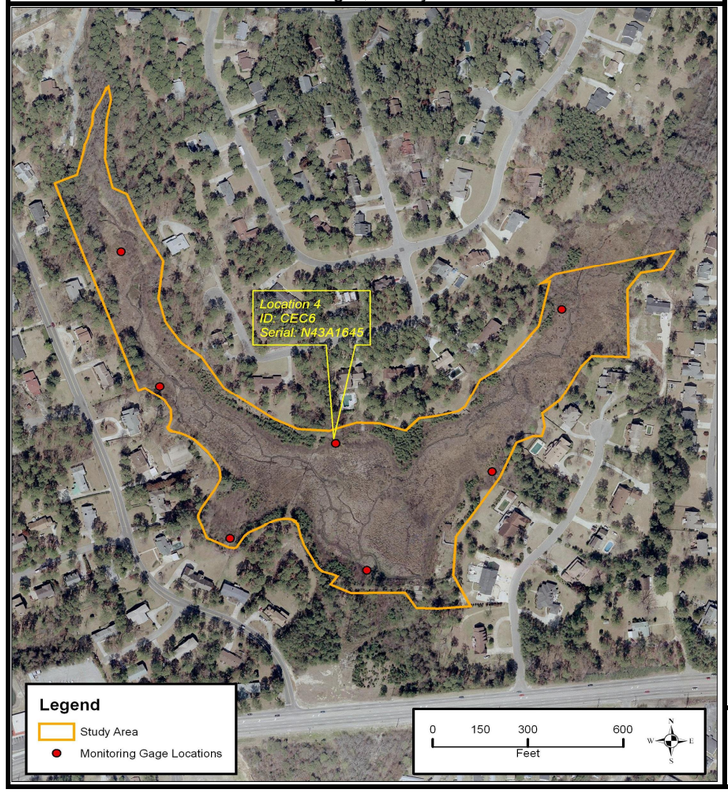
Project:	**Tarlton Site (Cumberland County, NC)**
Installed: 1/17/2006	**Inspected:** 10/19/2006
By: CWE, TBC	**By:** CWE, JD

GAGE DESCRIPTION:

Location: 4
Type: Free water surface, water table
ID: CEC6
Serial #: N43A1645

INSTALLATION SITE DESCRIPTION: The gage is located in the northern portion of the project area above the confluence of the eastern and western prongs. The gage is located at the approximate midpoint between the historic limit of the lake and the more recent limit of the beaver impoundment open water. There are areas of ponded water and sheet flow (i.e no adjacent stream channel). There also are many burrows and channels around the gage from beavers and the adjacent beaver lodge (non-active). **Soil Profile**: 0-8" 10 YR 3/1 Loam some oxidized root channels; 8-16" 10 YR 2/1 Sandy loam; 16-24" 10 YR 4/1 Loamy sand; 24-36"10 YR 4/6 Loamy sand. **Vegetation**: *Alnus serrulata* (dead?) **Hydology:** Soil is saturated at the surface with a free water surface at 4" below the surface.

Observation Date:	10/19/2006
Climate/recent rainfall:	75 deg.F, heavy rain w/in last 48 hours.



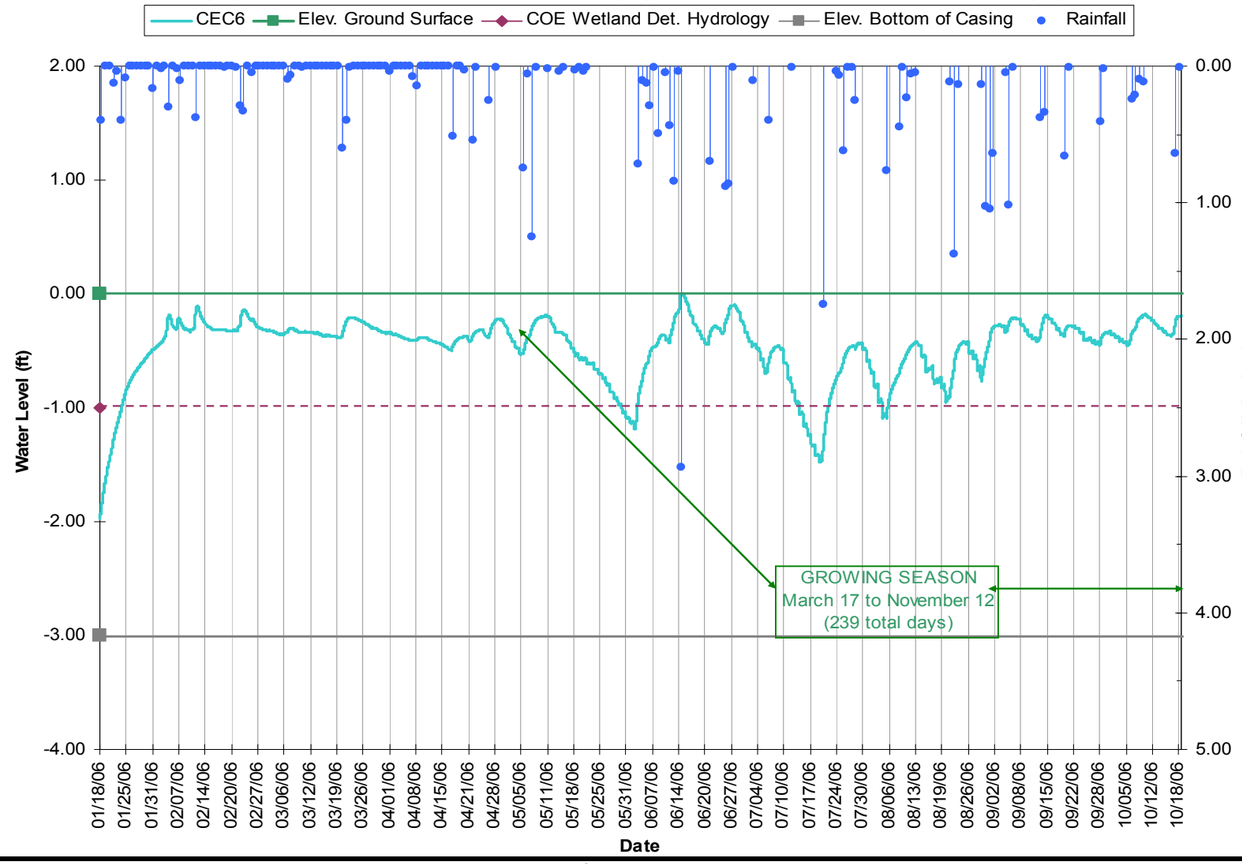
1/17/2006 (south view)

