

**ANNUAL MONITORING REPORT
YEAR 5 (2010)
BIG BULL CREEK BUFFER RESTORATION SITE
JOHNSTON COUNTY, NORTH CAROLINA
(Contract Number D05015-2)**



Prepared for:

**NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
ECOSYSTEM ENHANCEMENT PROGRAM
RALEIGH, NORTH CAROLINA**



Prepared by:

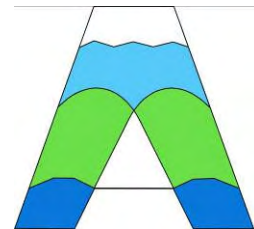
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1101 Haynes Street, Suite 211
Raleigh, North Carolina 27604**

And

**Axiom Environmental, Inc.
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Natural Resources
Restoration & Conservation



Axiom Environmental, Inc.

October 2010

EXECUTIVE SUMMARY

Restoration Systems, LLC (Restoration Systems) has completed riparian buffer restoration at the Big Bull Creek Buffer Restoration Site (hereafter referred to as the “Site”) to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling restoration goals in the region. The Site is located approximately 4 miles southwest of Clayton, in Johnston County. This portion of Johnston County is located centrally within Neuse River Basin 14-digit Cataloging Unit 03020201110040.

The Site Conservation Easement encompasses 36.76 acres immediately adjacent to White Oak Creek and unnamed tributaries to White Oak Creek. Within the Site, restoration of 35.84 Buffer Mitigation Units (BMUs) was completed in January 2006. Measurements made by the North Carolina Division of Water Quality (DWQ) in 2009 determined that 7.68 acres of the originally proposed credits were in areas of previously existing closed canopy forest and an additional 0.71 acre was less than 50 feet from the edge of the water to the Conservation Easement boundary. These areas do not qualify as restoration under DWQ rules and were excluded from the original 35.84 BMUs; thus, the Site actually generates 27.45 BMUs.

Prior to restoration, Site land use consisted of livestock pasture and hay fields. A few isolated stands of hardwood forest were scattered throughout the Site; however, these areas were highly disturbed with low plant densities. Site streams and tributaries are characterized by extensively eroding stream banks. Residential development adjacent to the southern Site boundary exacerbated stream-bank erosion problems caused by onsite land use.

Site reforestation, consisting of a Piedmont Bottomland Forest community, was implemented within the entire 36.76-acre Site. The primary goals of the buffer restoration project focused on reforestation of the Site with native species to 1) improve water quality; 2) enhance flood attenuation; 3) reduce sedimentation/siltation; 4) increase channel bank stability; 5) filter and reduce pollutants prior to entering Swift Creek; 6) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 7) provide increased habitat for aquatic and terrestrial wildlife; 8) increase organic matter, carbon export, and woody debris in the stream corridor; 9) restore shade to Site open waters; 10) increase potential for appropriate mussel habitat; and 11) enhance macroinvertebrate species populations in the channel.

As a whole, the densities of eight vegetation plots across the Site were well-above the required 320 stems per acre with an average of 6500 tree stems per acre counting towards success criteria in the Fifth Monitoring Year (Year 2010). There was a substantial increase in the number of average stems per acre between 2008 and 2010 due to the prolific natural recruitment of *Acer rubrum*, *Fraxinus pennsylvanica*, and *Liquidambar styraciflua*, and within plot 2 of *Quercus alba*. Each individual vegetation plot met success criteria, had good species diversity with 11 to 18 Character Tree Species present within each plot, and an abundance of natural recruitment from adjacent seed sources.

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**BIG BULL CREEK BUFFER RESTORATION SITE
ANNUAL MONITORING REPORT
YEAR 5 (2010)
JOHNSTON COUNTY, NORTH CAROLINA**

1.0 INTRODUCTION

Restoration Systems, LLC (Restoration Systems) has completed riparian buffer restoration at the Big Bull Creek Buffer Restoration Site (hereafter referred to as the “Site”) to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling restoration goals in the region. The Site is located approximately 4 miles southwest of Clayton, in Johnston County (Figure 1).

