FINAL
ANNUAL MONITORING REPORT
TERRIBLE CREEK

BUFFER RESTORATION
WAKE COUNTY, NORTH CAROLINA
(EEP Project Number 134, Contract Number 004458)
NEUSE RIVER BASIN
CATALOGING UNIT 03020201
Monitoring Year 6 (2013)

Prepared for:

North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, North Carolina 27699-1652
EEP Project Manager: Jessica Kemp

December 2013

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Prepared by:

Axiom Environmental, Inc.
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December 2013

Table of Contents

List of Figures

List of Tables

Appendices

1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

This report describes annual monitoring at the **Terrible Creek Buffer Restoration Site** (Site), which was designed specifically to assist in fulfilling North Carolina Ecosystem Enhancement Program (EEP) restoration goals. This report (compiled based on EEP's *Procedural Guidance and Content Requirements for EEP Monitoring Reports Version 1.4* dated 11/7/11) summarizes data for year 6 (2013) monitoring.

The primary goals of this buffer restoration project focused on reforestation of the floodplain 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 Terrible 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; and
10) enhance characteristic macroinvertebrate species populations in the channel.

The Site is located approximately 1 mile northeast of Willow Spring and 4 miles northeast of Fuquay-Varina, in Wake County. This portion of Wake County is located within Neuse River Basin Cataloging Unit 03020201120010 (Figure 1, Appendix A). This document details annual monitoring results for riparian buffer restoration on the 47.84-acre Site, which resulted in a total of 45.6 acres of riparian buffer restoration. The Site is protected by a permanent conservation easement held by the State of North Carolina. This project was instituted prior to October 11, 2007 and therefore is eligible for riparian buffer restoration credit up to 200 feet from the top of bank of all perennial and intermittent waterways within the Site.

Sixteen vegetation plots (10-meters by 10-meters) were installed within the Site after planting was completed. An average density of 320 stems per acre of Character Tree Species must be surviving after five monitoring years in accordance with North Carolina Division of Water Quality Administrative Code 15A NCAC 02B.0242 (*Neuse River Basin, Mitigation Program for Protection and Maintenance of Existing Riparian Buffers*) (NCDWQ 2007). Based on the number of stems counted, average densities were measured at 473 planted stems per acre (excluding livestakes) surviving in year 6 (2013). When considering hardwood tree species only and no shrub species average densities were measured at 440 planted tree stems per acre (excluding livestakes) surviving in year 6 (2013). The dominant species identified at the Site were planted stems of cherrybark oak (*Quercus pagoda*), swamp chestnut oak (*Quercus michauxii*), and river birch (*Betula nigra*). An additional random 15 transects (50m x 2m) were completed within the Site in Year 6 (2013). Hardwood tree species averaged 375 stems per acre within all transects. Transect locations are depicted on Figures 2 and 3 (Appendix A), and data and photographs are included in Appendix C.

Woody vegetation immediately adjacent to Terrible Creek and planted willow livestakes declined drastically throughout the monitoring years; therefore, EEP replanted portions of the easement on February 9, 2012 and April 29, 2012. Areas planted on February 9, 2012 included Zone 1 adjacent to Terrible Creek (top of bank to 30 feet, shown in dark pink and brown on Figure 2, Appendix A), which

was planted with approximately 1596 containerized tree stems and 350 livestakes. Additionally, areas between vegetation plots 2-3 and vegetation plots 9-10 were planted with approximately 654 tree stems (shown in brown on Figure 2, Appendix A). Newly planted containerized trees appear to be thriving. In general, livestakes did not appear to have taken root (depicted in yellow on Figure 2, Appendix A). Planted species and quantities of each are as follows.

Livestakes (planted on February 9, 2012)
175 black willow, *Salix nigra*
175 silky dogwood, *Cornus amomum*
TOTAL 350 Livestakes

Containerized Trees (planted on February 9, 2012)
361 green ash, *Fraxinus pennsylvanica*
235 overcup oak, *Quercus lyrata*
623 river birch, *Betula nigra*
100 shumard oak, *Quercus shumardii*
820 willow oak, *Quercus phellos*
111 yellow poplar, *Lirodendron tulipifera*
TOTAL 2250 Containerized Trees

On April 29, 2012 Bruton Natural Services performed an additional replant on the far eastern braid of Terrible Creek that flows north. Areas were planted with 150 five-gallon containerized trees (4-6 feet in height) in Zone 1 adjacent to Terrible Creek (top of bank to 30 feet, shown in orange on Figure 2, Appendix A) and 250 lives stakes on both banks of Terrible Creek. Planted species and quantities of each are as follows.

Livestakes (planted on April 29, 2012)
250 black willow, *Salix nigra*
TOTAL 250 Livestakes

Containerized Trees (planted on April 29, 2012)
30 green ash, *Fraxinus pennsylvanica*
30 river birch, *Betula nigra*
30 swamp chestnut oak, *Quercus michauxii*
30 willow oak, *Quercus phellos*
30 sycamore, *Platanus occidentalis*
TOTAL 150 Containerized Trees

A growing population of blackberry (*Rubus* sp.) and baccharis (*Baccharis halimifolia*), located within the western end of the Site, is reducing stem densities.

Approximately 430 linear feet of outerbend within the Site shows some sign of bank sloughing/erosion or reduced integrity. However, when compared to preconstruction conditions the issue areas have not worsened and in general, the stream channel as a whole is trending toward more stable conditions. Cut banks tend to be relatively low (3-4 feet in height) and are associated with point/side bars that suggest the cross-sectional area is not increasing. Bank pins were installed on two outerbends ([outerbend 13 and outerbend 24] depicted as green stars on Figure 2, Appendix A) in January 2011 and were subsequently monitored in February 2012 and August 2012. Measurements indicated approximately 12 inches of sloughing from January 2011 to February 2012. Only one bank pin was found in August 2012 due to heavy herbaceous vegetation; this pin indicated minimal changes going from 4 inches of exposure in February 2012 to approximately 5 inches of exposure in August 2012. Bank pins will need to be reevaluated during the winter when herbaceous vegetation has died back and pins are easier to identify.

On April 14, 2013, three bank pins installed by EEP in January 2011 were located in outerbend 24; pins in outerbend 13 were not found. The downstream pin was exposed approximately 14 inches, and the two upstream pins (one located at top of bank and one lower on the bank) were exposed approximately 6 inches. Each pin was hammered flush with the surface of the bank.

Visual observation of the entire reach of Terrible Creek reveals very good in-stream habitat diversity including the following.

1. Large woody debris
2. Log sills
3. Undercut banks with root masses
4. Fine organic material (leaf packs and sticks)
5. Deep pools in bends
6. Coarse gravel (often associated with large wood or old dams)
7. Cobble inputs from channel bounded by a steep valley wall

Several small beaver dams located in the northern portion of the Site were removed in August 2009 (Appendix D); the larger dam located just off-site has also been removed, there are no signs of beaver activity in the vicinity. Beaver dams located within the Site were mapped on January 28, 2011 and subsequently removed (Appendix D).