4/21/2006 (south view)

10/19/2006 (south view)

4/21/2006 (north view)

10/19/2006 (north view)



COMMENTS: 4/21/06 - area is dewatering slightly with new herbaceous growth. fennel is more dominant herbaceous veg. **10/19/06** - Fennel has taken over the location making locating the gage difficult. Many young alders are re-establishing.

Kimley-Horn and Associates, Inc.

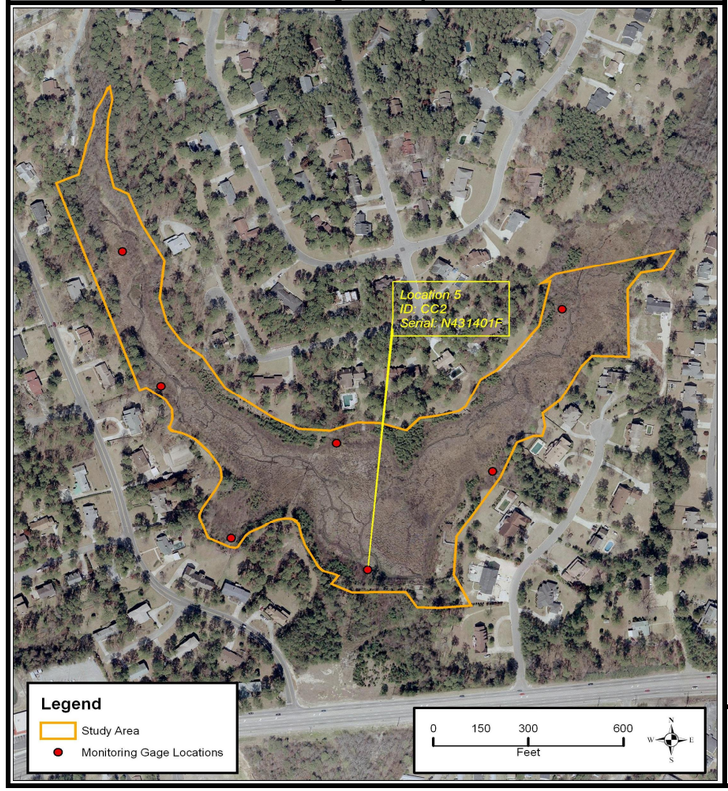
Project:	**Tarlton Site (Cumberland County, NC)**		
Installed:	1/17/2006	**Inspected:**	10/19/2006
By:	CWE, TBC	**By:**	CWE, JD

GAGE DESCRIPTION:

Location: 5
Type: Free water surface, water table
ID: CC2
Serial #: N43A1645

INSTALLATION SITE DESCRIPTION: The gage is located in the southern portion of the project area adjacent to the remnant of the Country Club Lake dam. The gage is located in an area that was inundated by the beaver impoundment prior to removal of the dam. The gage is located near the re-establishing stream below the confluence of the two prongs. The area is very wet and likely will subside somewhat once the growing season starts. **Soil Profile**: 0-9" 10 YR 3/1 Clay loam; 9-13" 10 YR 2/1 Sandy clay loam; 13-17" 10 YR 3/1 Sandy clay loam; 17-23"10 YR 3/1 Clay loam; 23-36" 7.5 YR 7/1 Sand. **Vegetation**: none. the immediate area is denuded. *Alnus serrulata* (most appears dead), *Betula nigra* and *Salix nigra* are adjacent closer to the dam remnant. **Hydrology:** Soil is saturated at the surface with evidence of ponding and inundation.

Observation Date:	10/19/2006
Climate/recent rainfall:	75 deg.F, heavy rain w/in last 48 hours.



1/17/2006 (northwest view)

