



**MONITORING YEAR 4
ANNUAL REPORT
Final**

BUCKWATER BUFFER MITIGATION SITE
Orange County, NC

NCDEQ Contract No. 006829
DMS Project Number 97084
NCDWR Project Number 2016-0406

Data Collection Period: October 2022 Draft
Submission Date: November 11, 2022 Final
Submission Date: January 10, 2023

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BUCKWATER BUFFER MITIGATION SITE

Monitoring Year 4 Report

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Section 1: PROJECT OVERVIEW

1.1 Project Summary

Wildlands Engineering, Inc. (Wildlands) implemented a full delivery project at the Buckwater Mitigation Site (Site) for the North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) to restore a total of 16,276 linear feet of perennial and intermittent streams in Orange County, NC. The Site included the restoration of Buckwater Creek and 14 unnamed tributaries. The project also restored, enhanced, and preserved a total of 36.03 acres (1,569,567 ft²) of riparian buffer at the Site, which will provide Riparian Buffer Credits and Nutrient Offset Credits. The Site is located approximately 4.5 miles northeast of Hillsborough, NC (Figure 1) in the Neuse River Basin 8-Digit Hydrologic Unit Code (HUC) 03020201 and NC Division of Water Resources (NCDWR) Subbasin 03-04-01 and is within the DMS-targeted HUC 03020201030030. The Site streams drain to the Eno River, which flows to Falls Lake, and are classified as Water Supply Waters (WS-IV) and Nutrient Sensitive Waters (NSW).

Work at the Site was planned, designed, and constructed per the Buckwater Mitigation Plan (Wildlands, 2017) and the Consolidated Buffer Mitigation Rule 15A NCAC 02B .0295 (effective November 1, 2015). The purpose of the riparian buffer restoration is to provide riparian buffer credits to compensate for buffer impacts within the HUC 03020201 and the Falls Lake Watershed. The service area for the Riparian Buffer and Nutrient Offset Credits is depicted in Figure 2. The mitigation credits generated from the Site are listed in Tables 1a and 1b and shown in Figure 3.

1.2 Project Goals and Objectives

Prior to construction activities, the primary causes of Site degradation were stream channelizing and livestock grazing/agriculture, both of which originated prior to 1938. Agricultural activity remained intensive through the 1990s with several thousand beef cattle and three hog houses. Currently, approximately 100 cows graze on two properties and non-forested land is used for cultivating hay. Several ponds along Buckwater Creek, T3, and T5 were built between 1938 and 1955. According to 1955 aerial photography, the top 1,000 feet of Buckwater Creek on the Site was channelized. Landowners maintained lower Buckwater Creek below Walnut Hill Drive as a straightened channel until the 1990s.

The major goals of the buffer project are to provide ecological and water quality enhancements to the Neuse River Basin within the Falls Lake Water Supply Watershed by creating a functional riparian corridor and restoring the riparian buffer. This project supports specific goals identified in the 2010 Neuse River Basin Restoration Priorities Plan (RBRP) (Breeding, 2010) for the Neuse River Targeted Local Watershed. This document highlights the importance of riparian buffers for stream restoration projects. Riparian buffers immobilize and retain nutrients and suspended sediment. The RBRP also supports the Falls Lake Watershed Plan. Specific enhancements to water quality and ecological processes are outlined below:

- Decrease nutrient levels - Nutrient inputs will be decreased by filtering runoff from the agricultural fields through restored, native buffer zones. Nutrient inputs will also be absorbed on-site by native vegetation, further reducing nutrient inputs to waters of the Neuse River Basin.
- Decrease sediment input - Sediment loading will be deposited on restored floodplain areas, thereby reducing sediment inputs to Falls Lake.
- Create higher quality terrestrial habitat - Buffer areas will be restored by removing invasive vegetation and planting native vegetation. A variety of native vegetation will improve wildlife habitat.
- Permanently protect the Site from harmful uses - Establish a conservation easement on the Site, which will protect aquatic habitat and reduce pollutant loading to a water supply.



The 51.84-acre Site is protected with a permanent conservation easement. Of the 51.84 acres, Neuse Riparian Buffer Credits were generated by restoring 21.80 acres, preserving 8.66 acres, and enhancing 5.57 acres. The remaining 15.81 acres will not generate buffer mitigation credit. In general, riparian buffer restoration widths extend 200 feet from the stream channels' top of bank for Neuse River Riparian Buffer Credits. Figure 3 details the buffer credit generation.

1.3 Monitoring Year 4 Data Assessment

The Mitigation Plan (Wildlands, 2017) was submitted and accepted by DMS in December 2017. Construction activities by Ecotone, Inc. were finished in April 2019. The planting was completed by Bruton Natural Systems, Inc. in April 2019. The baseline as-built survey was completed by Turner Land Surveying in July 2019. Monitoring Year 1 (MY1) survey was completed in October 2019, MY2 survey was completed in September 2020, MY3 survey was completed in October 2021, and MY4 survey was completed in October 2022. Refer to Appendix 1 for detailed project activity, history, contact information, and watershed/site background information.

Vegetative performance for buffer restoration areas will be in accordance with 15A NCAC 02B .0295(n)(2)(B), and (n)(4) (effective November 1, 2015). To meet success criteria, areas generating buffer mitigation credits shall include a minimum of four native hardwood tree species, where no one species is greater than 50 percent of stems, and shall have a survival of at least 260 stems per acre at the end of the required five-year monitoring period. For the monitoring to be complete and buffer credit to be awarded, NCDWR must provide written approval of successful revegetation of buffer restoration areas.

1.3.1 Vegetative Assessment

The quantity of monitoring vegetation plots was determined in accordance with Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008) such that at least 2 percent of the Site is encompassed in monitoring plots. A total of 19 vegetation plots (10 meters by 10 meters) were established within the conservation easement boundaries and at least five feet from the top of stream banks. The plot corners have been marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs are taken at the origin looking diagonally across the plot to the opposite corner on an annual basis. Trees are annually marked with flagging tape. Also annually, species composition, vigor, height, density, and survival rates are evaluated by plot. As necessary, the extent of invasive species coverage is monitored and controlled.

The 2022 annual vegetation monitoring resulted in an average survival of 396 planted stems per acre. This is greater than the final requirement of 260 stems per acre, but approximately 34% less than the baseline density (MY0) recorded (601 planted stems per acre) in April 2019. There is an average of 9 stems per plot as compared to 15 stems per plot in MY0. A total of 17 of the 19 vegetation plots currently meet the final success criteria (260 stems per acre) required for MY5. Vegetation plots 8 and 18 do not meet the final success criteria with 243 and 202 planted stems per acre, respectively. Despite the mortality of planted stems in these plots the number of desirable volunteer species remains high. When accounting for volunteers each of these plots surpass the success criteria with the number of stems per acre totaling 728 and 688, respectively. Volunteer species include sweetgum (*Liquidambar styraciflua*) in vegetation plot 8 and American Elm (*Ulmus americana*), sycamore (*Platanus occidentalis*), loblolly pine (*Pinus taeda*), Eastern red cedar (*Juniperus virginiana*) and sweetgum in vegetation plot 18. Along with a diverse and developing successional canopy, the herbaceous vegetation is dense and providing wildlife habitat. These plots seem to be outliers from their surrounding areas and not considered an area of concern.



Refer to Appendix 3 for vegetation plot criteria attainment data, CVS vegetation plot metadata, and vegetation summary tables and Appendix 2 for vegetation plot photographs, vegetation condition assessment table, and monitoring plan view.

1.3.2 Vegetation Areas of Concern

Based on visual observations, Wildlands was concerned about lack of species diversity along portions of T3 and T7. With this in mind, Wildlands created and received approval from the IRT to supplementally plant 4.3 acres across the Site (Appendix 5). The supplemental planting occurred on November 7, 2022. Bone meal and Terrasorb (water retention beads) were added to each hole before the tree was planted to help establishment. Further amendments and management actions such as ring sprays are planned for the upcoming monitoring year.

Several small areas totaling 1.72 acres of Chinese privet (*Ligustrum sinense*) growth were noted along Buckwater Creek Reach 7 and T4. An invasive removal of these areas will be scheduled in 2023.