Summary information and data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in table and figures within this report's appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on EEPs website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

2.0 METHODOLOGY

Sixteen vegetation plots (10-meters by 10-meters) were installed within the Site after planting was completed as depicted on Figure 2 (Current Conditions Plan View) in Appendix A. These plots were surveyed in September 2013 for the 2013 (year 6) monitoring season using the *CVS-EEP Protocol for Recording Vegetation, Version 4.2, Levels 1 and 2 Plot Sampling Only* (Lee et al. 2008) (http://cvs.bio.unc.edu/methods.htm); results are included in Appendix C. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007).

3.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

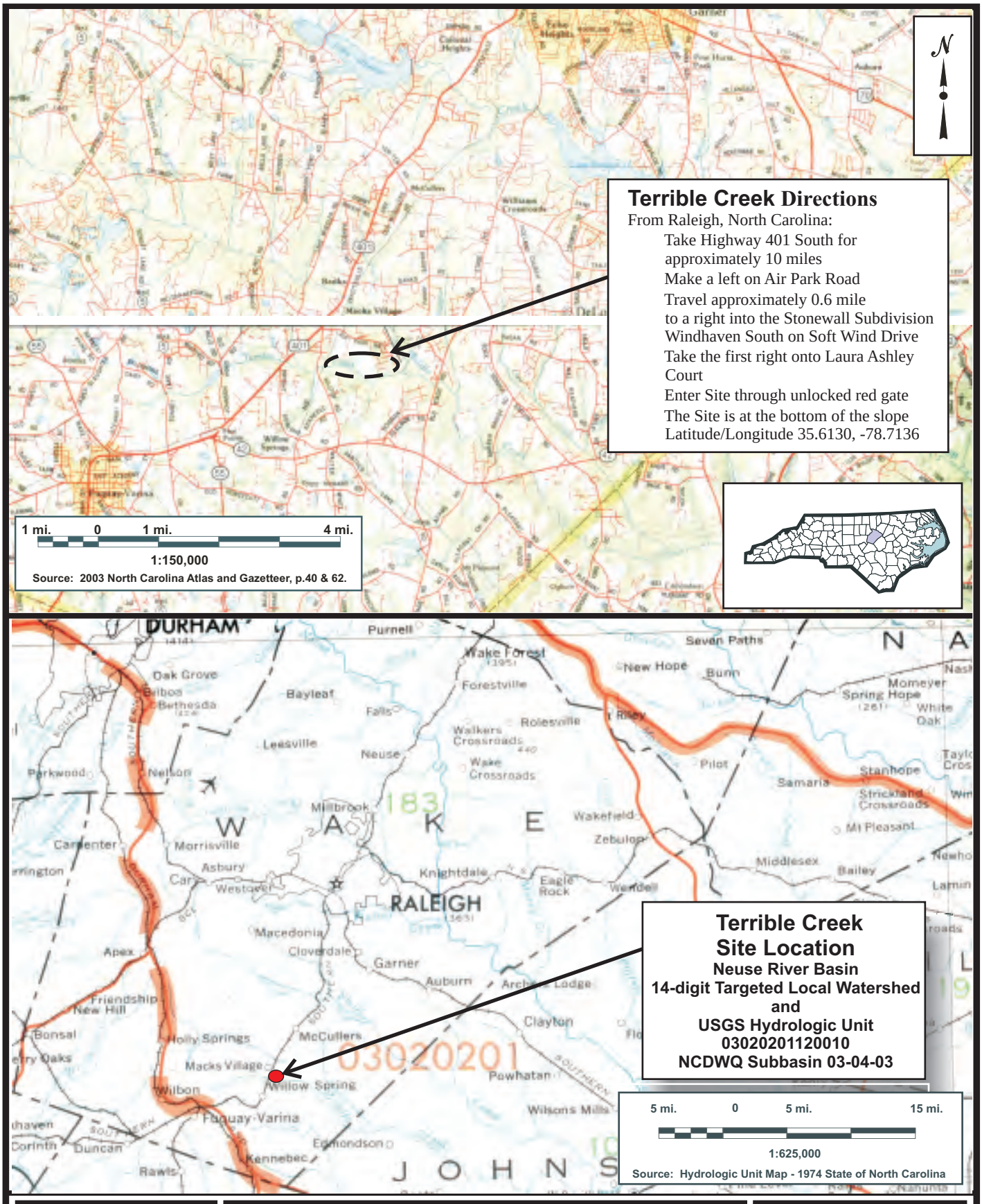
North Carolina Division of Water Quality (NCDWQ). 2007. Redbook, Surface Waters and Wetlands Standards. North Carolina Department of Environment and Natural Resources, Division of Water Quality. Raleigh, North Carolina.

United States Geological Survey (USGS). 1974. Hydrologic Unit Map - 1974. State of North Carolina.

Weakley, Alan S. 2007. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas (online). Available: http://www.herbarium.unc.edu/WeakleysFlora.pdf [February 1, 2008]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

APPENDIX A
FIGURES AND PLAN VIEWS

Figure 1. Site Location
Figure 2. Current Conditions Plan View
Figure 3. Vegetation Map



