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MY1 FINAL MONITORING REPORT  
Odell's House Buffer Mitigation Project  
Monitoring Year 1  
Calendar Year of Data Collection: 2021

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NCDEQ DMS Project Identification #100041  
NCDEQ DMS Contract # 7420  
Neuse River Basin (CU 03020201)  
DWR Project # 2018-0200  
USACE Action ID Number: SAW-2018-00431  
Johnston County, NC  
Data Collection Period: November 2021  
Submission Date: December 2021



Prepared for:

**NC Department of Environmental Quality**  
**Division of Water Resources**  
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**Raleigh, North Carolina 27620**



## Table of Contents

1	Project Summary.....	1
1.1	Project Location and Description.....	1
1.2	Project Success Criteria.....	1
1.2.1	Vegetation.....	2
1.2.2	Performance Standards for Vegetation Adjacent to Single-Thread Streams .....	2
1.2.3	Performance Standards for Vegetation Adjacent to Coastal Headwater Streams.....	2
1.2.4	Performance Standard for Coastal Headwater Streams.....	2
1.2.5	Visual Assessment.....	2
2	Project Mitigation Components.....	3
2.1	Project Components .....	3
2.2	Design Approach .....	5
3	Monitoring Year 1 Assessment and Results.....	5
3.1	Vegetation.....	5
3.2	Visual Assessment.....	6

## **LIST OF APPENDICES**

### **Appendix A Background Tables and Figures**

Figure 1 Site Location Map

Figure 2 Current Condition Plan View (CCPV)

### **Appendix B Vegetation Assessment Data**

Table 1 Red-line Plant List

Table 2 Vegetation Performance Standards Summary Table

Table 3 Vegetation Plot Counts and Densities

### **Appendix C Vegetation Monitoring Plot Photos and Encroachment Area Photos**

### **Appendix D Vegetation Monitoring Plot Maps**

### **Appendix E Headwater Stream Channel Formation Table**

# 1 Project Summary

## 1.1 Project Location and Description

The Odell's House Mitigation Site ("Site") is a riparian buffer mitigation project in conjunction with a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) stream and wetland mitigation project. The Site was planned according to the Consolidated Buffer Mitigation Rule 15A NCAC 02B .0295, which became effective on November 1, 2015.

The Site (35.716526 N, -78.349830 W) is located in Johnston County, North Carolina, between the Town of Wendell and Archer Lodge. The Site boundary is within the 8-digit Hydrologic Unit Code (HUC) 03020201, in the NCDEQ sub-basin 03-04-06 (Warm Water Thermal Regime).

This Site provides riparian buffer mitigation credits for unavoidable impacts due to development in the Neuse River Basin, United States Geologic Survey (USGS) 8-digit HUC 03020201. Nutrient offset credits may be used for stormwater requirements for new and existing development requiring nutrient offsets. The project involves the restoration and preservation of riparian vegetation to reduce non-point source discharge of contaminants into streams and agricultural ditch channels within the Neuse River basin. The project area is comprised of two separate easement locations totaling 15.092 acres, including stream and wetland mitigation areas.

Based on the sealed survey the as-built acres are as follows, the easement area is 15.092 acres, with 10.390 acres being restored for Neuse buffer credit. In general, Neuse buffer widths extend a minimum width of 50 feet from tops of stream and ditch banks, while nutrient offset restoration area widths will extend out to a maximum of 200 feet from the top of the channel or ditch bank. The buffer restoration credit adjacent to coastal headwater stream mitigation is classified as alternative mitigation under Rule 15A NCAC 02B .0295 (o)(2). The buffer preservation credit is classified as alternative mitigation under Rule .0295 (o).

Monitoring Year 1 (MY1) activities occurred during the second week of November 2021. This report presents the data for MY1. The Project meets the MY1 success criteria for vegetation. Based on these results, the Project is on trajectory to meet interim and final success criteria.

## 1.2 Project Success Criteria

The success criteria for the Site will follow the approved performance standards and monitoring protocols presented in the approved Mitigation Plan, developed in compliance with the DWR Rule 15A NCAC 02B 0295. Annual vegetation monitoring will occur each year for a minimum of five years and will be conducted during the fall season with the first year occurring at least five months from initial planting. Permanent vegetation monitoring plots will be installed and evaluated within the buffer restoration and nutrient offset areas to measure the survival of the planted trees. Riparian buffer vegetation monitoring will be based on the *Carolina Vegetation Survey-Ecosystem Enhancement Program Protocol for Recording Vegetation: Level 1-2 Plot Sampling Only Version 4.2*.

The measures of vegetative success for the Site will be the survival of at least four native hardwood tree species, where no one species is greater than 50 percent of the established stems, established at a density of at least 260 planted trees per acre at the end of Year 5. Appropriate native volunteer stems of native hardwood tree species may be included to meet the performance standards with DWR approval.



### 1.2.1 Vegetation

Seven 100 square-meter vegetation monitoring plots were installed for DWR monitoring; covering at least two percent of the 15.092 acres of the riparian restoration area. Plots were randomly placed throughout the planted riparian areas. The location of the plots is shown on Figures 2. Photos will be taken from all photo points annually. All planted stems will be marked with flagging tape and a wood stake. In the field, the four corners of each plot were permanently marked with PVC at the origin and rebar at the other corners. Photos of each plot will be taken from the origin each monitoring year. All seven of these plots are joint monitoring plots for 404/401 and there are an additional five 404/USACE plots for a total of 12 vegetation plots. Vegetation monitoring will occur in the fall each required monitoring year, prior to the leaf fall. Plots will be monitored for a minimum of five years. The following data are recorded for all planted trees in the plots: species, common name, height, planting date, and grid location. The total number of volunteer woody stems will also be documented and reported by species. Vegetation plot monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition, density, and height. Data are processed using the NCDMS Shiny App data entry tool.

