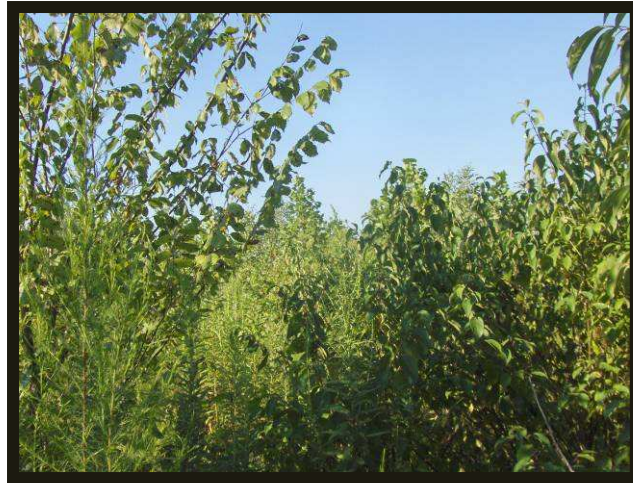


**ANNUAL MONITORING REPORT
YEAR 4 (2008)
WALNUT CREEK BUFFER RESTORATION SITE
WAYNE COUNTY, NORTH CAROLINA
(Contract Number D04009-2)**



Prepared for:

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



Prepared by:

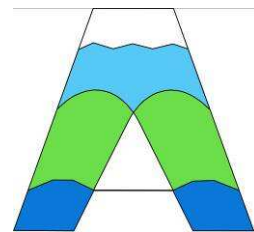
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2126 Rowland Pond Drive
Raleigh, North Carolina 27592**



Natural Resources
Restoration & Conservation



Axiom Environmental, Inc.

September 2008

EXECUTIVE SUMMARY

Restoration Systems, LLC (Restoration Systems) has completed riparian buffer restoration at the Walnut 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 one mile east of Goldsboro, in Wayne County. This portion of Wayne County is located in the western portion of Neuse River Basin Cataloging Unit 03020202. The Site encompasses 25 acres of buffer restoration immediately adjacent to Walnut Creek and one of its tributaries and was completed in June 2005.

Prior to restoration, Site land use consisted primarily of agricultural fields utilized for row crop production in addition to a small area of abandoned pasture. Site ditch banks were characterized by little or no vegetation and tilling took place within one to two feet of the top of bank. Excessive runoff during storms contributed to nutrient, pesticide, and sediment runoff.

Site reforestation, consisting of a Nonriverine Wet Hardwood Forest community, was implemented within the entire 25-acre Site. The primary goals of the buffer restoration project focused on reforestation of the Site with native tree and shrub species to: 1) intercept and assimilate nutrient, pesticide, and sediment runoff from agricultural activities in the headwaters of Walnut Creek and ultimately into the Neuse River; 2) convert croplands within the Site into riparian forest to reestablish forest functions; 3) improve water quality; 4) enhance flood attenuation; 5) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 6) provide increased quantity and quality of habitat for aquatic and terrestrial wildlife; and 7) augment efforts by Wayne County and the City of Goldsboro to establish buffer areas near Seymour Johnson Air Force Base.

As a whole, the densities of eight vegetation plots across the Site were well-above the required 320 stems/acre with an average of 2892 tree stems per acre counting towards success criteria in the Fourth Monitoring Year (Year 2008). Each individual vegetation plot met success criteria and had a species diversity consisting of 9 to 19 species per plot.

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**WALNUT CREEK BUFFER RESTORATION SITE
ANNUAL MONITORING REPORT
YEAR 4 (2008)
WAYNE COUNTY, NORTH CAROLINA**

1.0 INTRODUCTION

Restoration Systems, LLC (Restoration Systems) has completed riparian buffer restoration at the Walnut 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 in the western portion of Cataloging Unit 03020202 (Hydrologic Unit 03020202010040) of the Neuse River Basin, approximately one mile east of Goldsboro, in Wayne County (Figures 1 and 2). The Site conservation easement encompasses 27.9 acres immediately adjacent to Walnut Creek and an unnamed tributary to Walnut Creek within subbasin 03-04-02 of the Neuse River Basin (Figure 3). Site soils are comprised primarily of poorly drained wet flat soil series such as Bibb, Johnston, Rains, and Weston (Figure 4).