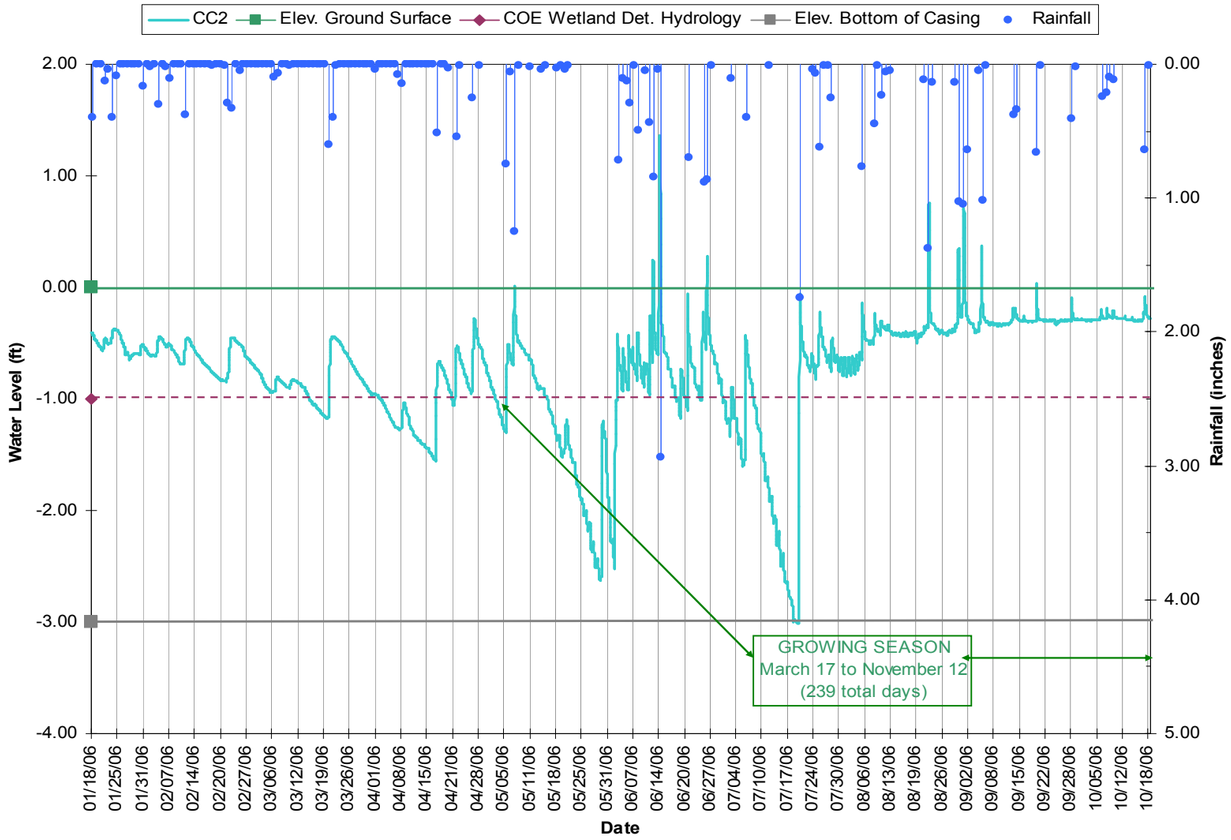
4/21/2006 (northwest view, at gage)

10/19/2006 (south view)

1/17/2006 (northeast view)

4/21/2006 (northeast view, at gage)

10/19/2006 (north view)



COMMENTS: 4/21/06 - area is dewatering slightly with new herbaceous growth. **10/19/06** - Herbaceous vegetation and planted shrubs are doing well. The surface has dewatered and become more solid (compared to soupy… see January photo where boards were needed to access the gage).

Kimley-Horn and Associates, Inc.

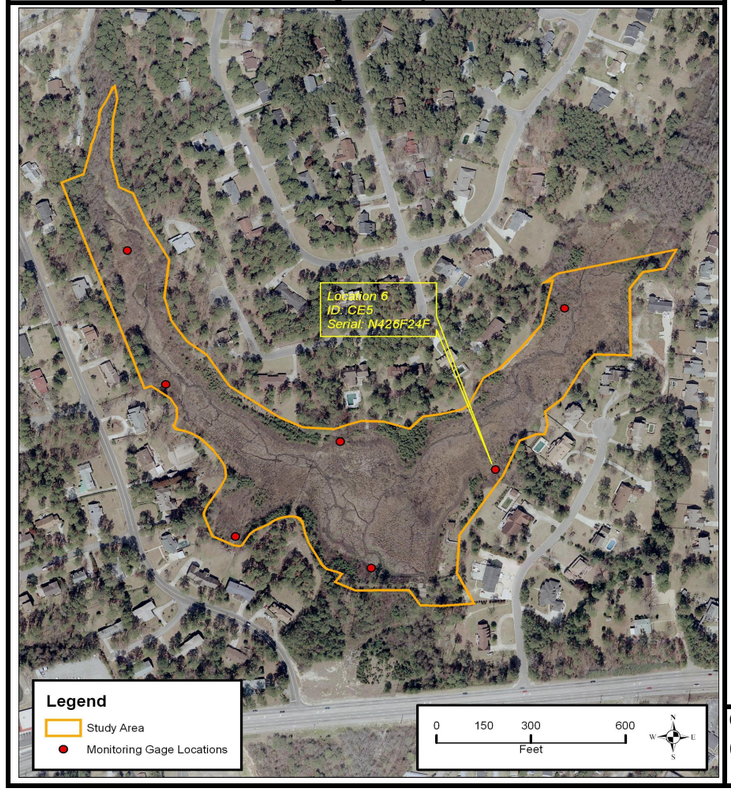
Project:	**Tarlton Site (Cumberland County, NC)**		
Installed:	1/17/2006	**Inspected:**	10/19/2006
By:	CWE, TBC	**By:**	CWE, JD

GAGE DESCRIPTION:

Location: 6
Type: Free water surface, water table
ID: CE5
Serial #: N426F24F

INSTALLATION SITE DESCRIPTION: The gage is located in the easthern portion of the project area along the eastern prong. The gage is located in the fringe of the area inundated by the beaver impoundment prior to removal of the dam (approximately 25' from the historic limit of the lake, and approximately 15' from the limit of the beaver impoundment water edge). The gage is located in an area that is very swampy with multiple barided channels in the old lake bed. The area is very wet and likely will subside somewhat once the growing season starts. **Soil Profile**: 0-3" 10 YR 4/1 Loam; 3-24" 10 YR 3/1 Loam. **Vegetation**: *Alnus serrulata* (most older shrubs appear dead, many younger ones re-establishing), *Betula nigra, Acer rubrum, Myrica cerifera* . **Hydrology:** Soil is saturated at the surface with evidence of ponding/inundation, braided drainage patterns. Free water surface in the auger hole is within 1 in of the surface.