1.4 Monitoring Year 4 Summary

A total of 17 of the 19 vegetation plots exceeded the MY5 final success criteria. While the tree mortality of planted stems in vegetation plots 8 and 18 increased, the number of volunteer species have also increased. Despite the mortality of planted stems in vegetation plots 8 and 18 the total number of stems per acre and species diversity in each of the plots remains high. When including volunteer species, all vegetation plots exceed performance criteria. Vegetation has become well established along the stream banks providing shade, stability, and a source of organic material. An approved supplemental planting occurred on November 7, 2022. Further management actions are planned in MY5 to ensure tree survivability and growth. An invasive vegetation treatment will be scheduled for 2023 to address scattered populations of Chinese privet. Summary information/data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information, formerly found in these reports, can be found in the Mitigation Plan (Wildlands, 2017) available on DMS's website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 2: REFERENCES

Breeding, R. 2010. Neuse River Basin Restoration Priorities. North Carolina Ecosystem Enhancement Program.

Lee, Michael T. Peet, Robert K., Steven D. Wentworth, Thomas R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. <http://cvs.bio.unc.edu/protocol/cvs-EEP-protocol-v4.2-lev1-2.pdf>

http://portal.ncdenr.org/c/document_library/get_file?uuid=864e82e8-725c-415e-8ed9-c72dfcb55012&groupId=60329

North Carolina Department of Environmental Quality, Division of Mitigation Services (NCDMS), 2017. Riparian Buffer and Nutrient Offset Buffer Baseline and Annual Monitoring Report Template version 2.0

Wildlands Engineering, Inc. (2017). Buckwater Mitigation Project Mitigation Plan. DMS, Raleigh, NC.



APPENDIX 1. General Figures and Tables

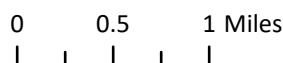
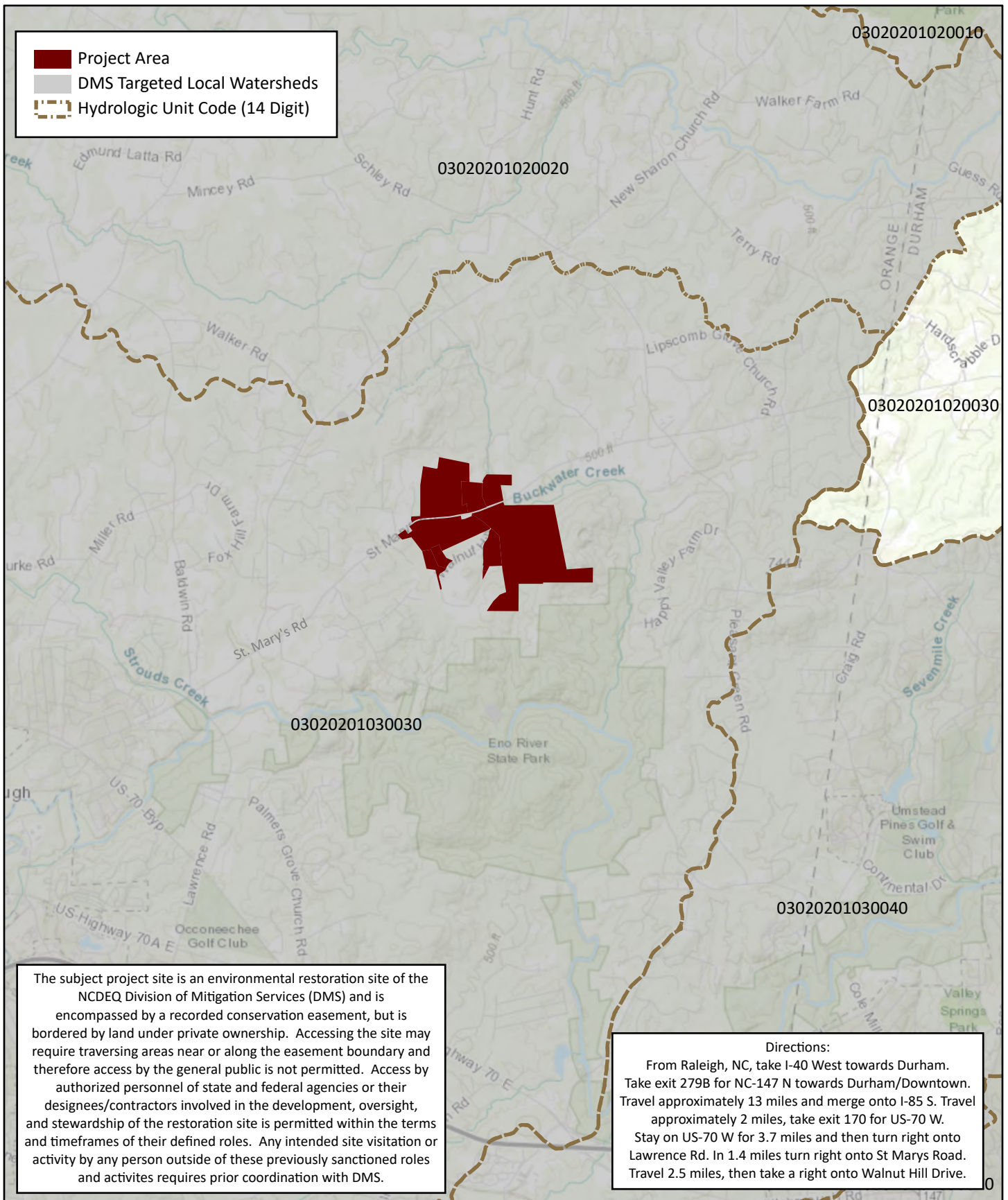


Figure 1. Project Vicinity Map
 Buckwater Buffer Mitigation Site
 Monitoring Year 4 - 2022
 Neuse River Basin (03020201)
 Orange County, NC

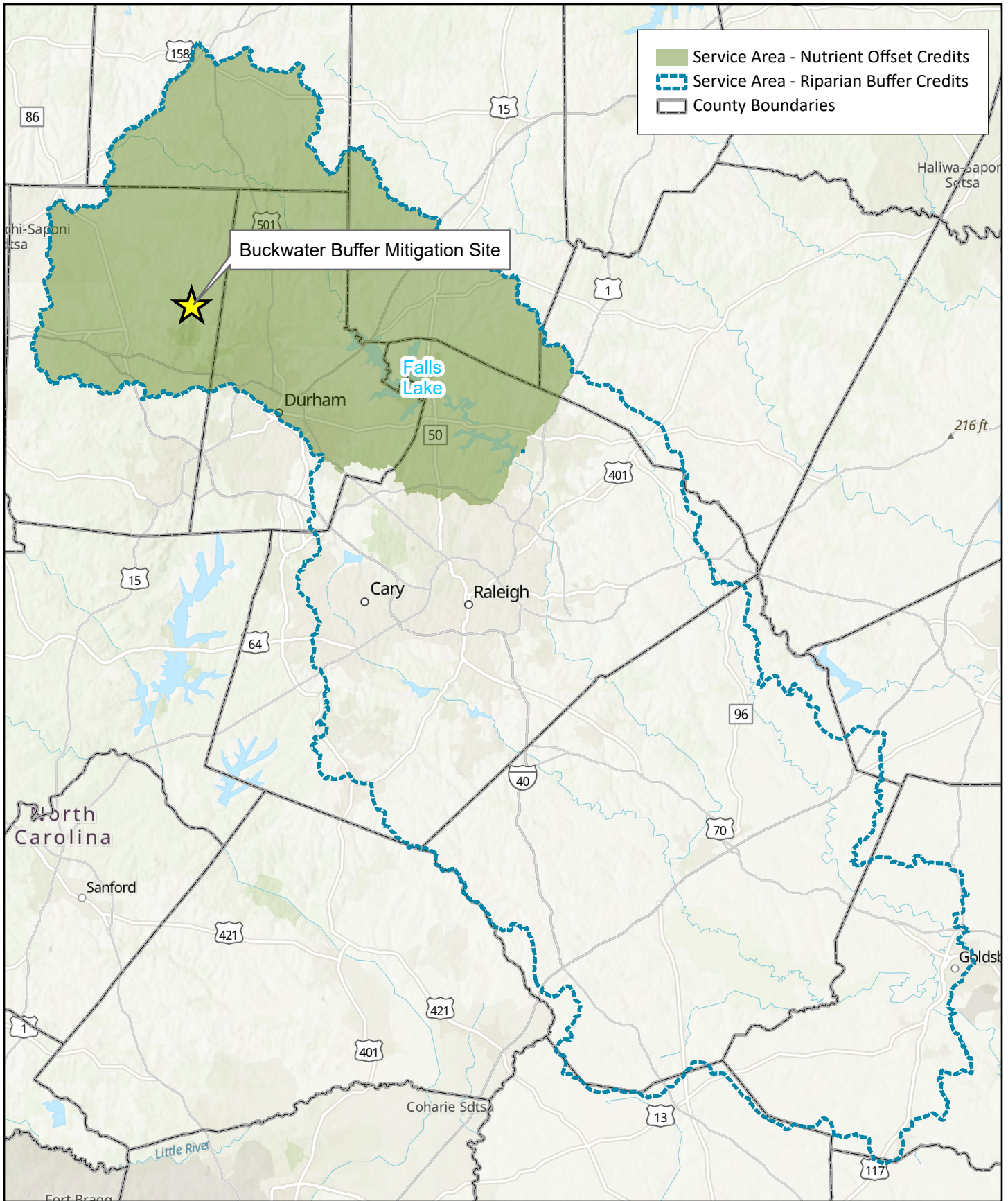
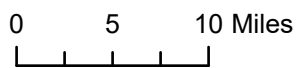