A Detailed Buffer Restoration Plan was completed for the Site in December 2006. The plan outlined methods designed to reforest the entire Site with native species. Prior to implementation, Part 1 of the Site (approximately 23.5 acres) was composed of row-crop agriculture. Part 2, approximately 1 mile east, consisted of approximately 1.5 acres of abandoned pasture. The following implemented activities provide 25 Buffer Mitigation Units requested under EEP Request for Proposal (RFP) 16-D04009 dated December 31, 2003.

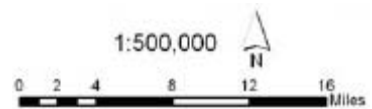
- Restoration of 25 acres of riparian buffer through planting with native forest species.
- Protection of the Site in perpetuity with a conservation easement which is held by the State of North Carolina.

The primary goals of the buffer restoration project focused on reforestation of the Site with native tree and shrub species to: 1) intercept and assimilate nutrient, pesticide, and sediment runoff from agricultural activities in the headwaters of Walnut Creek and ultimately into the Neuse River; 2) convert croplands within the Site into riparian forest to reestablish forest functions; 3) improve water quality; 4) enhance flood attenuation; 5) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 6) provide increased quantity and quality of habitat for aquatic and terrestrial wildlife; and 7) augment efforts by Wayne County and the City of Goldsboro to establish buffer areas near Seymour Johnson Air Force Base.

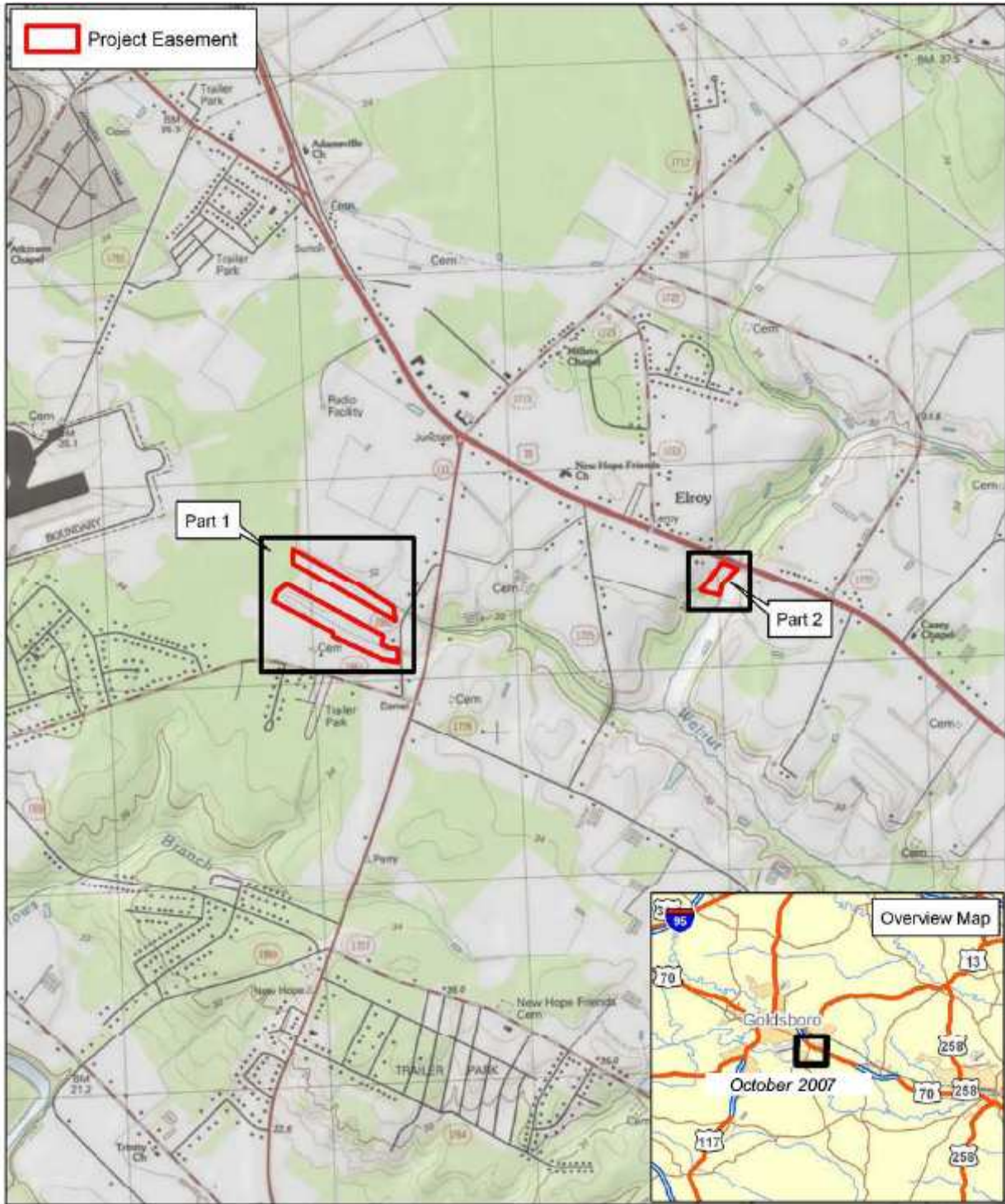
The primary goals were accomplished by removing nonpoint sources of pollution associated with agricultural production including the cessation of broadcasting fertilizer, pesticides, and other agricultural materials into and adjacent to Site streams and providing a vegetative buffer adjacent to streams to treat surface runoff.