Observation Date:	10/19/2006
Climate/recent rainfall:	75 deg.F, heavy rain w/in last 48 hours.



1/17/2006 (west view)

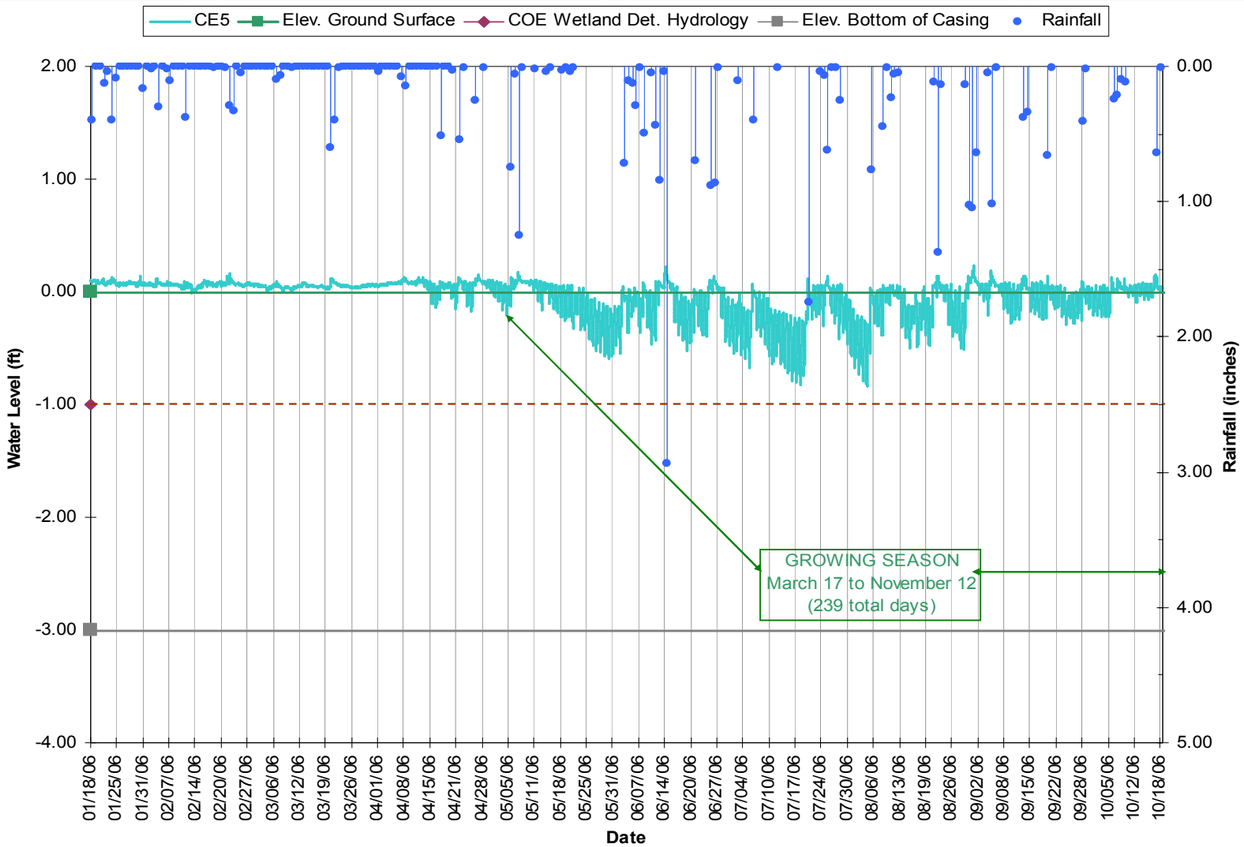
4/21/2006 (west view, at gage)

10/19/2006 (west view, at gage)

1/17/2006 (east view)

4/21/2006 (east view)

10/19/2006 (east view)



COMMENTS: 4/21/06 - area is dewatering slightly with new herbaceous growth. Alders are re-establishing **10/19/06** - Herbaceous vegetation is well established (*Polygonum sagittatum*).

Kimley-Horn and Associates, Inc.

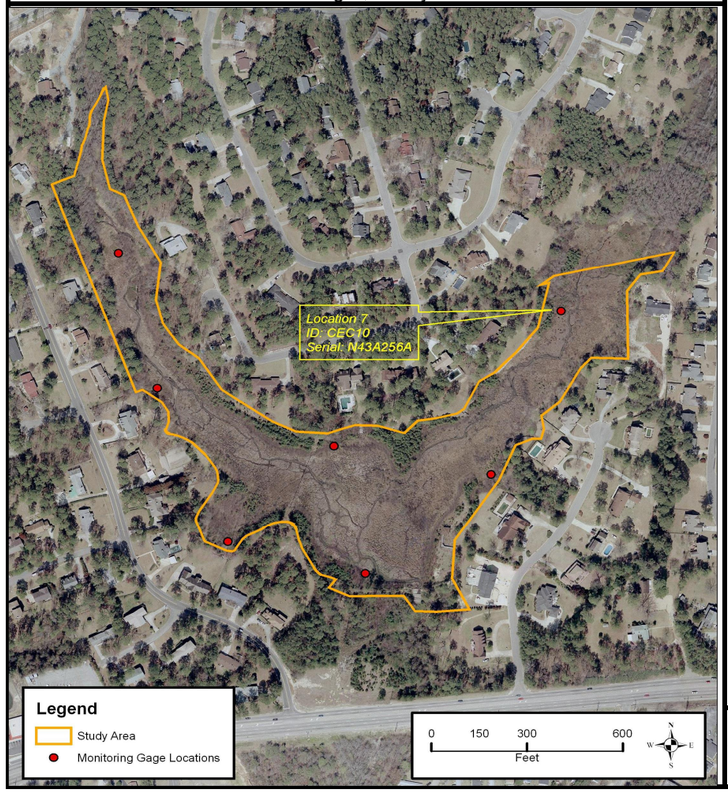
Project:	**Tarlton Site (Cumberland County, NC)**		
Installed: 3/13/2006	**Inspected:**	10/19/2006	
By: CWE, TBC	**By:**	CWE, JD	