Figure 2. Service Area
 Buckwater Buffer Mitigation Site
 Monitoring Year 4 - 2022
 Neuse River Basin (03020201)
 Orange County, NC



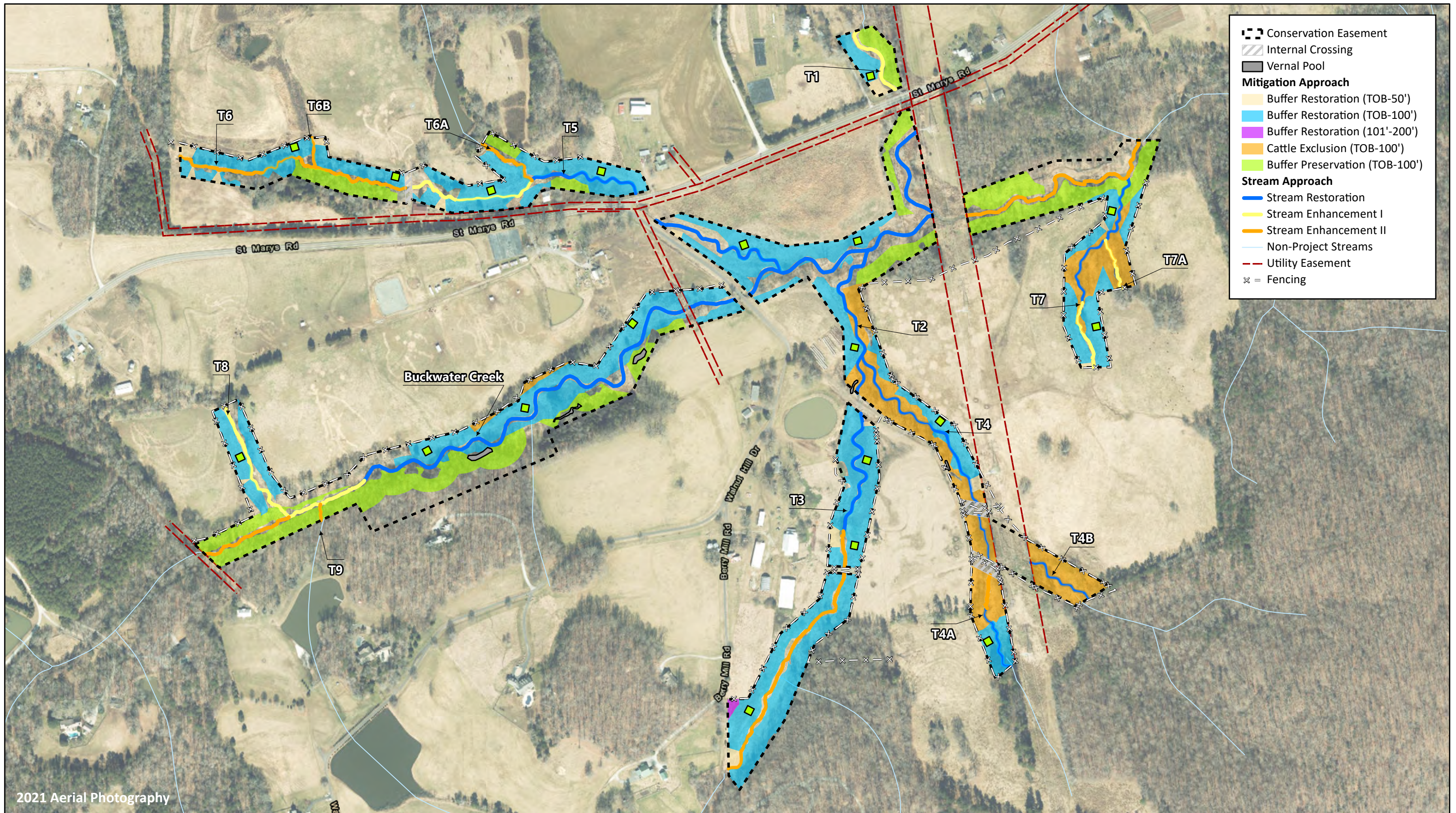


Table 1a. Buffer Project Areas and Assets

Buckwater Buffer Mitigation Site

DMS Project No. 97084

Monitoring Year 4 - 2022

Location	Jurisdictional Streams	Method	Feature Name	Min-Max Buffer Width (ft)	Total Area (sf)*	Creditable Area (sf)	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits
Rural	Subject	Restoration	Buffer Area E	20-29	27,683	27,683	1	75%	1.33333	20,762.302
Rural	Subject	Restoration	Buffer Area A	0-100	919,068	919,068	1	100%	1.00000	919,068.000
Rural	Subject	Restoration	Buffer Area B	101-200	2,899	2,899	1	33%	3.03030	956.671
Rural	Subject	Cattle Exclusion	Buffer Area C	0-100	242,491	242,491	2	100%	2.00000	121,245.500
SUBTOTALS						1,192,141				1,062,032.473

ELIGIBLE PRESERVATION AREA						397,380					
Location	Jurisdictional Streams	Method	Feature Name	Min-Max Buffer Width (ft)	Total Area (sf)*	Creditable Area (sf)	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits	
Rural	Subject	Preservation	Buffer Area D	0-100	377,426	377,426	10	100%	10.00000	37,742.600	
SUBTOTALS						377,426				37,742.600	
TOTALS						1,569,567				1,099,775.073	

*Differences in total area compared to the total area listed in the Mitigation Plan are due to the increased accuracy of the surveyed tree lines and the installation of vernal pools during stream construction.

Table 1b. Nutrient Offset Project Areas and Assets Available Upon Conversion

Buckwater Buffer Mitigation Site

DMS Project No. 97084

Monitoring Year 4 - 2022

Riparian Width	Credit Type	Mitigation Type	Feature Name	Credit Ratio	Mitigation Area from Survey (ac)	Mitigation Area from Survey (sq ft)	Credited Acreage	Generated Credits per Acre	Generated Credits (lb)
101' - 200'	Nitrogen	Restoration (TOB'-100)	Buffer Area A	1:1	21.10	919,068	21.10	2,273.02	47,958.196
		Restoration (101'-200)	Buffer Area B	1:1	0.07	2,899	0.07		151.274
	Phosphorous	Restoration (TOB'-100)	Buffer Area A	1:1	21.10	919,608	21.10	146.40	3,088.879
		Restoration (101'-200)	Buffer Area B	1:1	0.07	2,899	0.07		9.743
Total Nitrogen Credits									48,109.470
Total Phosphorous Credits									3,098.622

Table 2. Project Activity and Reporting History

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 4 - 2022

Activity or Report	Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	December 2017	December 2017
Final Design - Construction Plans	April 2018	April 2018
Construction	April 2018-April 2019	April 2019
Temporary S&E mix applied to entire project area ¹	April 2018-April 2019	April 2019
Permanent seed mix applied to reach/segments ¹	April 2018-April 2019	April 2019
Bare root and live stake plantings for reach/segments	April 2019	April 2019
Baseline Monitoring Document (Year 0)	April 2019	July 2019
Invasive Treatment		October 2019
Year 1 Monitoring	October 2019	December 2019
Soil Amendments		August 2020
Year 2 Monitoring	September 2020	December 2020
Replanting and Soil Amendments		February 2021
Ring Sprays		March 2021
Year 3 Monitoring	October 2021	December 2021
Year 4 Monitoring	October 2022	December 2022
Year 5 Monitoring	2023	December 2023

¹Seed and mulch is added as each section of construction is completed.