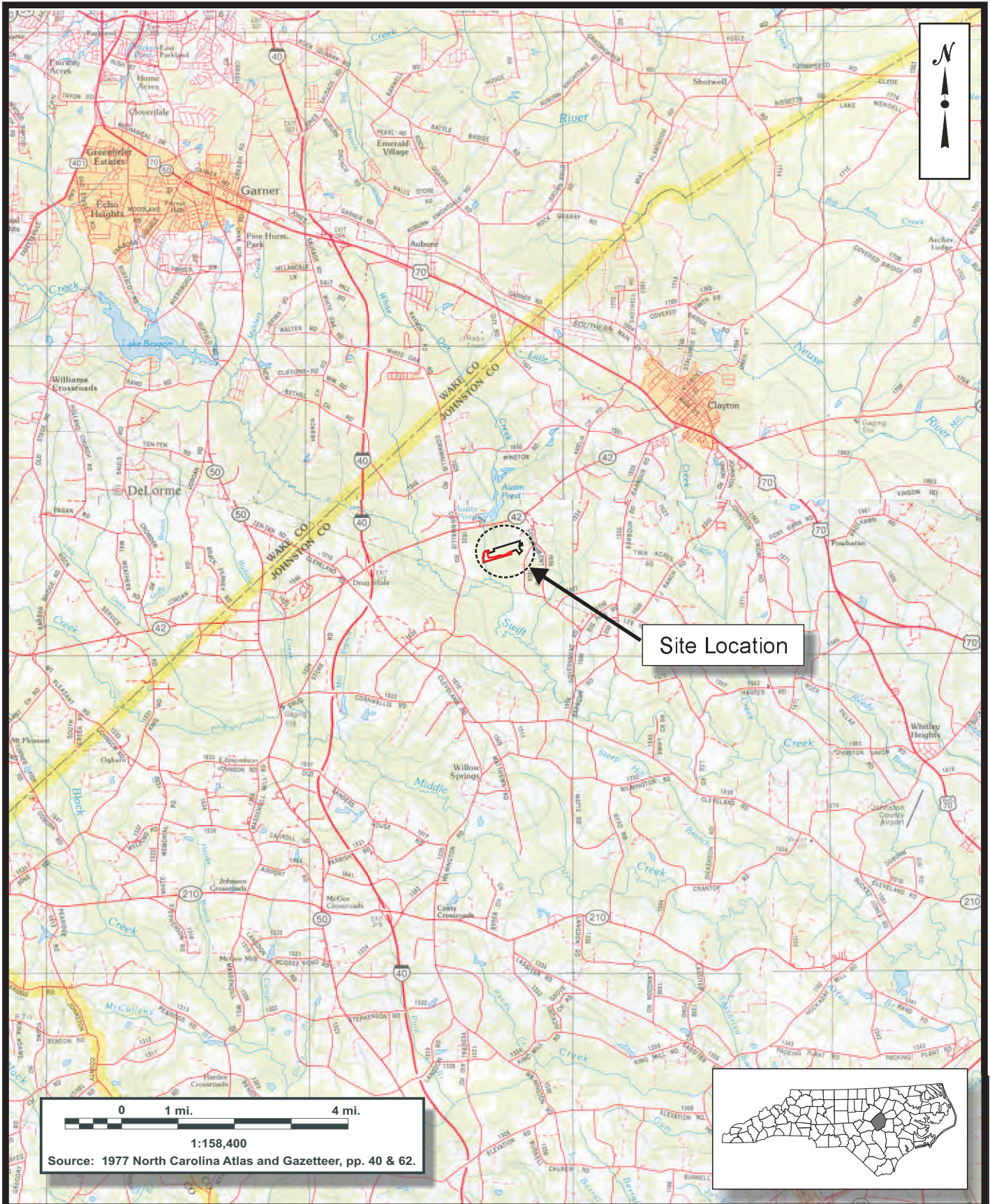
The Site conservation easement encompasses 36.76 acres immediately adjacent to White Oak Creek and unnamed tributaries to White Oak Creek within subbasin 03-04-02 of the Neuse River Basin. The Site is part of United States Geological Survey Catalog Unit 03020201110040 of the South Atlantic/Gulf Region.

A Detailed Buffer Restoration Plan was completed for the Site in July 2005. That plan outlined methods designed to reforest the entire 36.76-acre Site with native species. Prior to implementation, the entire Site was composed of livestock pasture and hay fields. The following implemented activities provide approximately 35.84 Buffer Mitigation Units requested under EEP Request for Proposal (RFP) 16-D05015 dated October 22, 2004.

- Restoration of 35.84 acres of riparian buffer through planting with native forest species.
- Protection of the Site in perpetuity with a conservation easement which is held by the State of North Carolina.