GAGE DESCRIPTION:

Location: 7
Type: Free water surface, water table
ID: CEC10
Serial #: N43A256A

INSTALLATION SITE DESCRIPTION: This gage was originally installed in January upstream of the project site and was relocated/installed in March. The gage is located in the upstream area of the eastern prong within the project site. There were multiple beaver dams in this area, and the gage is located in the fringe of an inundated beaver impoundment area. The gage was installed approximately 20' from the stream, and approximately 20 feet from the toe-of-slope and historic lake limit. **Soil Profile**: 0-30" 10 YR 2/1 Sandy loam (mucky); 30-36" 10 YR 3/1 Clay loam. **Vegetation**: *Juncus spp., Scirpus, spp. Typha, spp., Pinus taeda, Nyssa sylvatica, Salix nigra, Acer rubrum, Liquidambar styraciflua, Alnus serrulata.* **Hydrology:** Soil is saturated near the surface with evidence of recent ponding/inundation. Free water surface in the auger hole is approximately 2" from the surface.

Observation Date: 10/19/2006
Climate/recent rainfall: 75 deg.F, heavy rain w/in last 48 hours.



3/13/2006 (east view)

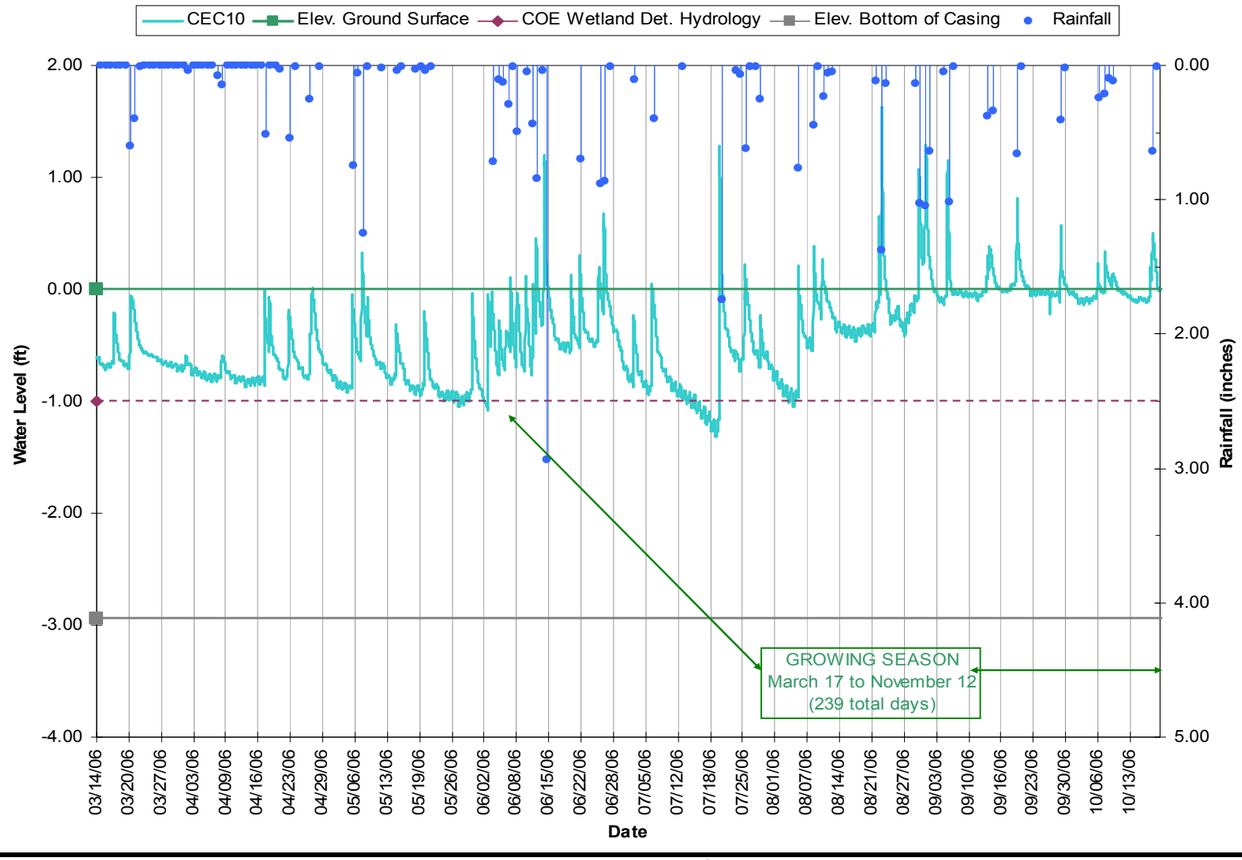
4/21/2006 (east view)

10/19/2006 (east view)

3/13/2006 (west view)

4/21/2006 (west view)

10/19/2006 (west view)



COMMENTS: 3/13/06 - gage relocated and installed within the project boundary. Remnants of beaver activity and smaller dams are evident. **10/19/06** - Herbaceous vegetation is well established (*Polygonum sagittatum*).

