ANNUAL MONITORING REPORT
YEAR 2 (2007)

(Contract Number D05015-2)

BIG BULL CREEK BUFFER RESTORATION SITE
JOHNSTON COUNTY, NORTH CAROLINA

Prepared for:

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

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EXECUTIVE SUMMARY

Restoration Systems, LLC (Restoration Systems) has completed riparian buffer restoration at the Big Bull Creek Buffer Restoration Site (hereinafter 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 approximately 36.76 acres immediately adjacent to White Oak Creek and unnamed tributaries to White Oak Creek. Within the Site, a total of 35.84 Buffer Mitigation Units were completed in January 2006.

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 and of low density. 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 on-site 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 8 vegetation plots across the Site were above the required 320 stems/acre with an average of 1,727 tree stems per acre in the Second Monitoring Year (Year 2007). Each individual vegetation plot met success criteria, had good species diversity with 8 to 13 Character Tree Species present within each plot, and an abundance of natural recruitment from adjacent seed sources. Average stems per acre increased slightly across the Site compared to 2006 monitoring data; however, species diversity decreased slightly.

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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.

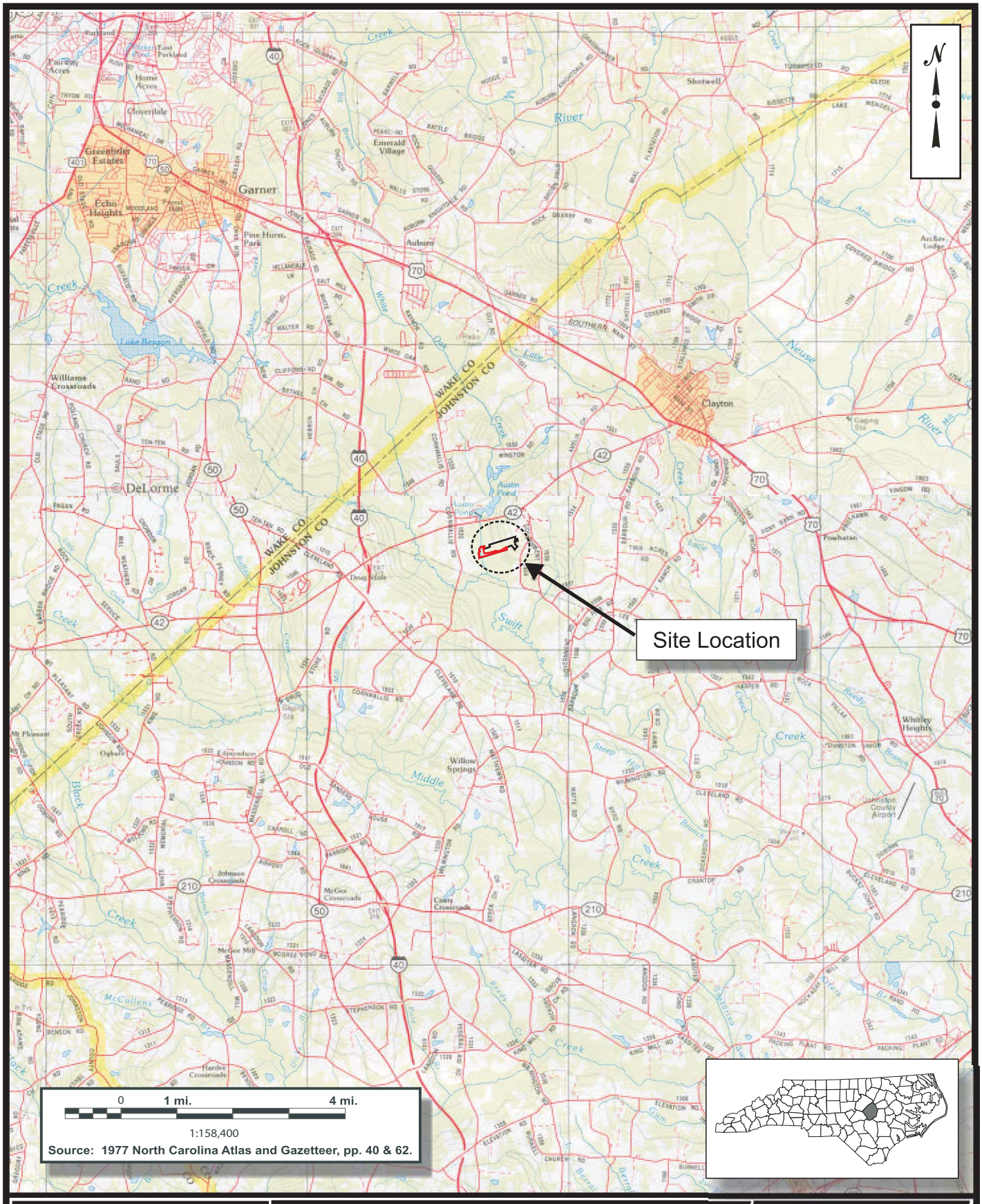
A Detailed Buffer Restoration Plan was completed for the Site in July 2005. That plan outlined methods designed to reforest the entire 36.76-acre Site with native species. Prior to implementation, the entire Site was composed of livestock pasture and hay fields. The following implemented activities provide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

- 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.