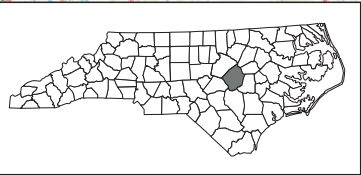
Approximately 0.92 acre of the conservation easement is located greater than 200 feet away from a stream or drainageway and therefore, is not included within the buffer restoration acreage. In 2009, DWQ determined that an additional 7.68 acres of the Site were in areas of previously existing closed canopy forest and 0.71 acre was less than 50 feet from the edge of the water to the Conservation Easement boundary. Under DWQ rules, these areas do not qualify as restoration and were excluded from the original 35.84 BMUs; thus, the Site actually generates 27.45 BMUs.

The primary goals of this buffer restoration project focused on reforestation of the entire 36.76-acre Site with native species to 1) improve water quality; 2) enhance flood attenuation; 3) reduce sedimentation/siltation; 4) increase channel bank stability; 5) filter and reduce pollutants prior to entering Swift Creek; 6) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 7) provide increased habitat for aquatic and terrestrial wildlife; 8) increase organic matter, carbon export, and woody debris in the stream corridor; 9) restore shade to Site open waters; 10) increase potential for appropriate mussel habitat; and 11) enhance macroinvertebrate species populations in the channel.



0 1 mi. 4 mi.
 1:158,400
 Source: 1977 North Carolina Atlas and Gazetteer, pp. 40 & 62.

Site Location




2126 Rowland Pond Dr
 Willow Springs, NC 27592
 (919) 215-1693
 (919) 341-3839 fax

Axiom Environmental, Inc.

SITE LOCATION
BIG BULL BUFFER RESTORATION SITE
 Johnston County, North Carolina

Dwn. by:	CLF
Ckd by:	WGL
Date:	May 2008
Project:	08-007

FIGURE
1

The primary goals were accomplished by:

1. Removing nonpoint sources of pollution associated with agricultural production including a) cessation of broadcasting fertilizer, pesticides, and other agricultural materials into and adjacent to Site streams and b) providing a vegetative buffer adjacent to streams to treat surface runoff.
2. Reducing sedimentation within onsite and downstream receiving waters through a) reduction of bank erosion associated with agricultural practices, b) filter surface runoff from adjacent land and reduce particulate matter deposited into area waterways, and c) planting a forested vegetative buffer adjacent to Site streams.
3. Promoting floodwater attenuation by revegetating Site floodplains thereby promoting increased frictional resistance on floodwaters crossing Site floodplains.
4. Providing wildlife habitat including a riparian forested corridor.

As constructed, the Site provides 27.45 acres of riparian buffer restoration (27.45 Buffer Mitigation Units).

On June 27, 2005, EEP contracted with Restoration Systems to complete restoration of the Site. A Detailed Buffer Restoration Plan was completed for the project in July 2005. Upon completion of the detailed plan, Carolina Silvics completed planting of the Site during the last week of January 2006. Axiom Environmental, Inc. completed an As-built Mitigation Plan in April 2006.

After Site planting was completed, beavers dammed White Oak Creek approximately 1500 feet downstream of the point where the unnamed tributary that flows through the Site enters White Oak Creek. Water levels in White Oak Creek have risen and backed onto the lower portion of the Site. This has resulted in the mortality of planted trees over approximately two acres of the area. At the recommendation of DWQ, 1000 bare root seedlings of bald cypress (*Taxodium distichum*) were planted in the wetter portions of the area and 1000 of water tupelo (*Nyssa aquatica*) were planted in the less wet area in April 2010.

Information on project managers, owners, and contractors follows:

Owner Information

Restoration Systems, L.L.C.
George Howard and John Preyer
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Designer and Monitoring Performer Information