**Figure 1. Cataloging Map
Walnut Creek
Buffer Restoration Site
Wayne County
Year 4 (2008) Annual Monitoring**



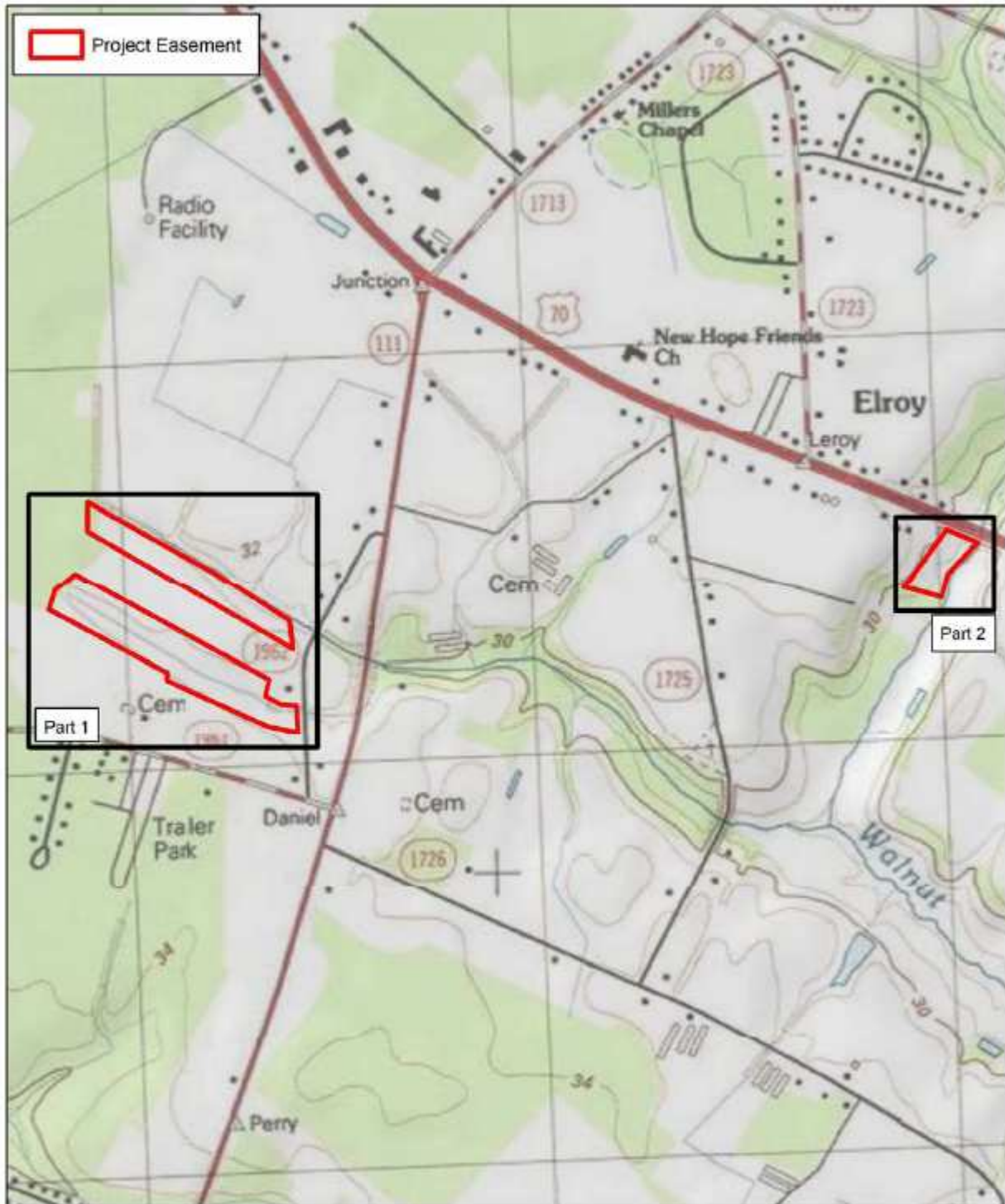
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Figure 2. Project Location
Walnut Creek
Buffer Restoration Site
Wayne County
Year 4 (2008) Annual Monitoring