Kimley-Horn and Associates, Inc.

Project:	**Tarlton Site (Cumberland County, NC)**		
Installed:	3/13/2006	**Inspected:**	10/19/2006
By:	CWE, TBC	**By:**	CWE, JD

GAGE DESCRIPTION:

Location: Reference

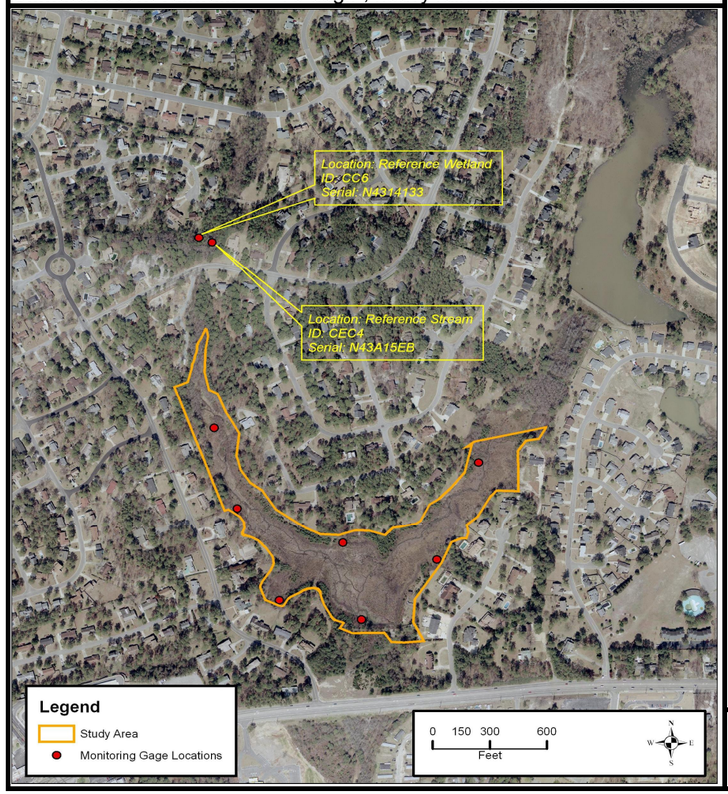
Types: wetland free water surface; stream water level

ID: CC6 (wetland); CEC4 (stream)

Serial #: N4314133 (wetland); N43A15EB (stream)

INSTALLATION SITE DESCRIPTION: **Stream level gage** - installed ~5' upstream of a riffle in the sownstream end of a shallow pool. The probe depth is approximately 2" deeper than the sand bottom sediments. The Gage is approximately 200' upstream from the culvert inlet and Hillard Drive. **Wetland gage** - The gage is installed nead the toe-of-slope and edge of the floodplain and is approximately 50' from the stream gage. There is some seepage and groudnwater discharge into the floodplain in this area, however there is evidence that the wetland is frequently flooded, sediment, debris, and wrack lines. Soil Profile: 0-4" 10 YR 5/3 Coarse sand (likely depositional due to the culvert), 4-40" 10 YR 2/1 Sandy loam (mucky). Vegetation: *Liriodendron tulipifera, Nyssa biflora, Pinus taeda, Pinus serrotina, Acer rubrum, Liquidambar styraciflua, Magnolia virginia, Persea borbonia, Ligustrum sinense, Clethra alnifolia, Cyrillia racemosa, Viburnum nudum, Leucothoe axillaris, Itea virginica, Vaccinium corymbosum, Ilex coriacea, Ilex glabra, Smilax laurifolia, Loniceria japonica, Woodwardia aerolata, Wood*

Observation Date:	10/19/2006
Climate/recent rainfall:	75 deg.F, heavy rain w/in last 48 hours.



3/13/2006 (CC6 east view to stream)