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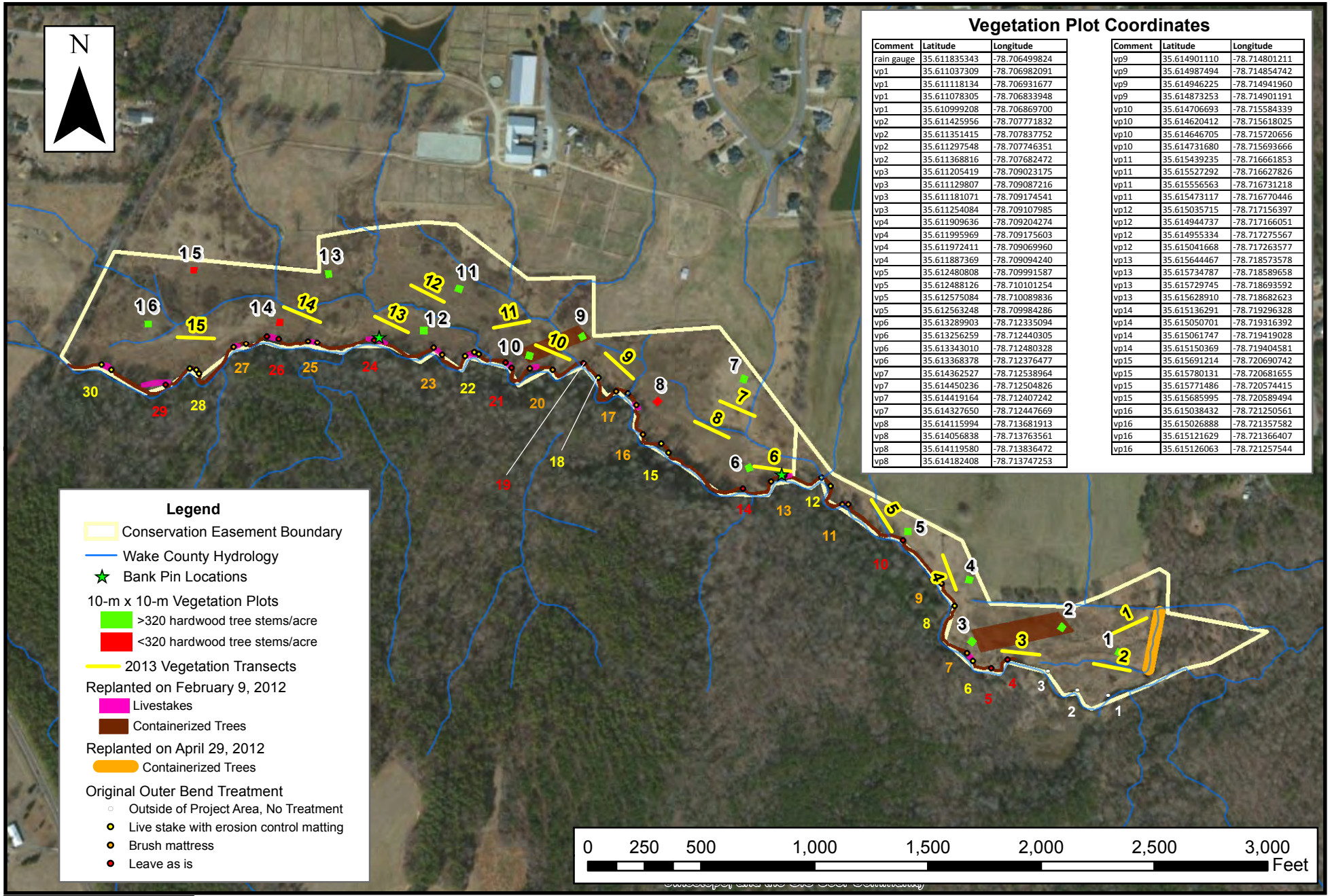
SITE LOCATION
TERRIBLE CREEK
ANNUAL MONITORING REPORT
Wake County, North Carolina

Dwn. by: CLF	FIGURE
Date: Aug 2010	1
Project: 09-010	



Vegetation Plot Coordinates

Comment	Latitude	Longitude
rain gauge	35.611835343	-78.706499824
vp1	35.611037309	-78.706982091
vp1	35.611118134	-78.706931677
vp1	35.611078305	-78.706833948
vp1	35.610999208	-78.706869700
vp2	35.611425956	-78.707771832
vp2	35.611351415	-78.707837752
vp2	35.611297548	-78.707746351
vp2	35.611368816	-78.707682472
vp3	35.611205419	-78.709023175
vp3	35.611129807	-78.709087216
vp3	35.611181071	-78.709174541
vp3	35.611254084	-78.709107985
vp4	35.611909636	-78.709204274
vp4	35.611995969	-78.709175603
vp4	35.611972411	-78.709069960
vp4	35.611887369	-78.709094240
vp5	35.612480808	-78.709991587
vp5	35.612488126	-78.710101254
vp5	35.612575084	-78.710089836
vp5	35.612563248	-78.709984286
vp6	35.613289903	-78.712335094
vp6	35.613256259	-78.712440305
vp6	35.613343010	-78.712480328
vp6	35.613368378	-78.712376477
vp7	35.614362527	-78.712538964
vp7	35.614450236	-78.712504826
vp7	35.614419164	-78.712407242
vp7	35.614327650	-78.712447669
vp8	35.614115994	-78.713681913
vp8	35.614056838	-78.713763561
vp8	35.614119580	-78.713836472
vp8	35.614182408	-78.713747253

Comment	Latitude	Longitude
vp9	35.614901110	-78.714801211
vp9	35.614987494	-78.714854742
vp9	35.614946225	-78.714941960
vp9	35.614873253	-78.714901191
vp10	35.614706693	-78.715584339
vp10	35.614620412	-78.715618025
vp10	35.614646705	-78.715720656
vp10	35.614731680	-78.715693666
vp11	35.615439235	-78.716661853
vp11	35.615527292	-78.716627826
vp11	35.615556563	-78.716731218
vp11	35.615473117	-78.716770446
vp12	35.615035715	-78.717156397
vp12	35.614944737	-78.717166051
vp12	35.614955334	-78.717275567
vp12	35.615041668	-78.717263577
vp13	35.615644467	-78.718573578
vp13	35.615734787	-78.718589658
vp13	35.615729745	-78.718693592
vp13	35.615628910	-78.718682623
vp14	35.615136291	-78.719296328
vp14	35.615050701	-78.719316392
vp14	35.615061747	-78.719419028
vp14	35.615150369	-78.719404581
vp15	35.615691214	-78.720690742
vp15	35.615780131	-78.720681655
vp15	35.615771486	-78.720574415
vp15	35.615685995	-78.720589494
vp16	35.615038432	-78.721250561
vp16	35.615026888	-78.721357582
vp16	35.615121629	-78.721366407
vp16	35.615126063	-78.721257544