Table 3. Project Contact Table

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 4 - 2022

Designer Nicole Macaluso, PE	Wildlands Engineering, Inc. 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Planting Contractor	Bruton Natural Systems, Inc P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	Ecotone, Inc 2120 High Point Rd Forest Hill, MD 21050
Seed Mix Sources	Green Resource, LLC
Nursery Stock Suppliers Bare Roots	Dykes and Sons Nursery and Greenhouse
Live Stakes	Bruton Natural Systems, Inc
Monitoring Performers Monitoring POC	Wildlands Engineering, Inc. Jason Lorch 919.851.9986, ext. 107

Table 4. Project Information and Attributes

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 4 - 2022

PROJECT INFORMATION	
Project Name	Buckwater Buffer Mitigation Site
County	Orange County
Project Area (acres)	51.84
Planted Area (acres)	23.60
Project Coordinates (latitude and longitude)	36° 6' 23.49" N, 79° 1' 29.11"W
PROJECT WATERSHED SUMMARY INFORMATION	
Physiographic Province	Carolina Slate Belt of the Piedmont Physiographic Province
River Basin	Neuse River
USGS Hydrologic Unit 8-digit	03020201
USGS Hydrologic Unit 14-digit	03020201030030
DWR Sub-basin	03-04-01
Project Drainage Area (acres)	2,259
Project Drainage Area Percentage of Impervious Area	3.90%
CGIA Land Use Classification	63.9% forested, 32.1% cultivated, 3.9% impervious

Table 5. Adjacent Forested Areas Existing Tree and Shrub Species

Buckwater Buffer Mitigation Site

DMS Project No. 97084

Monitoring Year 4 - 2022

Common Name	Scientific Name	Wetland Indicator Status
American Beech	<i>Fagus grandifolia</i>	FACU
Black Walnut	<i>Juglans nigra</i>	FACU
Green Ash	<i>Fraxinus pennsylvanica</i>	FACW
Mockernut Hickory	<i>Carya tomentosa</i>	UPL
Red Maple	<i>Acer rubrum</i>	FAC
Red Cedar	<i>Juniperus virginiana</i>	FACU
Sweet Gum	<i>Liquidambar styraciflua</i>	FAC
Spice Bush	<i>Lindera benzoin</i>	FAC
Yellow Buckeye	<i>Aesculus flava</i>	FACU