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**Figure 3. Topographic Map
Walnut Creek
Buffer Restoration Site
Wayne County
Year 4 (2008) Annual Monitoring**



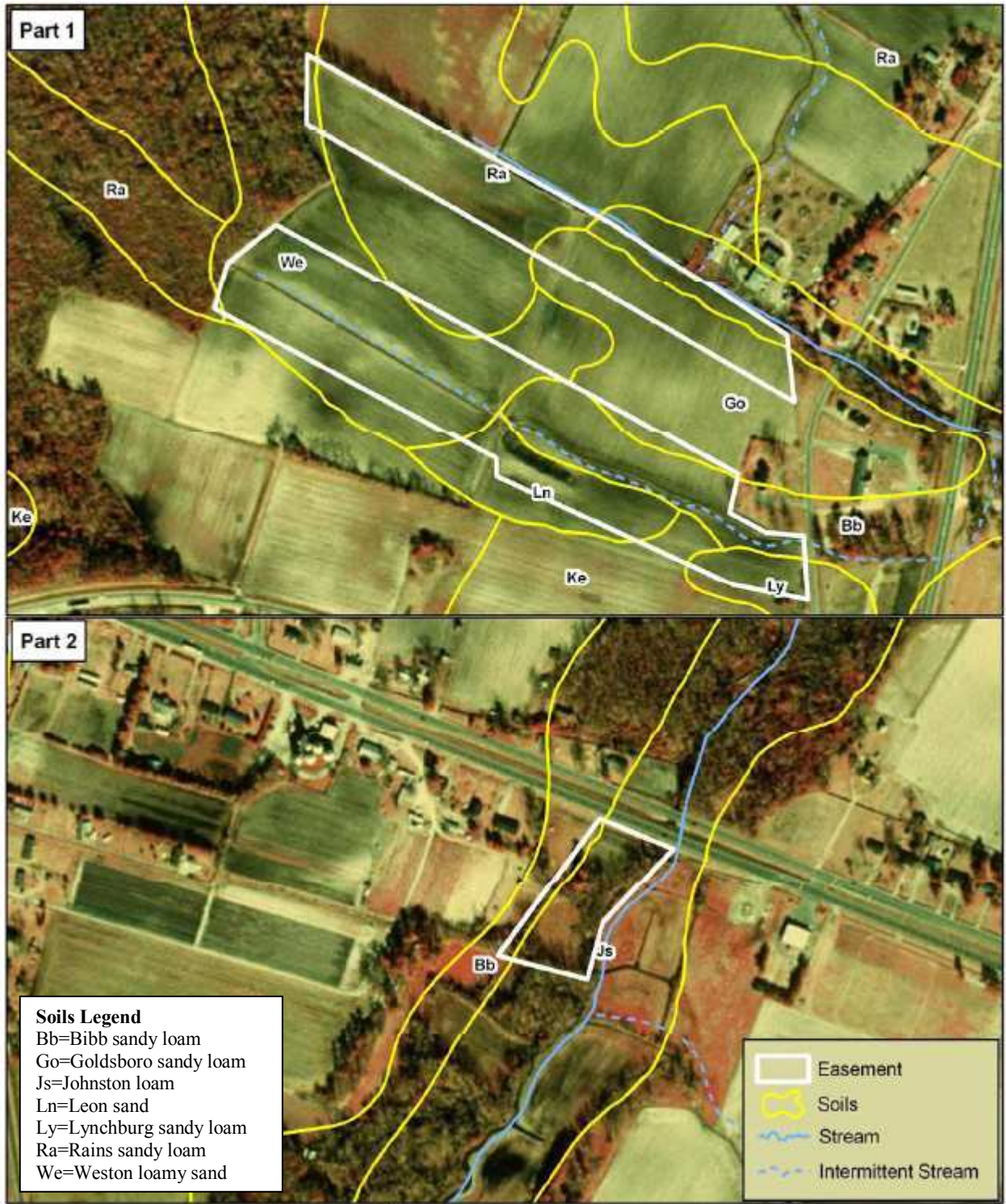


Figure 4. Soils
Walnut Creek
Buffer Restoration Site
Wayne County
Year 4 (2008) Annual Monitoring



As constructed, the Site provides 25 acres of riparian buffer restoration (25 Buffer Mitigation Units). Information on project managers, owners, and contractors follows:

Owner, Designer, and Monitoring Performer Information

Restoration Systems, L.L.C.
George Howard and John Preyer
1101 Haynes Street, Suite 211
Raleigh, North Carolina 27604
(919) 755-9490

Fourth Year Monitoring Performer Information

Axiom Environmental, Inc.
W. Grant Lewis
2126 Rowland Pond Drive
Willow Spring, North Carolina 27592
(919) 215-1693

Planting Contractor Information

Carolina Silvics
Dwight McKinney
908 Indian Trail Road
Edenton, North Carolina 27932
(919) 523-4375

2.0 VEGETATION MONITORING PROGRAM

Monitoring procedures for vegetation were designed in accordance with *Guidelines for Riparian Buffer Restoration* (NCEEP 2004) and 2000 North Carolina Administrative Code (15A NCAC 02B .0242). 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 Figures 5 and 6.

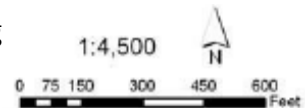