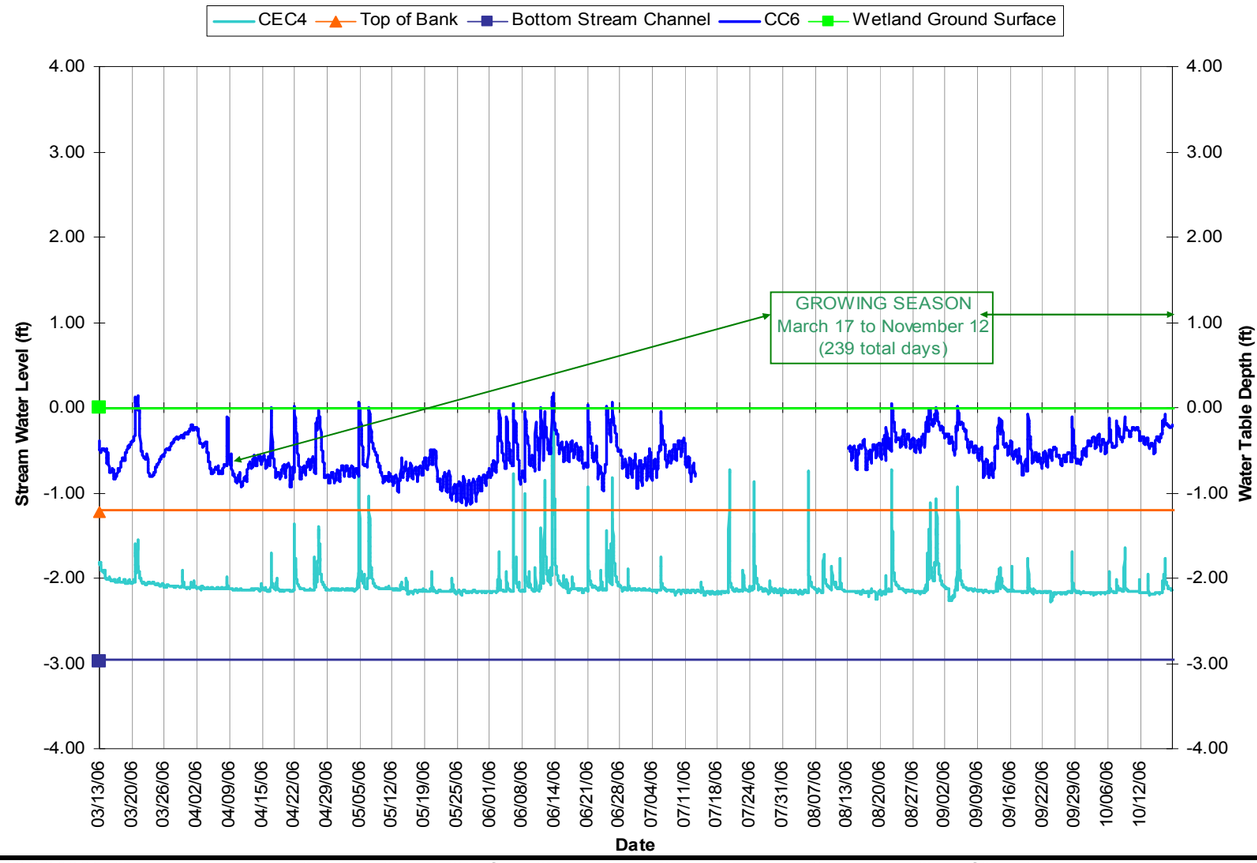
4/21/2006 (CC6 east view to stream)

10/19/2006 (CC6 east view, toe-of-

/13/2006 (CEC4 downstream, south view

4/21/2006 (CEC4 west view to CC6)

10/19/2006 (CEC4 upstream, north



COMMENTS: 4/21/2006 - the gages were painted to not be visible from the road or adjecant homes. A cross section of the stream was sureyed and included the wetland gage. The wetland gage ground surface was assumed as elevation 0.00 pending additional survey of the site.

Kimley-Horn and Associates, Inc.

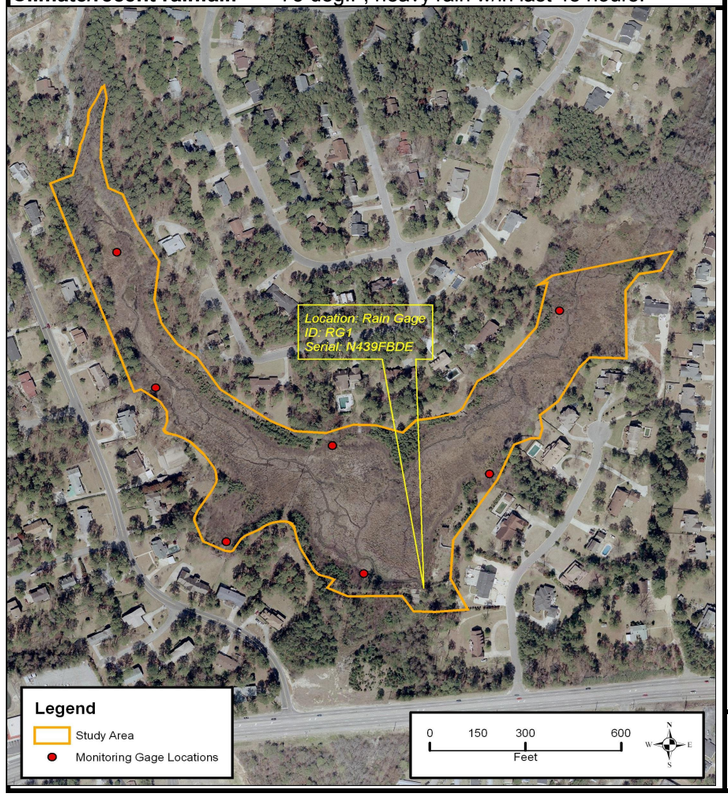
Project:	**Tarlton Site (Cumberland County, NC)**
Installed: 1/17/2006	**Inspected:** 10/19/2006
By: CWE, TBC	**By:** CWE, JD

GAGE DESCRIPTION:

Location: Rain Gage
Type: tipping bucket - daily sum
ID: RG1
Serial #: N439FBDE

INSTALLATION SITE DESCRIPTION: This rain gage was installed near the grade control in the area of the removed beaver dam and remnants of the historic Country Club Lake dam. The gage is unobstructed and is approximately 7' above the ground surface.