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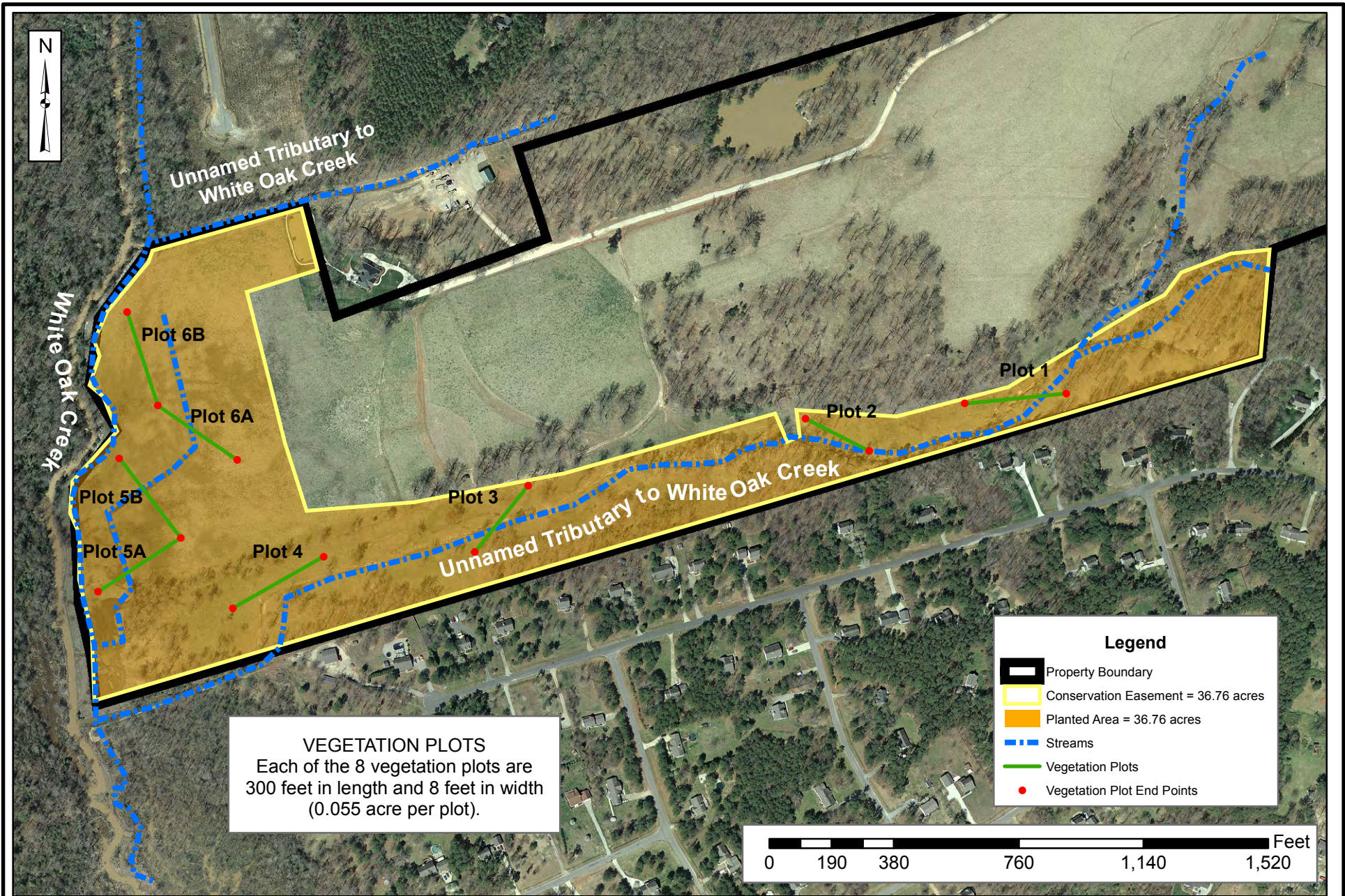
Planting Contractor Information

Carolina Silvics
Dwight McKinney
Edenton, North Carolina 27932
919) 523-4375

2.0 VEGETATION MONITORING PROGRAM

Monitoring procedures for vegetation were designed in accordance with *Stream Mitigation Guidelines* (USACE et al. 2003) and the *Draft Internal Guidance for Vegetation Monitoring Plans for NCWRP Riparian Buffer and Wetland Restoration Projects* (undated). A general discussion of the plant community restoration monitoring program is provided. Monitoring of restoration efforts will be performed for a minimum of 5 years or until success criteria are fulfilled. The locations of monitoring plots are depicted in Figure 2.

During the first year, vegetation received visual evaluation on a periodic basis to ascertain the degree of overtopping of planted species by nuisance species. Quantitative sampling was conducted in late summer of the first year. Subsequently, quantitative sampling of vegetation was performed between June 1 and September 30 of each monitoring year for five years or until the vegetation success criteria were achieved.



Eight sample transects were installed within planted areas of the Site shortly after replanting to equally represent the Site (Figure 2). Each transect is 300 feet in length and 8 feet in width (0.055 acre). In each sample plot, vegetation parameters monitored include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species were also noted. Photographs of the eight vegetation plots are included in Appendix A.