During the first year, vegetation received visual evaluation on a periodic basis to ascertain the degree of overtopping of planted species by nuisance species. Subsequent quantitative vegetation sampling will be performed between June 1 and December 30 of each monitoring year for five years or until the vegetation success criteria are achieved.

Eight sample transects were installed within planted areas of the Site shortly after planting. Transects 1-7 (Part 1) are 200 feet in length by 12 feet in width (0.055 acre). Transect 8 is 160 feet in length and 7.5 feet in width (0.0275 acre). In each sample plot, vegetation parameters monitoring include species composition and density. Visual estimates of the percent cover of herbaceous species were also noted. Photographs of the vegetation plots are included in Appendix A.



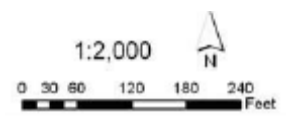
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**Figure 5. Planting Zones and Sampling
Transects in Part 1
Walnut Creek
Buffer Restoration Site
Wayne County
Year 4 (2008) Annual Monitoring**





**Figure 6. Planting Zones and Sampling
Transects in Part 2
Walnut Creek
Buffer Restoration Site
Wayne County
Year 4 (2008) Annual Monitoring**



2.1 Vegetation Success Criteria

Rules published in the North Carolina Administrative Code (NCAC 2000) have been established to determine success criteria. All planted tree and shrub species and all native colonizing hardwood tree and shrub species are counted in establishing success criteria.