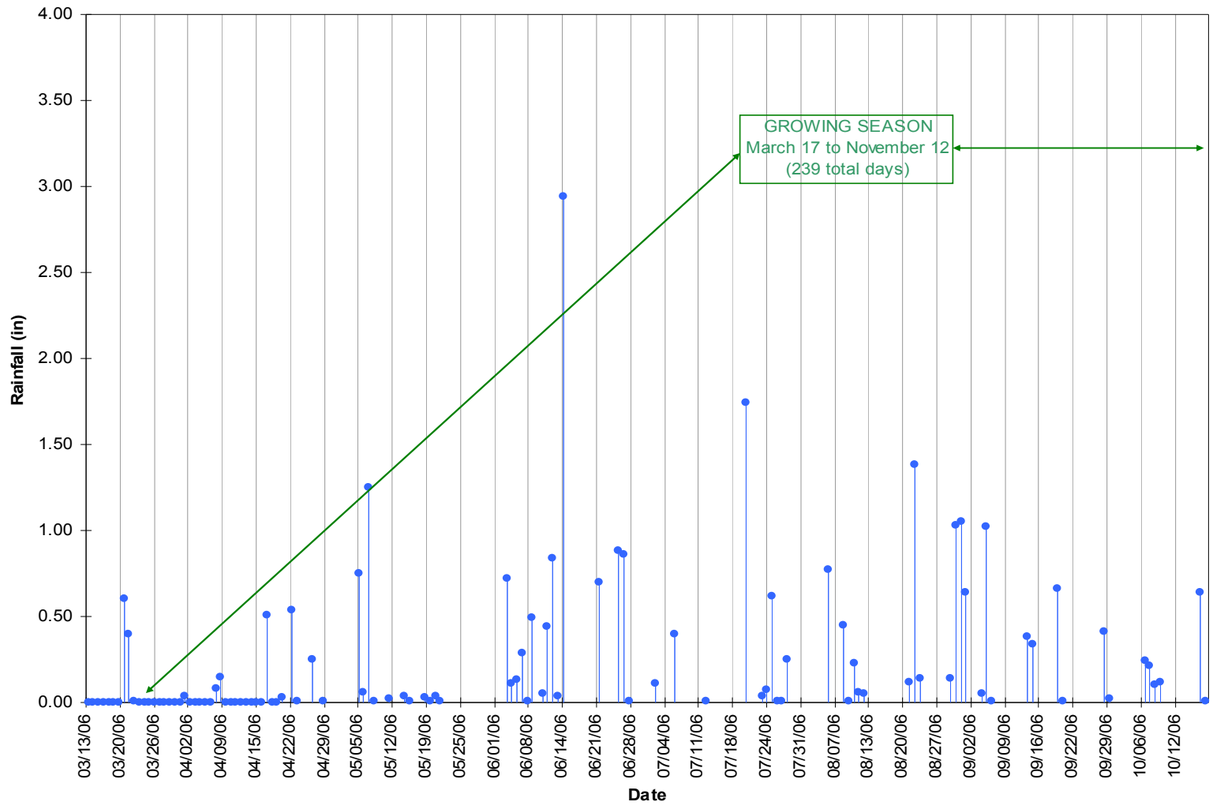
Observation Date:	10/19/2006
Climate/recent rainfall:	75 deg.F, heavy rain w/in last 48 hours.



1/17/2006 (north view)

4/21/2006 (northeast view)

10/19/2006 (west view)



COMMENTS:

FIGURES

CU: 03030004

35.10975 N
-78.89638 W

REFERENCE STREAM AND WETLAND GAGES

CONSERVATION EASEMENT BOUNDARY

CE2

35.10808 N
-78.89136 W

CEC10

CEC6

CC3

ORIGINAL POND BOUNDARY

35.10555 N
-78.89530 W

REEDS4

CC2

PHASE I ACTIVE PRIORITY I RESTORATION
(COMPLETED FALL 2005)

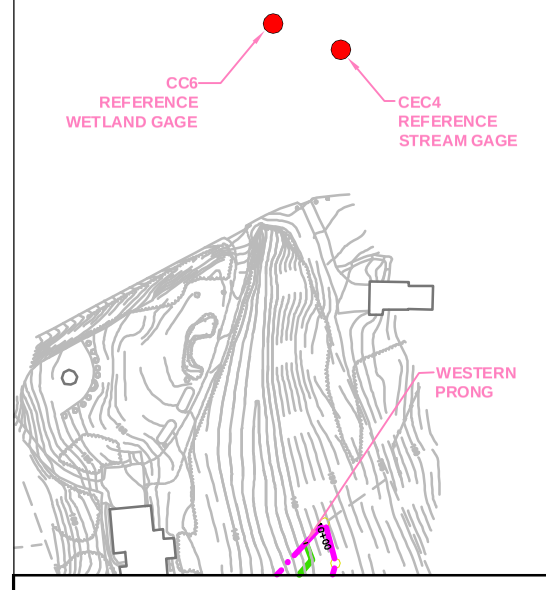
CE5

RIVERBEND ROAD

PERMANENT ACCESS

REMNANT DOCK EASEMENT ENCROACHMENT (REMOVED IN PHASE I)

35.10489 N
-78.89292 W



SITE LEGEND

- MAJOR CONTOUR
- MINOR CONTOUR
- PROPERTY BOUNDARY
- WETLAND ENHANCEMENT
- WETLAND RESTORATION
- STREAM RESTORATION
- STREAM ENHANCEMENT
- STREAM PRESERVATION
- PERMANENT RIFFLE CROSS SECTION
- PERMANENT POOL CROSS SECTION
- VEGETATION MONITORING QUAD
- MONITORING GAGE
- STORM WATER OUTFALL
- 20 PHOTOGRAPH LOCATIONS

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

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

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CLIENT: MID-ATLANTIC MITIGATION

TITLE: MONITORING PLAN MAP

SEAL:

DATE:	02/02/07
HORIZONTAL SCALE:	1": 200'
VERTICAL SCALE:	1": 200'
DRAWN BY:	JCD
DESIGNED BY:	JCD
CHECKED BY:	WRW

PROJECT: TARLTON STREAM AND WETLAND RESTORATION
CUMBERLAND COUNTY

ATTACHED REFERENCE FILES:

S.C.O. NUMBER: D05013-1

FIGURE NUMBER: 2