Table 6. Planted Tree Species

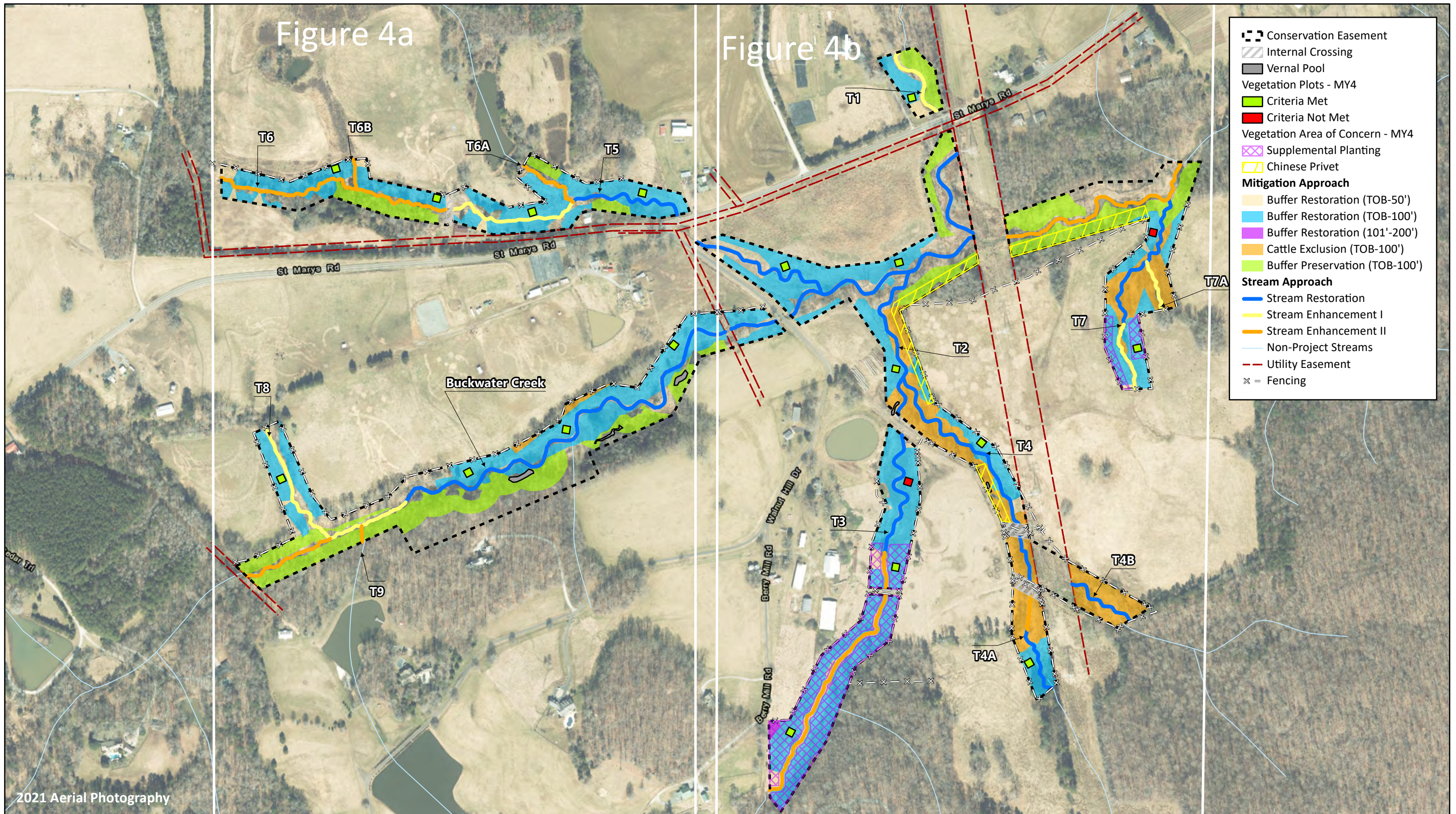
Buckwater Buffer Mitigation Site

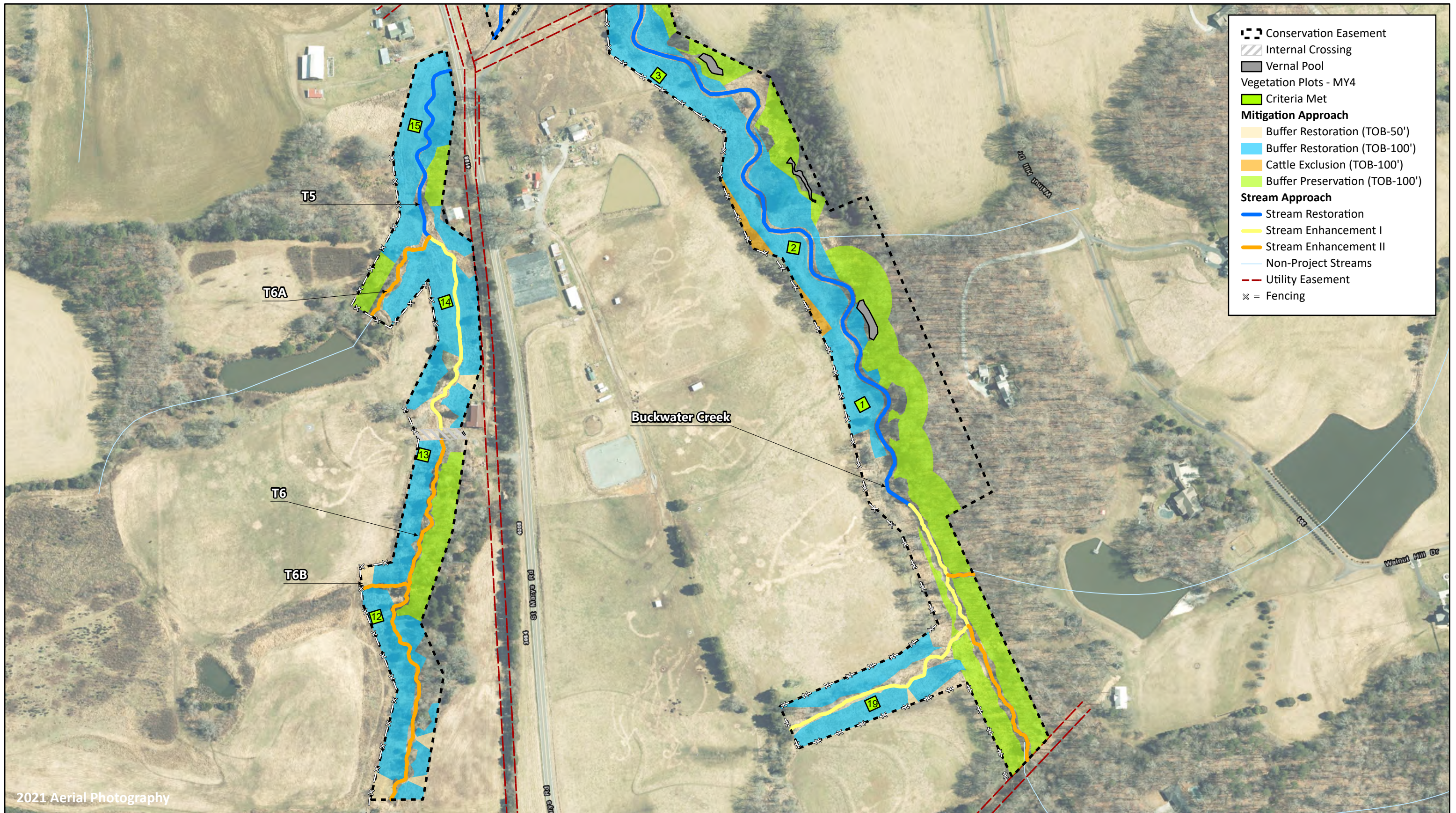
DMS Project No. 97084

Monitoring Year 4 - 2022

Common Name	Scientific Name	Number Planted	% of Total
Willow Oak	<i>Quercus phellos</i>	1,842	10%
Sycamore	<i>Platanus occidentalis</i>	3,686	20%
River Birch	<i>Betula nigra</i>	2,764	15%
Overcup Oak	<i>Quercus lyrata</i>	1,106	6%
Swamp Chestnut Oak	<i>Quercus michauxii</i>	738	4%
Tulip Poplar	<i>Liriodendron tulipifera</i>	2,764	15%
White Oak	<i>Quercus alba</i>	922	5%
Shumard Oak	<i>Quercus shumardii</i>	920	5%
Green Ash	<i>Fraxinus pennsylvanica</i>	3,132	17%
Possumhaw Viburnum	<i>Viburnum dentatum</i>	184	1%
Allegheny Serviceberry	<i>Amelanchier laevis</i>	184	1%
Red Buckeye	<i>Aesculus pavia</i>	184	1%

APPENDIX 2. Visual Assessment Data





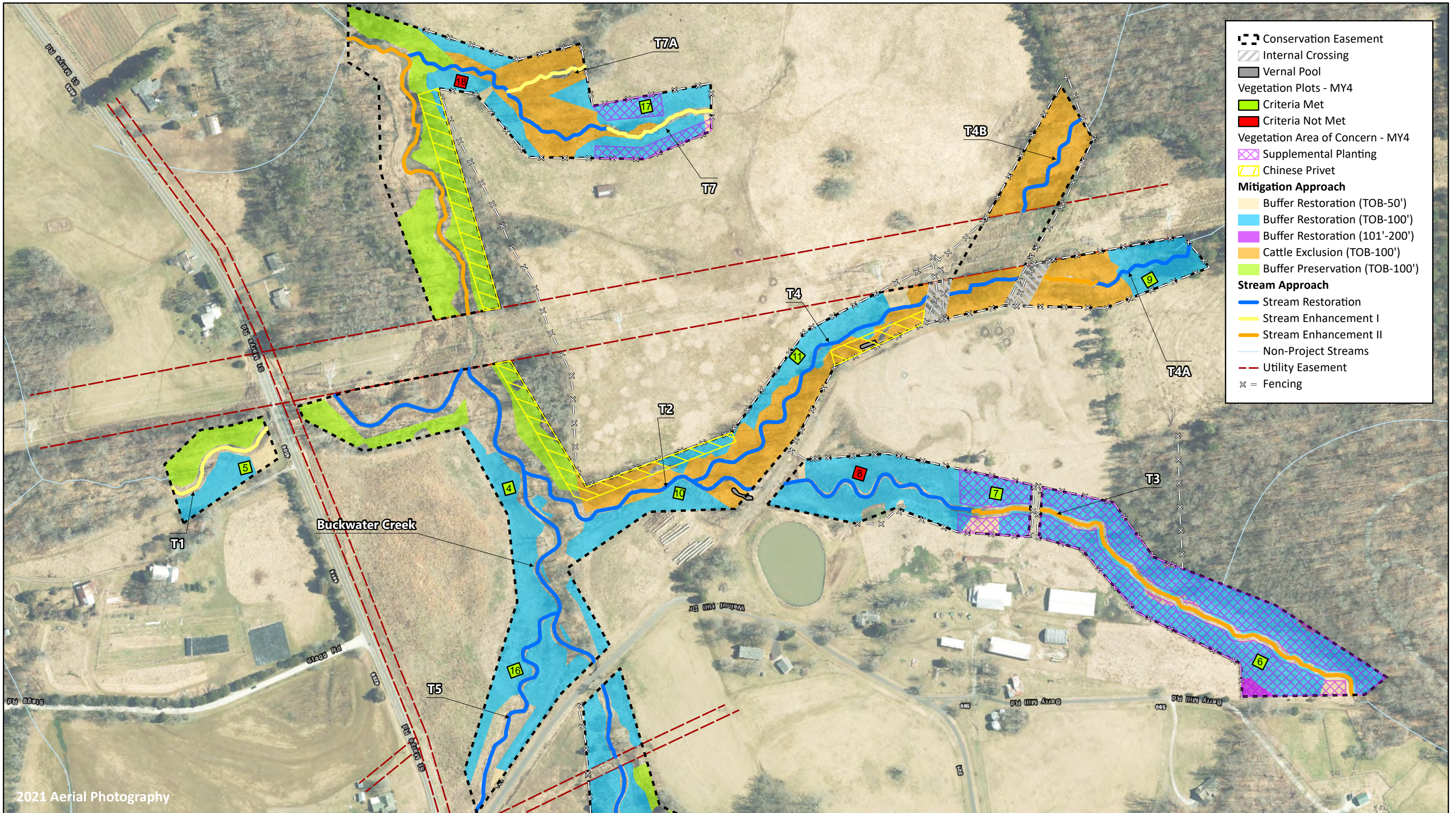


Table 7. Vegetation Condition Assessment Table

Buckwater Buffer Mitigation Site
 DMS Project No. 97084
 Monitoring Year 4 - 2022

Planted Acreage 23.60

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10	0	0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10	4.30*	18%
Total			4.30	18%
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.25	0	0%
Cumulative Total			4.30	18%

*An approved supplemental planting occurred on November 7, 2022 to increase species diversity.