Table 1. Planted Tree and Shrub Species

Canopy Trees	Shrubs and Understory Trees
<i>Betula nigra</i> (river birch)	<i>Callicarpa americana</i> (American beautyberry)
<i>Carya aquatic</i> (water hickory)	<i>Cephalanthus occidentalis</i> (buttonbush)
<i>Celtis laevigata</i> (sugarberry)	<i>Cornus amomum</i> (silky dogwood)
<i>Diospyros virginiana</i> (persimmon)	<i>Magnolia virginiana</i> (sweetbay)
<i>Fraxinus pennsylvanica</i> (green ash)	<i>Persea palustris</i> (red bay)
<i>Liriodendron tulipifera</i> (yellow poplar)	
<i>Nyssa biflora</i> (swamp blackgum)	
<i>Platanus occidentalis</i> (sycamore)	
<i>Quercus laurifolia</i> (laurel oak)	
<i>Quercus michauxii</i> (swamp chestnut oak)	
<i>Quercus nigra</i> (water oak)	
<i>Quercus pagoda</i> (cherrybark oak)	
<i>Quercus phellos</i> (willow oak)	
<i>Ulmus americana</i> (American elm)	

Vegetation success criteria for the Site will consist 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 native species. Supplemental planting will be performed as needed until vegetation success criteria is achieved.

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. Photographs of the vegetation plots are included in Appendix A.

2.2 Vegetation Sampling Results and Comparison to Success Criteria

2.2.1 Woody Trees and Shrubs

Quantitative sampling of vegetation was conducted in July 2008. Results are provided in Table 3. Vegetation success criteria for year 4 (320 stems per acre) were exceeded for the 2008 annual monitoring year with 2892 tree stems per acre across the Site. Each individual vegetation plot met success criteria and had a species diversity consisting of 9 to 19 species per plot.

Transects 1-7 were dominated by planted species most notably American sycamore (*Platanus occidentalis*), silky dogwood (*Cornus amomum*), and river birch (*Betula nigra*). Transect 8 was dominated by natural recruits consisting of red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) from an adjacent forest.

2.2.2 Herbaceous Vegetation

Table 2 includes the dominant herbaceous vegetation observed during monitoring. Herbaceous vegetation within Part 1 of the Site consists primarily of agricultural weeds in addition to a few vine species, and within Part 2 consists primarily of vine species for the 2008 monitoring year. Herbaceous vegetation within the Site is not causing any problems and no herbicide applications are recommended at this time.

Table 2. 2008 Herbaceous Vegetation Monitoring Data and Results

Species	Part 1 (Plots 1-7)	Part 2 (Plot 8)
<i>Andropogon virginicus</i> (broomsedge)	x	
<i>Asplenium platyneuron</i> (ebony spleenwort)		x
<i>Aster</i> sp. (aster)	x	
<i>Campsis radicans</i> (trumpet creeper)	x	x
<i>Eupatorium capillifolium</i> (dogfennel)	x	
<i>Juncus effusus</i> (soft rush)	x	
<i>Juncus</i> sp. (rush)	x	
<i>Lonicera japonica</i> (Japanese honeysuckle)		x
<i>Rubus argutus</i> (blackberry)	x	x
<i>Solidago</i> sp. (goldenrod)	x	x
<i>Toxicodendron radicans</i> (poison ivy)		x

3.0 CONCLUSIONS

In summary, vegetation plots across the Site were well-above the required 320 stems/acre with an average of 2892 tree stems per acre counting towards success criteria in the Fourth Monitoring Year (Year 2008). In addition, each individual vegetation plot met success criteria and had good species diversity with 9 to 19 species present within each plot. The average tree stems per acre has increased slightly each year, most notably in 2008 within plots 1, 3, 6, and 8 due to an increase of natural recruits of red maple, sweetgum, and American sycamore (Table 4).

TABLE 3
2008 VEGETATION MONITORING DATA AND RESULTS
 Note: Plots 1-7 total 0.055 acre in size, Plot 8 totals 0.0275 acre in size.