2.1.1 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component is dependent upon density and growth of "Character Tree Species." Characteristic Tree Species include planted species, those observed in forest stands near the Site, and those listed in the Piedmont Bottomland Forest community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990). All canopy tree species planted and those identified in Schafale and Weakley (1990) will be utilized to define "Characteristic Tree Species" as termed in the success criteria (Table 1).

Table 1. Character Tree Species

Planted Species	Examples of Piedmont Bottomland Hardwood Species*
River Birch (<i>Betula nigra</i>)	Red Maple (<i>Acer rubrum</i>)
Sugarberry (<i>Celtis laevigata</i>)	Ironwood (<i>Carpinus carolinia</i>)
Green Ash (<i>Fraxinus pennsylvanica</i>)	Bitternut Hickory (<i>Carya cordiformis</i>)
Blackgum (<i>Nyssa sylvatica</i>)	Shagbark Hickory (<i>Carya ovata</i>)
Sycamore (<i>Platanus occidentalis</i>)	Flowering Dogwood (<i>Cornus florida</i>)
Cherrybark Oak (<i>Quercus pagoda</i>)	American Holly (<i>Ilex opaca</i>)
Willow Oak (<i>Quercus phellos</i>)	Tulip Tree (<i>Liriodendron tulipifera</i>)
Northern Red Oak (<i>Quercus rubra</i>)	Sweetgum (<i>Liquidambar styraciflua</i>)
	Loblolly Pine (<i>Pinus taeda</i>)
	Swamp Chestnut Oak (<i>Quercus michauxii</i>)
	American Elm (<i>Ulmus americana</i>)

* Species described in Schafale and Weakley (1990) and observed within adjacent sites; this is not a comprehensive list.

Vegetation success criteria for the Site includes the existence of an overall density of at least 320 stems per acre five years after the initial planting. Additional seedlings are expected to be recruited to the Site from adjacent forested communities. These individuals may also be counted in the overall success rate for the Site provided they are native hardwood tree species.

If vegetation success criteria are not achieved based on average density calculations from combined plots over the entire restoration area, supplemental planting may be performed with Character Tree Species. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

No quantitative sampling requirements are proposed for herb assemblages as part of the vegetation success criteria. Development of floodplain forests over several decades will dictate the success in recruitment and establishment of desired understory and groundcover populations. Visual estimates of the percent cover of herbaceous species will be noted and documented through periodic photographs. Photographs of the vegetation plots are included in Appendix A.

2.1.2 Vegetation Sampling Results and Comparison to Success Criteria

Quantitative sampling of vegetation was conducted in June 2010. Results are provided in Table 2. Vegetation success criteria for year 5 (320 stems per acre) were exceeded for the 2010 annual monitoring year with 6500 tree stems per acre across the Site. Each individual vegetation plot met success criteria and had good species diversity with 11 to 18 Character Tree Species present within each plot.

3.0 CONCLUSIONS

In summary, as a whole, vegetation plots across the Site were well-above the required 320 stems per acre with an average of 6500 tree stems per acre counting towards success criteria in the Fifth Monitoring Year (Year 2010). In addition, each individual vegetation plot met success criteria and had good species diversity with 11 to 18 Character Tree Species present within each plot.

Table 3. Summary of Vegetation Plot Results

Plot	Stems/Acre Counting Towards Success Criteria				
	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
1	2127	1855	1782	3473	2400
2	1291	1927	2309	5055	6873
3	1018	727	1218	1145	655
4	1127	636	709	909	873
5A	836	1764	2673	12418	10,673
5B	1345	1945	2436	8255	11,800
6A	2491	2164	2691	6345	8000
6B	2927	2836	1345	5945	10,727
Average Plots 1-6B	1645	1727	1895	5443	6500

There was a substantial increase in the number of average stems per acre between 2008 and 2010 due to the prolific natural recruitment of *Acer rubrum*, *Fraxinus pennsylvanica*, and *Liquidambar styraciflua*, and within plot 2 of *Quercus alba*. Each individual vegetation plot met success criteria, had good species diversity with 11 to 18 Character Tree Species present within each plot, and an abundance of natural recruitment from adjacent seed sources. The Site should be considered successful after five years of monitoring as evidenced by stem counts and species diversity observed throughout the Site.

TABLE 2
2010 VEGETATION MONITORING DATA AND RESULTS

Note: Each plot totals 0.055 acre in size.