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.

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.



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

FIGURE 1

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 35.84 acres of riparian buffer restoration (35.84 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.

Information on project managers, owners, and contractors follows:

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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 second year sampling was conducted on September 5, 2007. Subsequently, quantitative sampling of vegetation will be performed between June 1 and September 30 of each monitoring year for 5 years or until the vegetation success criteria are 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.

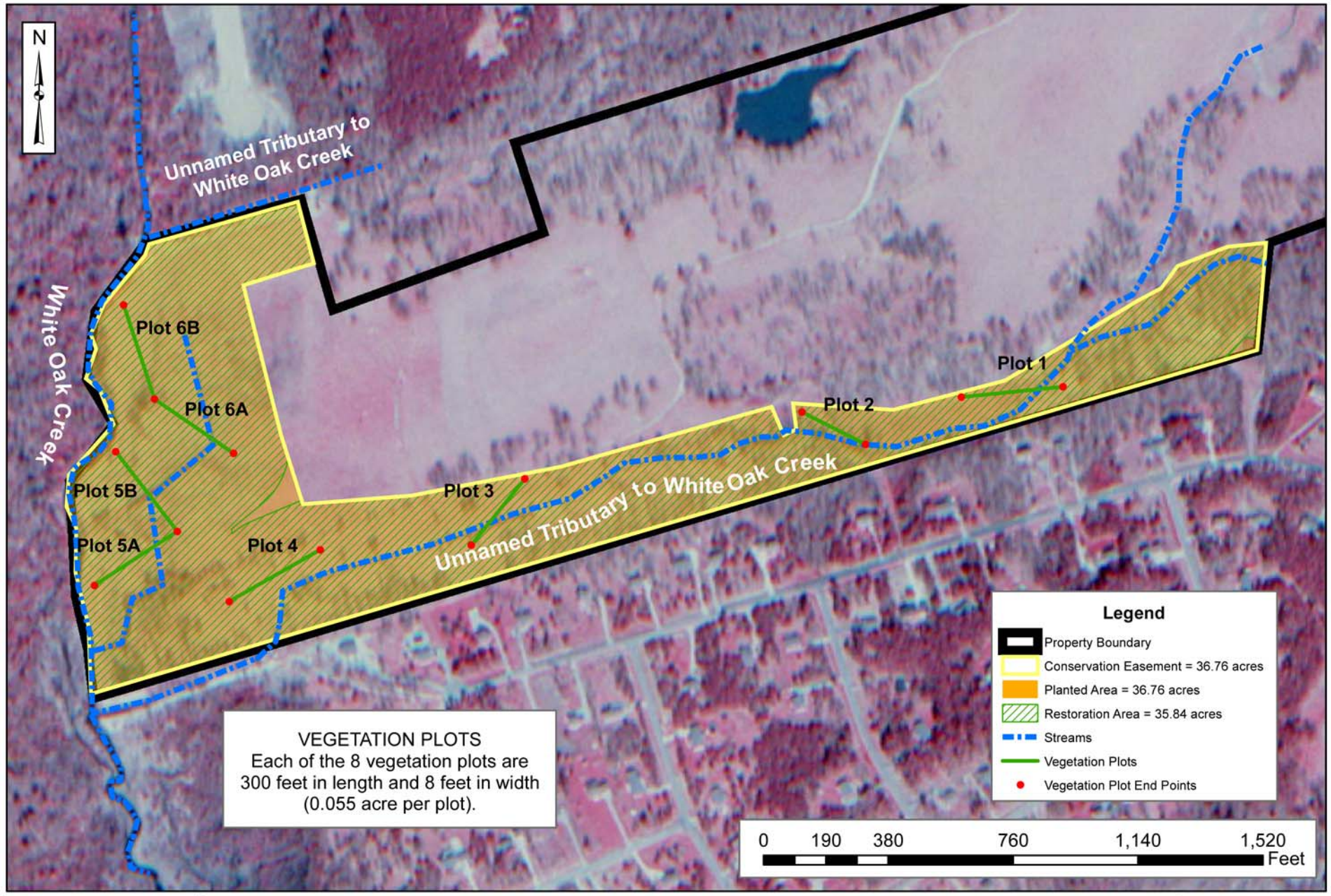
2.2.1 Vegetation Success Criteria

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. Character Tree Species

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

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



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MONITORING PLAN
BIG BULL BUFFER RESTORATION SITE
Johnston County, North Carolina

FIGURE 2

Vegetation success criteria for the Site will be the existence of an overall density of at least 320 stems per acre 5 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.

2.2.2 Vegetation Sampling Results and Comparison to Success Criteria

Quantitative sampling of vegetation was conducted in September 2007. Results are provided in Table 2. Vegetation success criteria for year 2 (320 stems per acre) were exceeded for the 2007 annual monitoring year with 1,727 tree stems per acre across the Site. Each individual vegetation plot met success criteria and had good species diversity with 8 to 13 Character Tree Species present within each plot.