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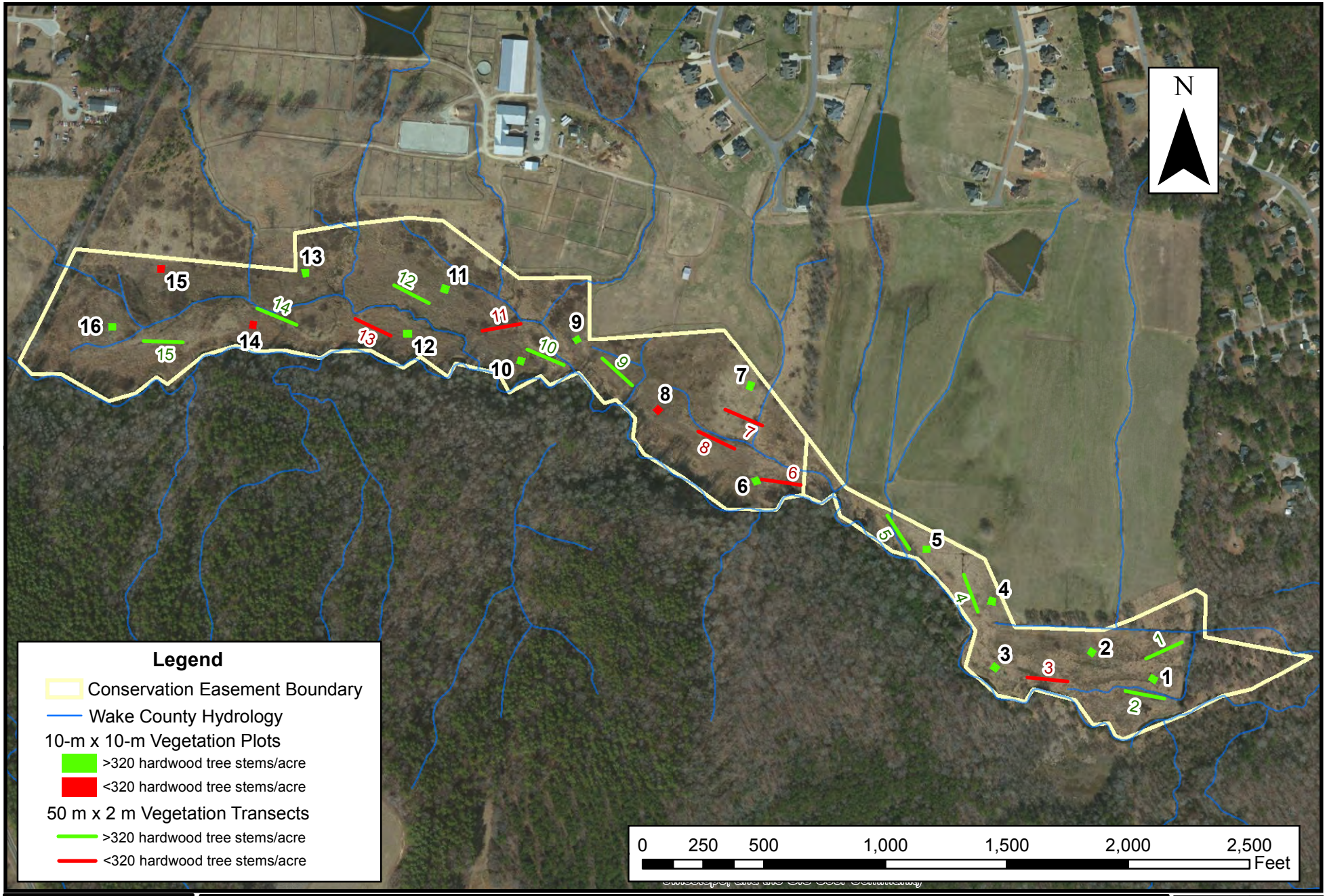
CURRENT CONDITIONS PLAN VIEW
TERRIBLE CREEK BUFFER RESTORATION SITE
Wake County, North Carolina

Dwn. by: CLF/KRJ
Date: Nov. 2013
Project: 12-004.01

FIGURE 2



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VEGETATION MAP
TERRIBLE CREEK BUFFER RESTORATION SITE
Wake County, North Carolina

Dwn. by:	CLF/KRJ
Date:	Nov. 2013
Project:	12-004.01

FIGURE 3

APPENDIX B
GENERAL PROJECT TABLES

Table 1. Site Restoration Structures and Objectives
Table 2. Project Activity and Reporting History
Table 3. Project Contacts Table
Table 4. Project Attributes Table

Table 1. Project Restoration Components

Project Segment or Reach ID	Existing Acreage	Mitigation Type	Approach	Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment
Riparian Buffer	45.6	Restoration	--	45.6	1	45.6	--	--

Mitigation Unit Summations

Stream	Riparian Wetland	Nonriparian Wetland	Total Wetland	Buffer	Comment
0	0	0	0	45.6	--

Table 2. Project Activity and Reporting History

Activity or Report	Data Collection Completion	Actual Completion or Delivery
Restoration Plan	---	July 2007
Construction	---	February 2008
Planting/Permanent Seed Mix Applied	---	February 2008
Mitigation Plan/As-built Report (Year 0 Monitoring – baseline)	---	June 2008
Year 1 Monitoring (2008)	September 2008	July 2009
Year 2 Monitoring (2009)	July 2009	August 2009
Conservation Easement Boundary Marking	---	March 2010
Year 3 Monitoring (2010)	July 2010	July 2010
Year 4 Monitoring (2011)	June 2011	August 2011
Supplemental Planting	---	February & April 2012
Year 5 Monitoring (2012)	August 2012	August 2012
Year 6 Monitoring (2013	September 2013	November 2013

Table 3. Project Contacts Table

Designer and Year 1-6 (2008-2013) Monitoring Performers	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis (919) 215-1693
Construction, Planting, and Seeding Contractor	Backwater Environmental PO Box 1654 Pittsboro, North Carolina 27312 Wes Newell (919) 523-4375

Table 4. Project Background Table	
Project County	Wake County, North Carolina
Drainage Area	13-square miles
Drainage impervious cover estimate (%)	< 10 percent
Stream Order	Terrible Creek-fourth order, UTs-first order
Physiographic Region	Piedmont
Ecoregion	Outer Piedmont
Rosgen Classification of As-built	Not Applicable
Cowardin Classification	Palustrine
Dominant Soil Types	Appling, Augusta, Chewacla, Wehadkee
Reference Site ID	Terrible Creek
USGS HUC for Project and Reference	03020201
NCDWQ Subbasin for Project and Reference	03-04-03
NCDWQ Classification for Project and Reference	C NSW
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	Not Applicable
% of project easement fenced	None

APPENDIX C

VEGETATION ASSESSMENT DATA

Table 5. Vegetation Plot Mitigation Success Summary

Vegetation Monitoring Plot Photos

Site Replanting Photographs

CVS Summary Data Tables

Table 6. Vegetation Metadata Table

Table 7. Total and Planted Stems by Plot and Species

Table 8. 2013 Vegetation Transect Data

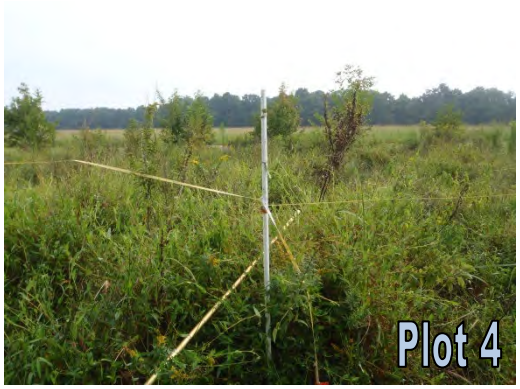
Vegetation Transect Photos

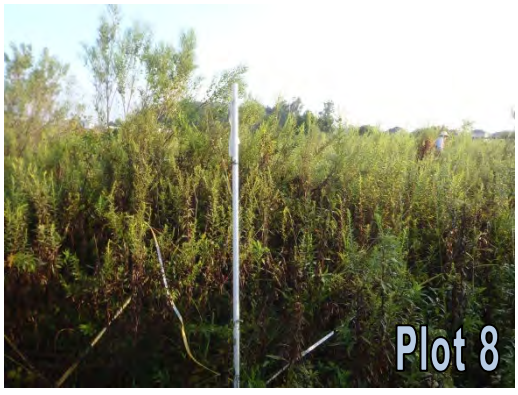
Table 5. Vegetation Plot Mitigation Success Summary based on Riparian Buffer Success

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	Yes	81.3%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	Yes	
7	Yes	
8	No*	
9	Yes	
10	Yes	
11	Yes	
12	Yes	
13	Yes	
14	No*	
15	No*	
16	Yes	

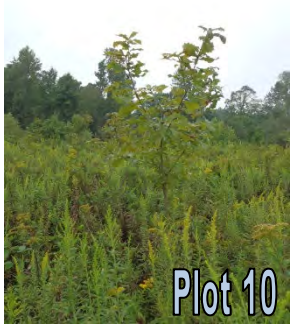
*When including naturally recruited hardwood tree stems these plots met success criteria.