Community	Piedmont Bottomland Forest										Total Stems/Acre Counting Towards Success Criteria	
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5A	Plot 5B	Plot 6A	Plot 6B	Totals	Total Stems/ Acre		
Species*												
Character Tree Species (count toward success)												
<i>Acer rubrum</i> (red maple)	1	100	9	4	420	370	180	350	1434	3259	3259	
<i>Acer negundo</i> (box elder)					1				1	2	2	
<i>Betula nigra</i> (river birch)	11	11	2	4	7	2	2		39	89	89	
<i>Carya alba</i> (mockernut hickory)		4							4	9	9	
<i>Carya illinoensis</i> (pecan)						1			1	2	2	
<i>Celtis laevigata</i> (sugarberry)	2	2		3					7	16	16	
<i>Cornus florida</i> (flowering dogwood)		3							3	7	7	
<i>Diospyros virginiana</i> (common persimmon)				2	4		2	1	9	20	20	
<i>Fraxinus pennsylvanica</i> (green ash)	3	1	7	10	50	170	180	190	611	1389	1389	
<i>Ilex opaca</i> (American holly)	2	1							3	7	7	
<i>Juniperus virginiana</i> (eastern red cedar)		4						1	5	11	11	
<i>Liquidambar styraciflua</i> (sweetgum)	90	60	14	4	68	46	29	15	326	741	741	
<i>Liriodendron tulipifera</i> (tulip poplar)	4								4	9	9	
<i>Pinus taeda</i> (loblolly pine)	2	26				5	5		38	86	86	
<i>Nyssa sylvatica</i> (black gum)			1	2	2			2	7	16	16	
<i>Platanus occidentalis</i> (American sycamore)	10	1	2	6	9	4	8	6	46	105	105	
<i>Prunus serotina</i> (black cherry)	1								1	2	2	
<i>Quercus alba</i> (white oak)		120	1						121	275	275	
<i>Quercus falcata</i> (southern red oak)		15							15	34	34	
<i>Quercus lyrata</i> (overcup oak)						1			1	2	2	
<i>Quercus nigra</i> (water oak)		1			2				3	7	7	
<i>Quercus michauxii</i> (swamp chestnut oak)	1								1	2	2	
<i>Quercus pagoda</i> (cherrybark oak)	2	10		5	3	5	6	10	41	93	93	
<i>Quercus phellos</i> (willow oak)	2	8		5	12	15	8	3	53	120	120	
<i>Quercus rubra</i> (northern red oak)		6		3	1	3	1	4	18	41	41	
<i>Quercus</i> sp. (oak)		1							1	2	2	
<i>Salix nigra</i> (black willow)	1								1	2	2	
<i>Taxodium distichum</i> (bald cypress)					1				1	2	2	
<i>Ulmus alata</i> (winged elm)		2					3	6	11	25	25	
<i>Ulmus</i> sp. (elm)		2			7	27	16	2	54	123	123	
Species that Don't Count Toward Success												
<i>Baccharis halimifolia</i> (eastern baccharis)	6	4				1	2	1	14	32	0	
TOTAL STEMS IN PLOT	138	382	36	48	587	650	442	591	2874	6532	6500	
TOTAL STEMS/PLOT COUNTING TOWARDS SUCCESS CRITERIA	132	378	36	48	587	649	440	590				
TOTAL STEMS/ACRE COUNTING TOWARDS SUCCESS CRITERIA	2400	6873	655	873	10673	11800	8000	10727				

* Planted species are in bold.

4.0 REFERENCES

North Carolina Wetlands Restoration Program (NCWRP). Undated. Draft Internal Guidance for Vegetation Monitoring Plans for NCWRP Riparian Buffer and Wetland Restoration Projects. North Carolina Department of Environment and Natural Resources, Raleigh, North Carolina.

Schafale, M. P., A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation, North Carolina Natural Heritage Program, Division of Parks and Recreation, NC DEM, Raleigh North Carolina.

United States Army Corps of Engineers (USACE), United States Environmental Protection Agency (USEPA), North Carolina Wildlife Resources Commission (NCWRC), Natural Resources Conservation Service (NRCS), and North Carolina Division of Water Quality (NCDWQ). 2003. Stream Mitigation Guidelines. State of North Carolina.

APPENDIX A

VEGETATION PLOT PHOTOGRAPHS

**Big Bull Creek Buffer Restoration Site Year 5 (2010) Annual Monitoring
Vegetation Plot Pictures Taken June 2010**