3.0 CONCLUSIONS

In summary, as a whole, vegetation plots across the Site were above the required 320 stems/acre with an average of 1,727 tree stems per acre in the Second Monitoring Year (Year 2007). In addition, each individual vegetation plot met success criteria and had good species diversity with 8 to 13 Character Tree Species present within each plot. The average number of stems per acre slightly increased across the Site compared to 2006 monitoring data, however, species diversity decreased slightly.

TABLE 2.
2007 VEGETATION MONITORING DATA AND RESULTS

Note: Each plot totals 0.055 acre in size.

Community	Mesic Pine Flatwoods										
Species*	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5A**	**Plot 5B**	**Plot 6A**	**Plot 6B**	**Total Stems for Plots 1-6B**	**Total Stems/Acre**	**Total Stems/Acre Counting Towards Success Criteria****
Character Tree Species (count toward success)											
Acer negundo (box-elder)	0	0	0	0	0	0	0	1	1	2	2
Acer rubrum (red maple)	0	30	1	3	35	13	12	46	140	318	318
***Betula nigra* (river birch)**	10	3	6	3	6	7	3	1	39	89	89
***Celtis laevigata* (sugarberry)**	4	3	0	3	1	0	1	1	13	30	30
Diospyros virginiana (persimmon)	0	0	0	0	0	0	1	0	1	2	2
***Fraxinus pennsylvanica* (green ash)**	1	4	5	6	10	44	57	63	190	431	431
Ilex opaca (American holly)	3	0	0	0	0	0	0	0	3	7	7
Liquidambar styraciflua (sweetgum)	52	16	5	0	19	17	14	8	131	297	297
Liriodendron tulipifera (tulip poplar)	4	0	0	0	0	0	0	0	4	9	9
Pinus taeda (loblolly pine)	0	4	0	0	0	0	0	1	5	11	11
***Platanus occidentalis* (sycamore)**	10	0	2	7	8	4	6	8	45	102	102
Quercus alba (white oak)	0	4	0	0	0	0	0	0	4	9	9
Quercus lyrata (overcup oak)	0	9	1	0	2	0	0	0	12	27	27
Quercus michauxii (swamp chestnut oak)	1	0	0	0	0	1	0	0	2	5	5
***Quercus pagoda* (cherrybark oak)**	3	8	4	4	3	5	4	4	35	79	79
***Quercus phellos* (willow oak)**	3	9	11	5	7	13	4	4	56	127	127
***Quercus rubra* (northern red oak)**	8	6	3	4	6	0	5	13	45	102	102
Salix nigra (black willow)	1	0	2	0	0	0	0	0	3	7	7
Ulmus americana (American elm)	0	8	0	0	0	1	2	4	15	34	34
Ulmus rubra (slippery elm)	2	2	0	0	0	2	10	2	18	41	41
Species that Don't Count Toward Success											
Lyonia lucida (fetterbush)	0	0	0	0	0	0	1	0	1	2	0
Rhus copallina (winged sumac)									0	0	0
Sambucus canadensis (elderbrry)	0	1	0	1	0	0	0	0	2	5	0
Baccharis halimifolia (eastern baccharis)	4	5	0	0	0	0	1	1	11	25	0
Ligustrum sinense (chinese privet)									0	0	0
TOTAL STEMS/PLOT	**106**	**112**	**40**	**36**	**97**	**107**	**121**	**157**	**775**	**1759**	**1727**
TOTAL STEMS/PLOT COUNTING TOWARDS SUCCESS CRITERIA	**102**	**106**	**40**	**35**	**97**	**107**	**119**	**156**			
TOTAL STEMS/ACRE COUNTING TOWARDS SUCCESS CRITERIA	**1855**	**1927**	**727**	**636**	**1764**	**1945**	**2164**	**2836**			

* Planted species are in bold.

4.0 REFERENCES

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1. United States Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

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APPPENDIX A
VEGETATION PLOT PHOTOGRAPHS

Big Bull Buffer Restoration Site
Year 2 (2007) Annual Monitoring Report
Vegetation Photographs Taken September 2007

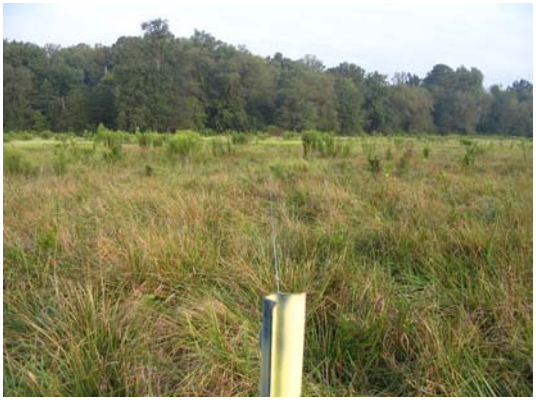
Plot 1

Plot 2

Plot 3

Plot 4

Plot 5a



Plot 5b

Plot 6a

Plot 6b