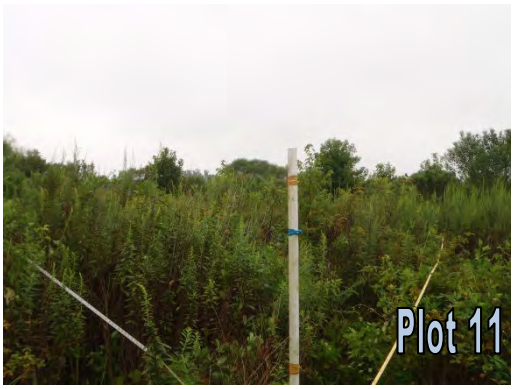
Terrible Creek Buffer Restoration
Year 6 (2013) Vegetation Plot Photographs
Taken September 2013





Terrible Creek Buffer Restoration
Year 6 (2013) Vegetation Plot Photographs (continued)
Taken September 2013





Terrible Creek Buffer Restoration
Site Replanting Photographs
Taken February 8 and 9, 2012

Table 6. Vegetation Metadata Table

Report Prepared By	Corri Faquin
Date Prepared	9/16/2013 15:29
database name	Axiom-EEP-2013-A-v2.3.1.mdb
database location	\\AE-SBS\RedirectedFolders\pperkinson\Desktop
computer name	PHILLIP-PC
file size	65798144
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	134
project Name	Terrible Creek Buffer (Fish Property) (G)
Description	Buffer Restoration Site
River Basin	Neuse
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	16

Table 7. Total and Planted Stems by Plot and Species
EEP Project Code 134. Project Name: Terrible Creek Buffer (Fish Property) (G)

			Current Plot Data (MY6 2013)																														
			E134-01-0001			E134-01-0002			E134-01-0003			E134-01-0004			E134-01-0005			E134-01-0006			E134-01-0007			E134-01-0008			E134-01-0009			E134-01-0010			E134-01-0011		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	**red maple**	**Tree**						3						18			4			2														2
Aesculus sylvatica	painted buckeye	Shrub																																
Asimina triloba	**pawpaw**	**Tree**																						2	2	2	2	2	2					
Baccharis halimifolia	eastern baccharis	Shrub																								4						1		
Betula nigra	**river birch**	**Tree**				7	7	7	2	2	2							1	1	1				1	1	1	6	6	6	4	4	4	1	1	1
Carya illinoinensis	**pecan**	**Tree**																																
Carya ovata	**shagbark hickory**	**Tree**																																
Celtis	**hackberry**	**Tree**																																
Celtis laevigata	**sugarberry**	**Tree**				1	1	1							1	1	1	1	1	1													1	1	1
Cephalanthus	buttonbush	Shrub																																
Cephalanthus occidentalis	common buttonbush	Shrub	3	3	3							1	1	1										6	6	6	3	3	3						
Diospyros virginiana	**common persimmon**	**Tree**				1	1	2			1															1			1				1	1	1
Fraxinus	**ash**	**Tree**																																
Fraxinus pennsylvanica	**green ash**	**Tree**	3	3	3	2	2	2	4	4	4	6	6	6	3	3	3	1	1	1							3	3	3	1	1	1			
Ilex verticillata	common winterberry	Shrub																																
Juglans nigra	**black walnut**	**Tree**													3	3	3																	
Liquidambar	**sweetgum**	**Tree**																																
Liquidambar styraciflua	**sweetgum**	**Tree**						8																					2			4			5
Liriodendron tulipifera	**tuliptree**	**Tree**																																
Morus	**mulberry**	**Tree**																					1											
Oxydendrum arboreum	**sourwood**	**Tree**																																
Pinus taeda	loblolly pine	Tree																																1
Platanus	**sycamore**	**Tree**																																
Platanus occidentalis	**American sycamore**	**Tree**													4	4	4	3	3	3										2	2	2			
Prunus serotina	**black cherry**	**Tree**																																
Pyrus calleryana	Callery pear	Exotic						1																					1					
Quercus	**oak**	**Tree**																																
Quercus lyrata	**overcup oak**	**Tree**																												1	1	1			
Quercus michauxii	**swamp chestnut oak**	**Tree**				1	1	1	1	1	1	2	2	2				1	1	1	3	3	3	1	1	1	1	1	1				4	4	4
Quercus nigra	**water oak**	**Tree**																												1	1	1			
Quercus pagoda	**cherrybark oak**	**Tree**	5	5	5	2	2	2	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1				7	7	7	1	1	1
Quercus phellos	**willow oak**	**Tree**							4	4	4																2	2	2						
Quercus rubra	**northern red oak**	**Tree**																									1	1	1	1	1	1			
Rhus	sumac	shrub																																
Rhus copallinum	flameleaf sumac	shrub																																
Sambucus canadensis	Common Elderberry	Shrub																																
Ulmus	**elm**	**Tree**																			6	6	16	2	2	2			1						
Ulmus alata	**winged elm**	**Tree**																			4	4	4												
Ulmus americana	**American elm**	**Tree**			1																														
Unknown		Shrub or Tree																																
Totals		**Stem count**	11	11	12	14	14	27	12	12	13	10	10	28	11	11	15	8	8	10	14	14	25	13	13	18	18	18	23	17	17	22	8	8	16
		size (ares)	1			1			1			1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	3	3	4	6	6	9	5	5	6	4	4	5	4	4	5	6	6	7	4	4	5	6	6	8	7	7	11	7	7	9	5	5	8
		Stems per ACRE	445.2	445.2	485.6	566.6	566.6	1093	485.6	485.6	526.1	404.7	404.7	1133	445.2	445.2	607	323.7	323.7	404.7	566.6	566.6	1012	526.1	526.1	728.4	728.4	728.4	930.8	688	688	890.3	323.7	323.7	647.5
Riparian Buffer Success		**Stem count**	8	8	9	14	14	26	12	12	13	9	9	27	11	11	15	8	8	10	14	14	25	7	7	8	15	15	19	17	17	21	8	8	15
		size (ares)	1			1			1			1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	2	2	3	6	6	8	5	5	6	3	3	4	4	4	5	6	6	7	4	4	5	5	5	6	6	6	9	7	7	8	5	5	7
		Stems per ACRE	323.7	323.7	364.2	566.6	566.6	1052	485.6	485.6	526.1	364.2	364.2	1093	445.2	445.2	607	323.7	323.7	404.7	566.6	566.6	1012	283.3	283.3	323.7	607	607	768.9	688	688	849.8	323.7	323.7	607