Easement Acreage 51.84

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete native, young, woody stems in the short-term or community structure for existing communities. Invasive species included in summation above should be identified in report summary.	0.10	1.72	3%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	0 Encroachments Noted / 0 ac	

VEGETATION PLOT PHOTOGRAPHS



VEG PLOT 1 (9/20/2022)



VEG PLOT 2 (9/20/2022)



VEG PLOT 3 (9/20/2022)



VEG PLOT 4 (10/11/2022)



VEG PLOT 5 (10/11/2022)



VEG PLOT 6 (10/11/2022)

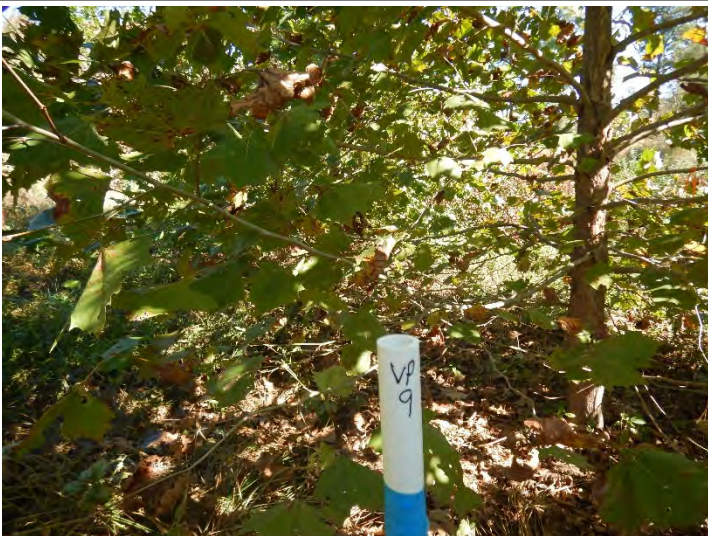




VEG PLOT 7 (10/11/2022)



VEG PLOT 8 (10/11/2022)



VEG PLOT 9 (10/11/2022)



VEG PLOT 10 (9/20/2022)



VEG PLOT 11 (10/11/2022)



VEG PLOT 12 (10/18/2022)





VEG PLOT 13 (10/18/2022)



VEG PLOT 14 (10/11/2022)



VEG PLOT 15 (10/11/2022)



VEG PLOT 16 (9/20/2022)



VEG PLOT 17 (10/11/2022)



VEG PLOT 18 (10/11/2022)





VEG PLOT 19 (10/18/2022)



APPENDIX 3. Vegetation Plot Data

Table 8. Vegetation Plot Criteria Attainment Table

Buckwater Buffer Mitigation Site

DMS Project No. 97084

Monitoring Year 4 - 2022

Plot	Success Criteria Met *	Tract Mean
1	Yes	89%
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	Yes	
15	Yes	
16	Yes	
17	Yes	
18	No*	
19	Yes	

*Vegetation Plots 8 and 18 do not meet the MY5 success criteria of 260 stems per acre. However, when including volunteers, both Vegetation Plots 8 and 18 do meet the MY5 success criteria for 260 stems per acre.

Table 9. CVS Vegetation Tables - Metadata

Buckwater Mitigation Project
 DMS Project No. 97084
 Monitoring Year 4 - 2022

Report Prepared By	Jason Lorch
Date Prepared	10/19/2022 10:08
Database Name	Buckwater Buffer- cvs-v2.5.0- MY4.mdb
Database Location	\\192.168.5.8\shared\Monitoring\Buckwater\MY4 - 2022\Buffer
Computer Name	RALEIGHINTERN
File Size	77271040
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Project Planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Project 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.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-----	
Project Code	97084
Project Name	Buckwater Mitigation Site
Description	Buffer Restoration Project
Sampled Plots	19

Table 10. Planted and Total Stem Counts

Buckwater Buffer Mitigation Site
 DMS Project No. 97084
 Monitoring Year 4 - 2022

			Current Plot Data (MY4 2022)																				
Scientific Name	Common Name	Species Type	VP 1			VP 2			VP 3			VP 4			VP 5			VP 6			VP 7		
			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
<i>Acer negundo</i>	Box Elder	Tree																3	3	3			
<i>Acer rubrum</i>	Red Maple	Tree																					
<i>Aesculus pavia</i>	Red Buckeye	Shrub Tree																			1	1	1
<i>Betula nigra</i>	River Birch, Red Birch	Tree	1	1	1	2	2	2	3	3	3	2	2	2	1	1	1						
<i>Carya</i>	Hickory spp.	Tree																					
<i>Celtis occidentalis</i>	Hackberry	Tree																					
<i>Diospyros virginiana</i>	American Persimmon	Tree												1									
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	3	3	3	1	1	1	2	2	2	4	4	4	1	1	2						
<i>Juglans nigra</i>	Black Walnut	Tree													1								2
<i>Juniperus virginiana</i>	Eastern Red Cedar	Tree																					
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree			1									2			1						
<i>Liriodendron tulipifera</i>	Tulip-poplar	Tree																					
<i>Nyssa biflora</i>	Swamp Tupelo	Tree																					
<i>Pinus taeda</i>	Loblolly Pine	Tree																					
<i>Platanus occidentalis</i>	Sycamore	Tree	1	1	1	5	5	5	4	4	4	2	2	6	4	4	4	4	4	4	1	1	1
<i>Pyrus calleryana</i>	Callery Pear	Exotic														1							
<i>Quercus alba</i>	White Oak	Tree				1	1	1							1	1	1				2	2	2
<i>Quercus lyrata</i>	Overcup Oak	Tree									3	3	3	1	1	1							
<i>Quercus michauxii</i>	Swamp Chestnut Oak	Tree	2	2	2				1	1	1												
<i>Quercus pagoda</i>	Cherrybark Oak	Tree													3	3	3						
<i>Quercus phellos</i>	Willow Oak	Tree	1	1	1							3	3	3	1	1	2				2	2	2
<i>Quercus shumardii</i>	Shumard Oak	Shrub Tree				3	3	3	1	1	1				2	2	2				1	1	1
<i>Salix nigra</i>	Black Willow	Tree																					
<i>Ulmus</i>	Elm spp.	Tree																					
<i>Ulmus alata</i>	Winged Elm	Tree																					
<i>Ulmus americana</i>	American Elm	Tree																					
<i>Viburnum dentatum</i>	Arrow-wood	Shrub Tree																					
Stem count			8	8	9	12	12	12	11	11	11	14	14	21	14	14	18	7	7	7	7	7	9
size (ares)			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			5	5	6	5	5	5	5	5	5	5	5	7	8	8	11	2	2	2	5	5	6
Stems per ACRE			324	324	364	486	486	486	445	445	445	567	567	850	567	567	728	283	283	283	283	283	364

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes

P-all: All planted stems

T: Total stems

Table 10. Planted and Total Stem Counts

Buckwater Buffer Mitigation Site
 DMS Project No. 97084
 Monitoring Year 4 - 2022

			Current Plot Data (MY4 2022)																				
Scientific Name	Common Name	Species Type	VP 8			VP 9			VP 10			VP 11			VP 12			VP 13			VP 14		
			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
<i>Acer negundo</i>	Box Elder	Tree																					
<i>Acer rubrum</i>	Red Maple	Tree													3			2					
<i>Aesculus pavia</i>	Red Buckeye	Shrub Tree																					
<i>Betula nigra</i>	River Birch, Red Birch	Tree												2	2	2	4	4	4	4	4	4	4
<i>Carya</i>	Hickory spp.	Tree																					
<i>Celtis occidentalis</i>	Hackberry	Tree				2	2	2															
<i>Diospyros virginiana</i>	American Persimmon	Tree						1															
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree						4	4	4	1	1	1				3	3	3	3	3	3	3
<i>Juglans nigra</i>	Black Walnut	Tree																					
<i>Juniperus virginiana</i>	Eastern Red Cedar	Tree														1						1	
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree			12										4			5					1
<i>Liriodendron tulipifera</i>	Tulip-poplar	Tree																		1	1	1	
<i>Nyssa biflora</i>	Swamp Tupelo	Tree																					
<i>Pinus taeda</i>	Loblolly Pine	Tree																					
<i>Platanus occidentalis</i>	Sycamore	Tree	4	4	4	3	3	3	1	1	1				5	5	5	4	4	4	1	1	2
<i>Pyrus calleryana</i>	Callery Pear	Exotic																					
<i>Quercus alba</i>	White Oak	Tree				1	1	1				4	4	4	1	1	1						
<i>Quercus lyrata</i>	Overcup Oak	Tree				2	2	2	3	3	3												
<i>Quercus michauxii</i>	Swamp Chestnut Oak	Tree							1	1	1				4	4	4	1	1	1			
<i>Quercus pagoda</i>	Cherrybark Oak	Tree										1	1	1									
<i>Quercus phellos</i>	Willow Oak	Tree	1	1	1										2	2	2						
<i>Quercus shumardii</i>	Shumard Oak	Shrub Tree	1	1	1	1	1	1				2	2	2	1	1	1						
<i>Salix nigra</i>	Black Willow	Tree					1			4													
<i>Ulmus</i>	Elm spp.	Tree																					
<i>Ulmus alata</i>	Winged Elm	Tree																					
<i>Ulmus americana</i>	American Elm	Tree														2			2				
<i>Viburnum dentatum</i>	Arrow-wood	Shrub Tree																			1	1	1
	Stem count		6	6	18	9	9	11	9	9	13	8	8	8	15	15	25	12	12	21	10	10	13
	size (ares)		1			1			1			1			1			1			1		
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02		
	Species count		3	3	4	5	5	7	4	4	5	4	4	4	6	6	10	4	4	7	5	5	7
	Stems per ACRE		243	243	728	364	364	445	364	364	526	324	324	324	607	607	1,012	486	486	850	405	405	526