Community	Nonriverine Wet Hardwoods Forest								Total Stems/Acre	Total Stems/Counting Towards Success Criteria		
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8			Totals	
Species Counting Toward Success												
<i>Acer rubrum</i> (red maple)								1	110	111	269	269
<i>Baccharis halimifolia</i> (eastern baccharis)	3	12	19	7	1	28		9	12	91	221	221
<i>Betula nigra</i> (river birch)	5	10	6	9		7		8		45	109	109
<i>Celtis laevigata</i> (sugarberry)								1		1	2	2
<i>Calliandra americana</i> (beauty berry)	3	6	6	3	2	4		7		31	75	75
<i>Carya</i> sp. (hickory)	1		1							2	5	5
<i>Cephaanthus occidentalis</i> (buttonbush)	7	4	6	8						25	61	61
<i>Cornus amomum</i> (silky dogwood)	20	10	10	9	3	12		16		80	194	194
<i>Diospyros virginiana</i> (common persimmon)	4	4	5	4		2		7		26	63	63
<i>Fraxinus pennsylvanica</i> (green ash)		4	3		3	3		3		16	39	39
<i>Liquidambar styraciflua</i> (sweetgum)	45	2	7	12				4	190	260	630	630
<i>Liriodendron tulipifera</i> (tulip poplar)	2		5	2	2	1		3		15	36	36
<i>Magnolia virginiana</i> (sweetbay)	2		4	7		4		6		23	56	56
<i>Persea palustris</i> (red bay)	3	5	8	1	4	3		1		24	58	58
<i>Pinus taeda</i> (loblolly pine)		1			3	12		1		17	41	41
<i>Platanus occidentalis</i> (American sycamore)	15	54	33	29		56		69	1	257	623	623
<i>Populus</i> sp. (cottonwood)	1									1	2	2
<i>Prunus caroliniana</i> (Carolina laurelcherry)	1									1	2	2
<i>Prunus serotina</i> (black cherry)	4	6	6	2	1	11		5	1	36	87	87
<i>Quercus michauxii</i> (swamp chestnut oak)			3	1		2				6	15	15
<i>Quercus nigra</i> (water oak)	2	1	8	1	2				3	17	41	41
<i>Quercus pagoda</i> (cherrybark oak)				1	1	2		1		5	12	12
<i>Quercus phellos</i> (willow oak)	2	12	6	5	10	12		6	5	58	141	141
<i>Rhus copallinum</i> (winged sumac)	20								3	23	56	56
<i>Salix nigra</i> (black willow)					2					2	5	5
<i>Ulmus</i> sp. (elm)	4	7	1	6		1		1		20	48	48
Species that Don't Count Toward Success												
<i>Albizia lulibrissin</i> (mimosa)		1								1	2	0
<i>Ligustrum sinense</i> (Chinese privet)									4	4	10	0
TOTAL STEMS IN PLOT	144	139	137	107	34	161		147	329	1198	2904	2892
TOTAL STEMS/PLOT COUNTING TOWARDS SUCCESS CRITERIA	144	139	137	107	34	161		147	325			
TOTAL STEMS/ACRE COUNTING TOWARDS SUCCESS CRITERIA	2618	2527	2491	1945	618	2927		2673	11818			

* Planted species are in bold.

Table 4. Summary of Vegetation Plot Results

Plot	Stems/Acre Counting Towards Success Criteria				
	Year 1 (2005)	Year 2 (2006)	Year 3 (2007)	Year 4 (2008)	Year 5 (2009)
1	1670	1343	1597	2618	
2	1851	1761	2831	2527	
3	980	853	1851	2491	
4	1143	1125	1960	1945	
5	744	472	744	618	
6	944	1180	2124	2927	
7	998	998	2723	2673	
8	2523	4011	6225	11818	
Average Plots 1-8	1357	1468	2507	2892	

4.0 REFERENCES

North Carolina Ecosystem Enhancement Program (NCEEP). 2004. Guidelines for Riparian Buffer Restoration. North Carolina Department of Environment and Natural Resources, Raleigh, North Carolina.

APPENDIX A

VEGETATION PLOT PHOTOGRAPHS

**Walnut Creek Buffer Restoration Site Year 4 (2008) Annual Monitoring
Vegetation Plot Pictures Taken September 2008**