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes
P-all = Planting including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

Table 7. Total and Planted Stems by Plot and Species (continued)
EEP Project Code 134. Project Name: Terrible Creek Buffer (Fish Property) (G)

Current Plot Data (MY6 2013)																		Annual Means																	
			E134-01-0012			E134-01-0013			E134-01-0014			E134-01-0015			E134-01-0016			MY6 (2013)			MY5 (2012)			MY4 (2011)			MY3 (2010)			MY2 (2009)			MY1 (2008)			MY0 (2008)		
Scientific Name	**Common Name**	**Species Type**	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	**red maple**	**Tree**						4			5						9			47			31			20			148			17			1			
Aesculus sylvatica	painted buckeye	Shrub																								1											
Asimina triloba	**pawpaw**	**Tree**	1	1	1													5	5	5	6	6	6	9	9	9	16	16	16	17	17	17	20	20	20	46	46	46
Baccharis halimifolia	eastern baccharis	Shrub			2			7			7			5			2			28			29			20			25			18					
Betula nigra	**river birch**	**Tree**																22	22	22	28	28	28	22	22	22	2	2	2	2	2	3	2	2	2	2	2	2
Carya illinoinensis	**pecan**	**Tree**																											1			2			1		
Carya ovata	**shagbark hickory**	**Tree**																						1	1	1	1	1	1	1	1	1	5	5	5	7	7	7
Celtis	**hackberry**	**Tree**																															4	4	4			
Celtis laevigata	**sugarberry**	**Tree**																4	4	4	5	5	5	10	10	10	9	9	9	9	9	9	9	9	9	18	18	18
Cephalanthus	buttonbush	Shrub																															8	8	10			
Cephalanthus occidentalis	common buttonbush	Shrub																13	13	13	16	16	16	18	18	30	16	16	18	10	10	13						4
Diospyros virginiana	**common persimmon**	**Tree**																2	2	6	2	2	2	1	1	1	1	1	3	1	1	1	1	1	1			
Fraxinus	**ash**	**Tree**																														1	3	3	3			
Fraxinus pennsylvanica	**green ash**	**Tree**				2	2	2	1	1	1	4	4	4	6	6	8	36	36	38	37	37	39	31	31	31	23	23	26	23	23	27	21	21	22	47	47	47
Ilex verticillata	common winterberry	Shrub																											2								
Juglans nigra	**black walnut**	**Tree**							1	1	1							4	4	4	5	5	5	5	5	5	3	3	4	3	3	3	1	1	1	5	5	5
Liquidambar	**sweetgum**	**Tree**																																	3			
Liquidambar styraciflua	**sweetgum**	**Tree**			3			4						14			13			53			17			121			16			5					
Liriodendron tulipifera	**tuliptree**	**Tree**			1															1									1								
Morus	**mulberry**	**Tree**																		1																	
Oxydendrum arboreum	**sourwood**	**Tree**																								1											
Pinus taeda	loblolly pine	Tree												1						2			1														
Platanus	**sycamore**	**Tree**																															7	7	7			
Platanus occidentalis	**American sycamore**	**Tree**							1	1	1							10	10	10	10	10	10	10	10	10	10	10	10	9	9	9	1	1	1			
Prunus serotina	**black cherry**	**Tree**																											1			1					
Pyrus calleryana	Callery pear	Exotic						1												3												2			1		
Quercus	**oak**	**Tree**																			1	1	1							2	2	2	5	5	5	134	134	134
Quercus lyrata	**overcup oak**	**Tree**																1	1	1	1	1	1														
Quercus michauxii	**swamp chestnut oak**	**Tree**	5	5	5							2	2	2	4	4	4	25	25	25	24	24	24	25	25	25	25	25	25	29	29	29	30	30	30			
Quercus nigra	**water oak**	**Tree**																1	1	1	1	1	1														
Quercus pagoda	**cherrybark oak**	**Tree**	2	2	2	11	11	11	3	3	3	1	1	1	4	4	4	41	41	41	41	41	41	40	40	40	39	39	39	41	41	41	42	42	42			
Quercus phellos	**willow oak**	**Tree**																6	6	6	5	5	5														
Quercus rubra	**northern red oak**	**Tree**																2	2	2	2	2	2														
Rhus	sumac	shrub																					1														
Rhus copallinum	flameleaf sumac	shrub																											1								
Sambucus canadensis	Common Elderberry	Shrub																											5								
Ulmus	**elm**	**Tree**												1	1	1	2	9	9	22	8	8	11						17			5					
Ulmus alata	**winged elm**	**Tree**																4	4	4	4	4	4														
Ulmus americana	**American elm**	**Tree**						1							2	2	2	2	2	4																	
Unknown		Shrub or Tree																															1	1	1	6	6	6
Totals		**Stem count**	8	8	14	13	13	30	6	6	18	7	7	28	17	17	44	187	187	343	196	196	280	172	172	347	145	145	370	147	147	206	160	160	169	265	265	269
		size (ares)	1			1			1			1			1			16			16			16			16			16			16			16		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.40			0.40			0.40			0.40			0.40			0.40			0.40		
		Species count	3	3	6	2	2	7	4	4	6	3	3	7	5	5	8	17	17	24	17	17	22	11	11	16	11	11	21	12	12	20	16	16	20	8	8	9
		Stems per ACRE	323.7	323.7	566.6	526.1	526.1	1214	242.8	242.8	728.4	283.3	283.3	1133	688	688	1781	473	473	867.5	495.7	495.7	708.2	435	435	877.7	366.7	366.7	935.8	371.8	371.8	521	404.7	404.7	427.4	670.3	670.3	680.4
Riparian Buffer Success		**Stem count**	8	8	12	13	13	22	6	6	11	7	7	22	17	17	42	174	174	297	180	180	233	154	154	296	129	129	319	137	137	173	151	151	157	259	259	259
		size (ares)	1			1			1			1			1			16			16			16			16			16			16			16		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.40			0.40			0.40			0.40			0.40			0.40			0.40		
		Species count	3	3	5	2	2	5	4	4	5	3	3	5	5	5	7	16	16	20	16	16	18	10	10	13	10	10	16	11	11	17	14	14	17	7	7	7
		Stems per ACRE	323.7	323.7	485.6	526.1	526.1	890.3	242.8	242.8	445.2	283.3	283.3	890.3	688	688	1700	440.1	440.1	751.2	455.3	455.3	589.3	389.5	389.5	748.7	326.3	326.3	806.8	346.5	346.5	437.6	381.9	381.9	397.1	655.1	655.1	655.1

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

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T = All planted and natural recruits including livestakes
T includes natural recruits