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes

P-all: All planted stems

T: Total stems

Table 10. Planted and Total Stem Counts

Buckwater Buffer Mitigation Site
 DMS Project No. 97084
 Monitoring Year 4 - 2022

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2022)														
			VP 15			VP 16			VP 17			VP 18			VP 19		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i>	Box Elder	Tree							3	3	3						
<i>Acer rubrum</i>	Red Maple	Tree															
<i>Aesculus pavia</i>	Red Buckeye	Shrub Tree															
<i>Betula nigra</i>	River Birch, Red Birch	Tree	3	3	5	4	4	4				1	1		3	3	3
<i>Carya</i>	Hickory spp.	Tree															
<i>Celtis occidentalis</i>	Hackberry	Tree															
<i>Diospyros virginiana</i>	American Persimmon	Tree							2	2	2						
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2
<i>Juglans nigra</i>	Black Walnut	Tree															
<i>Juniperus virginiana</i>	Eastern Red Cedar	Tree								1			1				
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree			6					8			8				1
<i>Liriodendron tulipifera</i>	Tulip-poplar	Tree															
<i>Nyssa biflora</i>	Swamp Tupelo	Tree															
<i>Pinus taeda</i>	Loblolly Pine	Tree			1									2			
<i>Platanus occidentalis</i>	Sycamore	Tree	4	4	4	4	4	4	1	1	1	1	1	2	2	2	2
<i>Pyrus calleryana</i>	Callery Pear	Exotic															
<i>Quercus alba</i>	White Oak	Tree				2	2	2									
<i>Quercus lyrata</i>	Overcup Oak	Tree			1							1	1	1			
<i>Quercus michauxii</i>	Swamp Chestnut Oak	Tree	1	1	1										1	1	1
<i>Quercus pagoda</i>	Cherrybark Oak	Tree				1	1	1									
<i>Quercus phellos</i>	Willow Oak	Tree				2	2	2	1	1	1						
<i>Quercus shumardii</i>	Shumard Oak	Shrub Tree															
<i>Salix nigra</i>	Black Willow	Tree															4
<i>Ulmus</i>	Elm spp.	Tree															
<i>Ulmus alata</i>	Winged Elm	Tree															
<i>Ulmus americana</i>	American Elm	Tree											1				
<i>Viburnum dentatum</i>	Arrow-wood	Shrub Tree	2	2	2	1	1	1	2	2	2	1	1	1			
	Stem count		12	12	22	15	15	15	10	10	19	5	5	17	8	8	13
	size (ares)			1			1			1			1			1	
	size (ACRES)			0.02			0.02			0.02			0.02			0.02	
	Species count		5	5	8	7	7	7	6	6	8	5	5	8	4	4	6
	Stems per ACRE		486	486	890	607	607	607	405	405	769	202	202	688	324	324	526

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes

P-all: All planted stems

T: Total stems

Table 10. Planted and Total Stem Counts

Buckwater Buffer Mitigation Site
 DMS Project No. 97084
 Monitoring Year 4 - 2022

Scientific Name	Common Name	Species Type	Annual Means														
			MY4 (2022)			MY3 (2021)			MY2 (2020)			MY1 (2019)			MY0 (2019)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i>	Box Elder	Tree	6	6	6	6	6	6									
<i>Acer rubrum</i>	Red Maple	Tree			5			6									
<i>Aesculus pavia</i>	Red Buckeye	Shrub Tree	1	1	1	2	2	2	1	1	1	9	9	9	10	10	10
<i>Betula nigra</i>	River Birch, Red Birch	Tree	30	30	32	33	33	33	22	22	24	34	34	35	41	41	41
<i>Carya</i>	Hickory spp.	Tree									1						
<i>Celtis occidentalis</i>	Hackberry	Tree	2	2	2	4	4	4									
<i>Diospyros virginiana</i>	American Persimmon	Tree	2	2	4	2	2	4			1						
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	29	29	30	32	32	38	33	33	33	34	34	34	34	34	34
<i>Juglans nigra</i>	Black Walnut	Tree			3			2			1			1			
<i>Juniperus virginiana</i>	Eastern Red Cedar	Tree			4			1									
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree			49			27			5			3			
<i>Liriodendron tulipifera</i>	Tulip-poplar	Tree	1	1	1	2	2	2	2	2	2	22	22	22	32	32	32
<i>Nyssa biflora</i>	Swamp Tupelo	Tree									1						
<i>Pinus taeda</i>	Loblolly Pine	Tree			3			1									
<i>Platanus occidentalis</i>	Sycamore	Tree	51	51	57	53	53	58	47	47	49	56	56	56	62	62	62
<i>Pyrus calleryana</i>	Callery Pear	Exotic			1												
<i>Quercus alba</i>	White Oak	Tree	12	12	12	19	19	19	5	5	5	10	10	10	11	11	11
<i>Quercus lyrata</i>	Overcup Oak	Tree	10	10	11	12	12	12	13	13	13	25	25	25	22	22	22
<i>Quercus michauxii</i>	Swamp Chestnut Oak	Tree	11	11	11	16	16	16	10	10	10	13	13	13	13	13	13
<i>Quercus pagoda</i>	Cherrybark Oak	Tree	5	5	5	8	8	8									
<i>Quercus phellos</i>	Willow Oak	Tree	13	13	14	17	17	18	10	10	10	33	33	33	33	33	33
<i>Quercus shumardii</i>	Shumard Oak	Shrub Tree	12	12	12	12	12	12	5	5	5	8	8	8	9	9	9
<i>Salix nigra</i>	Black Willow	Tree			9			10			3						
<i>Ulmus</i>	Elm spp.	Tree						4									
<i>Ulmus alata</i>	Winged Elm	Tree				1	1	2									
<i>Ulmus americana</i>	American Elm	Tree			5												
<i>Viburnum dentatum</i>	Arrow-wood	Shrub Tree	7	7	7	7	7	7	9	9	9	13	13	13	15	15	15
Stem count			186	186	283	226	226	292	157	157	173	257	257	262	282	282	282
size (ares)			19			19			19			19			19		
size (ACRES)			0.47			0.47			0.47			0.47			0.47		
Species count			14	14	22	16	16	23	11	11	17	11	11	13	11	11	11
Stems per ACRE			396	396	603	481	481	622	334	334	368	547	547	558	601	601	601

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%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes

P-all: All planted stems

T: Total stems

APPENDIX 4. Overview Photographs





APPENDIX 5. Additional Documentation

Carolyn Lanza

From: Jason Lorch
Sent: Monday, October 24, 2022 1:19 PM
To: Chris Roessler; Carolyn Lanza; Andrew Radecki
Subject: FW: Buckwater Mitigation Site / Orange County
Attachments: Supplemental Planting MY4.pdf

See the IRTs response below. They are fine with our species, but would like additional transects, and MY6 vegetation data. Let me know if you have any questions. Thanks!