Table 8. 2013 Vegetation Transect Data
Terrible Creek

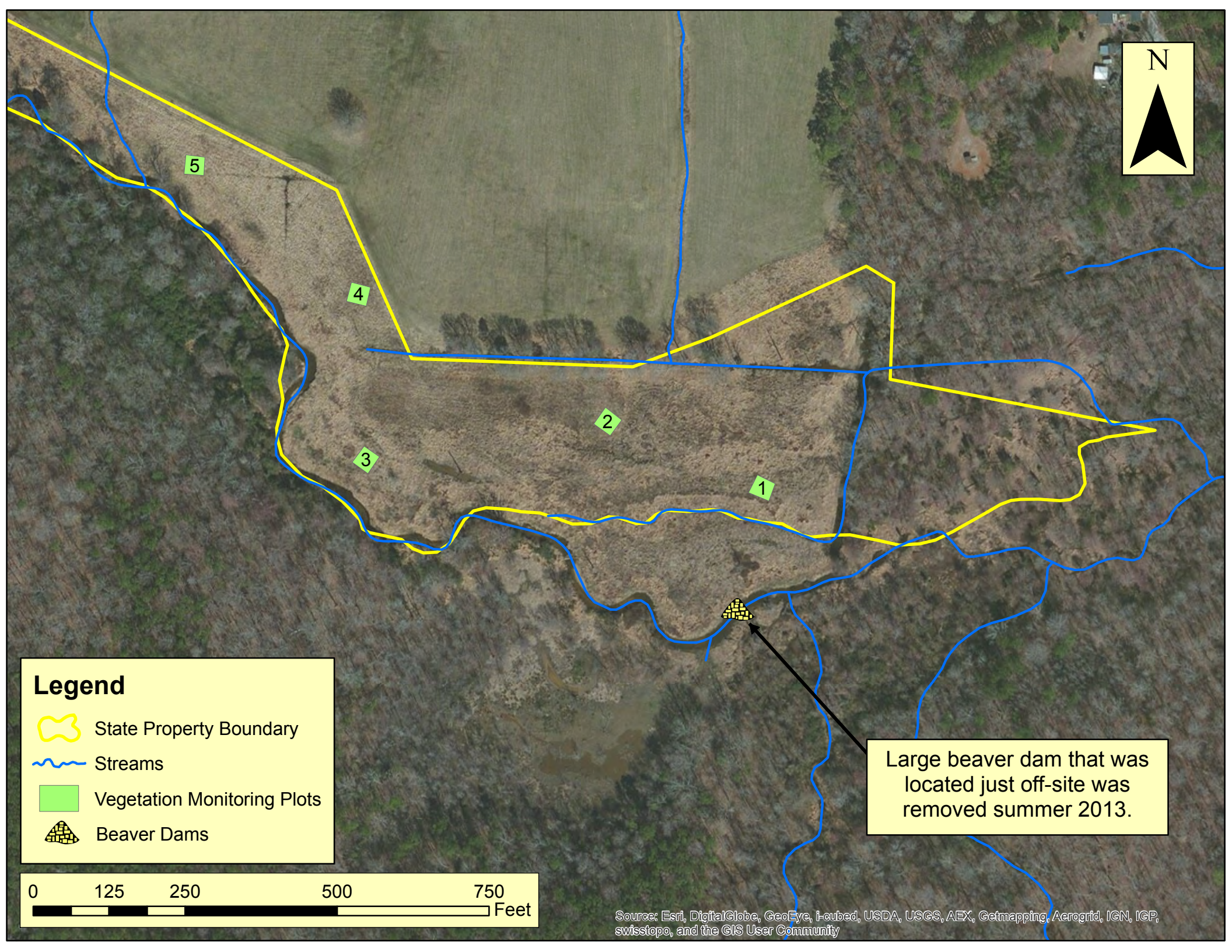
Transect	Size	Acreage	Total Number Hardwood Stems	Total Hardwood Stems/Acre
1	50m x 2m	0.0247	8	324
2	50m x 2m	0.0247	10	405
3	50m x 2m	0.0247	7	283
4	50m x 2m	0.0247	14	567
5	50m x 2m	0.0247	14	567
6	50m x 2m	0.0247	7	283
7	50m x 2m	0.0247	4	162
8	50m x 2m	0.0247	2	81
9	50m x 2m	0.0247	21	850
10	50m x 2m	0.0247	9	364
11	50m x 2m	0.0247	3	121
12	50m x 2m	0.0247	11	445
13	50m x 2m	0.0247	6	243
14	50m x 2m	0.0247	11	445
15	50m x 2m	0.0247	12	486
TOTALS		**0.37**	**139**	**375**

Terrible Creek Buffer Restoration
Year 6 (2013) Vegetation Plot Photographs
Taken October 9, 2013

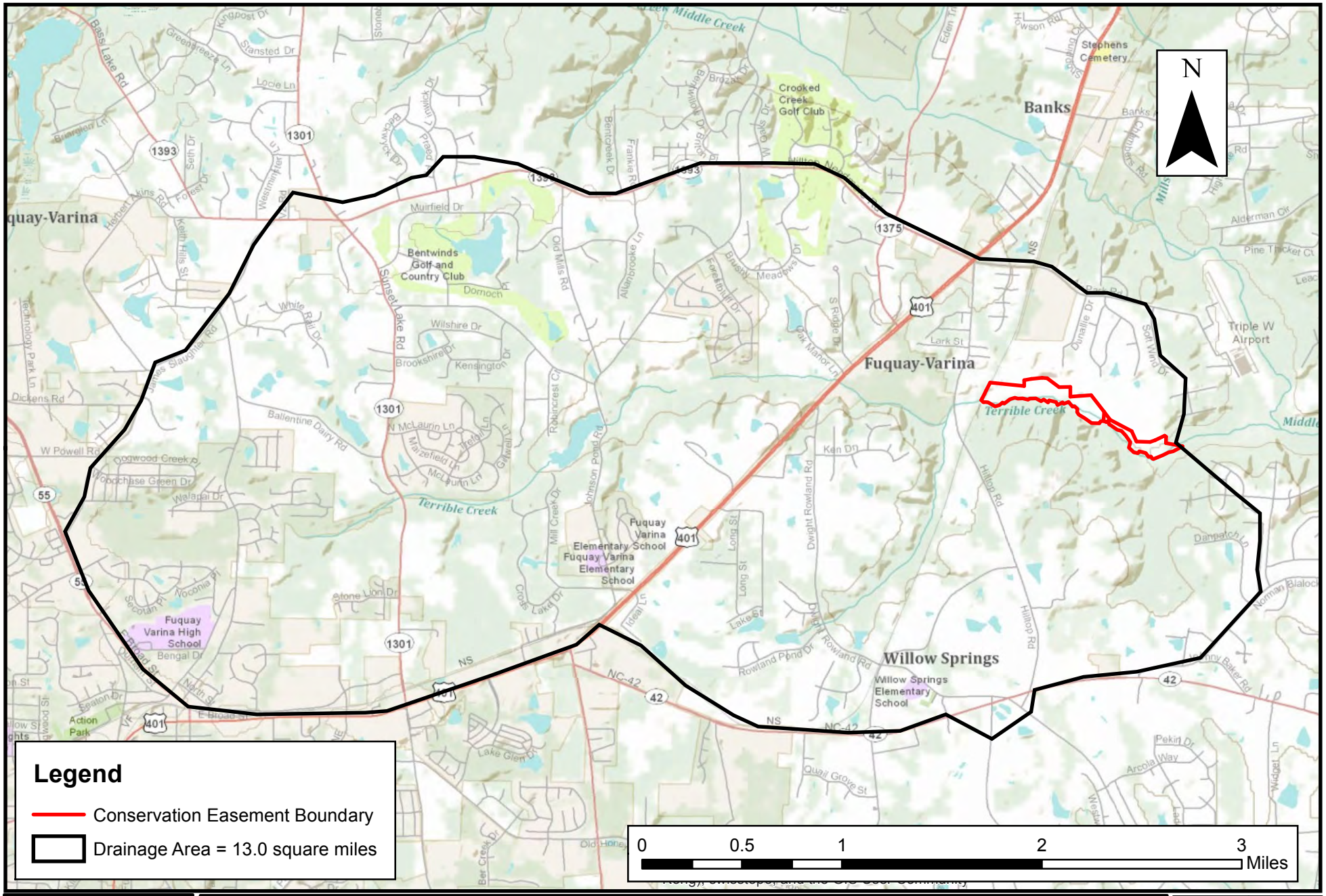
Terrible Creek Buffer Restoration
Year 6 (2013) Vegetation Plot Photographs (continued)
Taken October 9, 2013

Terrible Creek Buffer Restoration
Year 6 (2013) Vegetation Plot Photographs (continued)
Taken October 9, 2013

APPENDIX D
BEAVER MANAGEMENT INFORMATION
2013 Map of Removed Beaver Dams


N
5
4
3
2
1
Legend
State Property Boundary
Streams
Vegetation Monitoring Plots
Beaver Dams
0
125
250
500
750
Feet
Large beaver dam that was located just off-site was removed summer 2013.
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

APPENDIX E
ADDITIONAL SITE MAPPING
Figure 4: Drainage Area Map (USGS Topo Map)
Figure 5: Soils Map

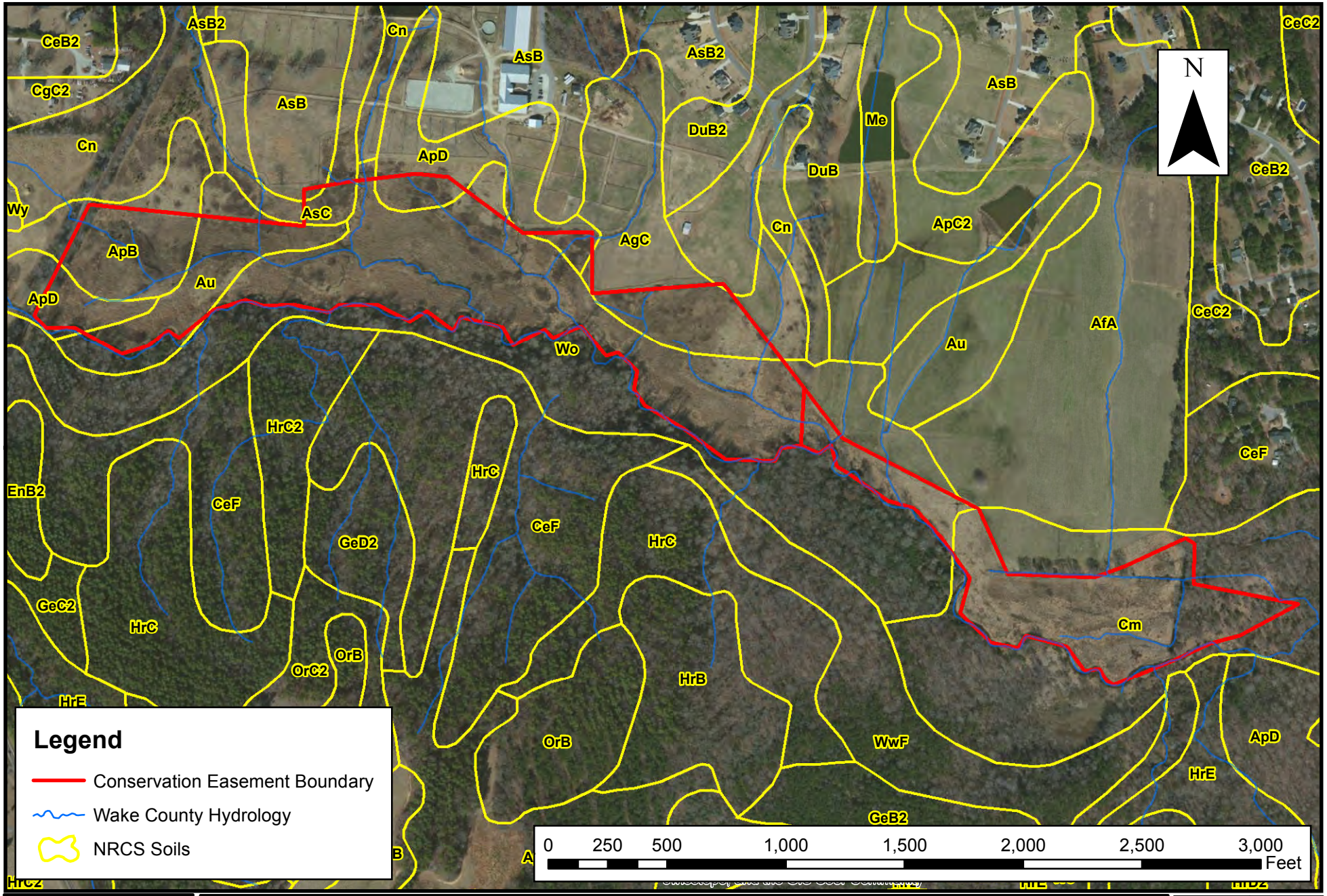


Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, NC 27603
(919) 215-1693

DRAINAGE AREA MAP
TERRIBLE CREEK BUFFER RESTORATION SITE
Wake County, North Carolina

Dwn. by: CLF/KRJ
Date: Nov. 2013
Project: 12-004.01

FIGURE 4



Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, NC 27603
(919) 215-1693

SOILS MAP
TERRIBLE CREEK BUFFER RESTORATION SITE
Wake County, North Carolina

Dwn. by: CLF/KRJ
Date: Nov. 2013
Project: 12-004.01

FIGURE 5

APPENDIX F
ADDITIONAL SITE PHOTOGRAPHS
Preconstruction Photographs
Asbuilt Photographs

Terrible Creek Buffer Restoration
Preconstruction Photographs
Taken July, 2006

Terrible Creek Buffer Restoration
Asbuilt Photographs
Taken January and July, 2008