Jason Lorch, GISP | Senior Environmental Scientist
O: 919.851.9986 x107 M: 919.413.1214

Wildlands Engineering, Inc.
312 West Millbrook Road, Suite 225
Raleigh, NC 27609

-----Original Message-----

From: Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Sent: Monday, October 24, 2022 1:13 PM
To: Jason Lorch <jlorch@wildlandseng.com>
Cc: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>; Haywood, Casey M CIV USARMY CEMVP (USA) <Casey.M.Haywood@usace.army.mil>; Crumbley, Tyler A CIV USARMY CESAW (USA) <Tyler.A.Crumbley2@usace.army.mil>; Bowers, Todd <bowers.todd@epa.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Munzer, Olivia <olivia.munzer@ncwildlife.org>; Matthews, Kathryn (kathryn_matthews@fws.gov) <kathryn_matthews@fws.gov>; Merritt, Katie <katie.merritt@ncdenr.gov>; Dow, Jeremiah J <jeremiah.dow@ncdenr.gov>; Melonie Allen <melonie.allen@ncdenr.gov>; Crocker, Lindsay <Lindsay.Crocker@ncdenr.gov>
Subject: RE: Buckwater Mitigation Site / Orange County

Hi Jason,

Thanks for the information. The IRT doesn't have any issues with the newly proposed species. Since this is the second supplemental planting effort, we'd request that Wildlands perform an additional year of vegetation monitoring during monitoring year 6. Please also provide random veg transects in the supplemental planting areas to demonstrate survival and adequate site cover. Please include this correspondence in next year's monitoring report.

Please reach out with any questions.

Thanks,
Kim

Kim Isenhour
Mitigation Project Manager, Regulatory Division | U.S. Army Corps of Engineers | 919.946.5107

-----Original Message-----

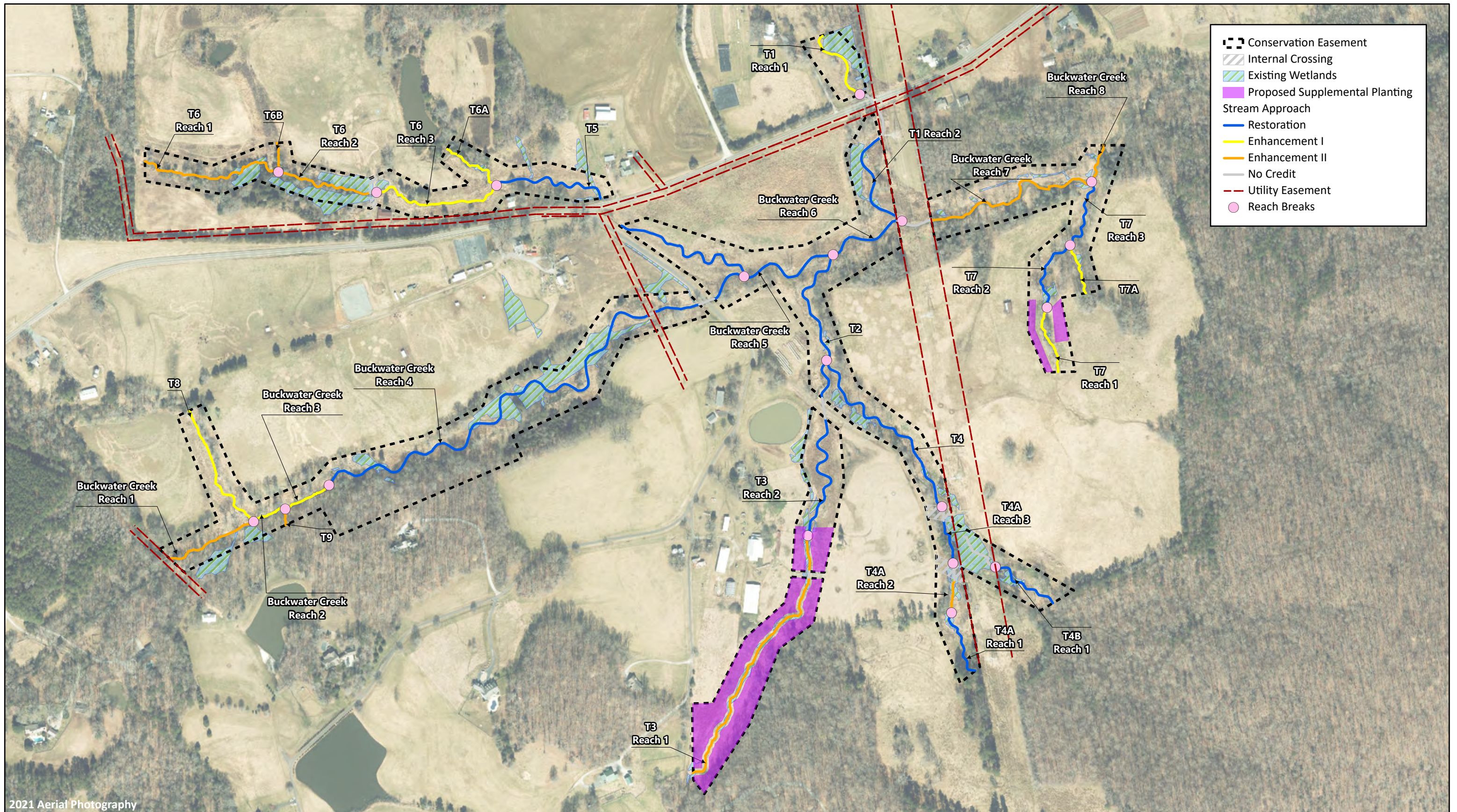
From: Jason Lorch <jlorch@wildlandseng.com>
Sent: Friday, October 14, 2022 2:10 PM
To: Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Subject: [URL Verdict: Neutral][Non-DoD Source] Buckwater Mitigation Site

Hey Kim,

Wildlands is purposing to do a supplemental planting at Buckwater to add plant diversity and supplement stem density in a few areas. We are purposing to plant 4.3 acres along UT3 and UT7 (Figure 1). This falls under the 20% threshold, so no adaptive management plan should be needed. There are a few new species we are proposing that were not in the original planting plan. We are planning to plant in the fall to allow the roots to establish over the winter and be more drought tolerant come spring. Bone meal and Terrasorb (water retention beads) will be added to the hole before the trees are planted to help establishment. Further amendments and management actions such as ring sprays in the supplementally planted areas are planned for the upcoming year. All these actions should improve stem survivability. Let me know if you have any comments or questions about the proposed plan. Have a good weekend. Thanks!

Jason Lorch, GISP | Senior Environmental Scientist
O: 919.851.9986 x107 M: 919.413.1214

Wildlands Engineering, Inc. <Blocked<http://www.wildlandseng.com/>>
312 West Millbrook Road, Suite 225
Raleigh, NC 27609



2021 Aerial Photography



0 400 800 Feet



Figure 1. Supplemental Planting Along UT3 and UT7
 Buckwater Mitigation Site
 DMS Project No. 97084
 Monitoring Year 4 - 2022

Orange County, NC

Table 1. Supplemental Planting Along UT3 and UT7

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 4 - 2022

Scientific Name	Common Name	Stratum	Wetland Indicator Status	Container Type	Percentage of Stems	Number of Stems
<i>Acer negundo</i>	Box elder	Canopy	FAC	Gallon	5%	30
<i>Betula nigra</i>	River Birch	Canopy	FACW	Gallon	8%	50
<i>Carya ovata</i>	Shagbark Hickory	Canopy	FACU	Gallon	3%	20
<i>Diospyros virginiana</i>	Persimmon	Understory	FAC	Gallon	3%	20
<i>Liriodendron tulipifera</i>	Tulip poplar	Canopy	FACU	Gallon	8%	50
<i>Nyssa sylvatica</i>	Black gum	Canopy	FAC	Gallon	8%	50
<i>Quercus alba</i>	White Oak	Canopy	FACU	Gallon	8%	50
<i>Quercus alba</i>	White Oak	Canopy	FACU	Tubling	10%	60
<i>Quercus michauxii</i>	Swamp chestnut oak	Canopy	FACW	Gallon	8%	50
<i>Quercus phellos</i>	Willow Oak	Canopy	FAC	Gallon	8%	50
<i>Quercus rubra</i>	Northern red oak	Canopy	FACU	Gallon	10%	60
<i>Quercus shumardii</i>	Shumard Oak	Canopy	FAC	Gallon	8%	50
<i>Ulmus americanus</i>	American elm	Canopy	FACW	Gallon	10%	60
Total					100%	600

Original Planted Acreage = 23.6

Supplemental Planted Acreage = 4.3 (18%)