### 1.2.2 Performance Standards for Vegetation Adjacent to Single-Thread Streams

The measures of vegetative success for the Project will be the survival of at least four native hardwood tree, where no one species is greater than 50 percent of the established stems, established at a density of at least 260 planted trees per acre at the end of Year 5. Appropriate volunteer stems of native hardwood tree species may be included to meet the performance standards upon DWR approval.

### 1.2.3 Performance Standards for Vegetation Adjacent to Coastal Headwater Streams

The measures of vegetative success for the Project will be the survival of at least four native hardwood tree species, where no one species is greater than 50 percent of the established stems, established at a density of at least 260 planted trees per acre at the end of Year 5 and 210 hardwood trees per acre at the end of Year 7 for riparian restoration areas adjacent to coastal headwater stream restoration. The seven years of monitoring only applies to the areas receiving credit under Rule 15A NCAC 02B .0295 (o)(2) for buffer mitigation. Appropriate volunteer stems of native hardwood tree species may be included to meet the performance standards upon DWR approval.

### 1.2.4 Performance Standard for Coastal Headwater Streams

The performance standards for the coastal headwater streams must be met each monitoring year for a minimum of seven years to comply with 15A NCAC 02B .0295 (o)(2) for buffer mitigation (permanent vegetation plots 1 and 6). Confirmation from the USACE that stream performance standards have been met will be provided to DWR prior to issuance of credit releases for riparian buffer credit along the coastal headwater streams. The success criteria for the coastal headwater streams include channel formation within the valley or crenulation that must be documented through identification of field indicators consistent with those listed in the mitigation plan, and continuous surface water flow within the valley or crenulation must be documented to occur every year for at least 30 consecutive days during the prescribed monitoring period.

### 1.2.5 Visual Assessment

Visual assessments are performed within the site semi-annually during the five-year monitoring period. Problem areas will be noted (e.g. low stem density, vegetation mortality, invasive species or encroachment). Areas of concern will be photographed, mapped, and accompanied by a written



description in the annual report. Problem areas will be re-evaluated during each subsequent visual assessment. Should remedial actions be required, recommendations will be provided in the annual monitoring report.

## 2 Project Mitigation Components

### 2.1 Project Components

The Odell's House Site includes a combination of stream restoration, enhancement, and preservation activities on 4,313 linear feet of designed streams and 3.890 acres of designed wetland re-establishment, rehabilitation, enhancement, and preservation. Out of 15.09 acres that will be protected with a permanent conservation easement, 10.400 acres (453,057.200 ft<sup>2</sup>) are proposed to generate riparian buffer credits along coastal headwater restoration, enhancement, and preservation streams.

The total potential riparian buffer that the Site generates are summarized in Table 1.







## 2.2 Design Approach

Riparian buffer mitigation adjacent to streams and ditches was approved by DWR via letter on October 30, 2020. Odell's House is also a stream and wetland mitigation site for the Division of Mitigation Services (DMS), and restoration of riparian areas will be accomplished through the goals and methods outlined by the Odell's House Mitigation Plan (SAW #2018-00431). All riparian buffer mitigation along channels begins from the top of bank and extends a minimum of 50 feet and a maximum of 200 feet perpendicular to the channel pursuant to 15A NCAC 02B .0295 and 15A NCAC 02B .0240. Land use proposed for buffer restoration was composed of pasture, fields, and woodlands. Wetland mitigation areas are excluded from riparian buffer credit areas.

A riparian headwater valley restoration approach was constructed for R1 and R5. Headwater stream restoration activities included draining the existing farm ponds, excavating a broader floodplain at or slightly above the existing bed elevation and will seek to restore groundwater hydrology and connection of surface flows. Shallow flow paths were connected to allow initial flow of water toward reach R1 and R5, which will gradually transition into a single thread channel that is more well defined. Figure 2 depicts the buffer restoration plan based on actual top of bank conditions. The riparian buffer credits located adjacent to coastal headwater valley restoration are based on the as-built survey centerline of the valley. The area of the buffer credits shall be measured perpendicular to the length of the valley being restored.

The riparian revegetation plan included permanent seeding, bare root trees, live stakes, and controlling invasive species growth. The riparian restoration efforts along the project streams are adjacent to reconstructed stream banks and extend perpendicular from tops of banks 50 feet to 200 feet.

## 3 Monitoring Year 1 Assessment and Results

### 3.1 Vegetation

Monitoring of the seven permanent vegetation plots was completed during November of 2021. Vegetation data can be found in Appendix B with the associated photos located in Appendix C. The MY1 average planted density is 647 stems per acre, which exceeds the interim measure of vegetative success of at least 260 planted stems per acre at the end of the fifth monitoring year. Each individual veg plot successfully meets criteria with stem counts between 486 and 1,174 stems per acre. No volunteer species were observed during year 1 of monitoring. Table 2 below details the average stem density per plot based on the number of years required for monitoring and associated performance criteria.





**Table: 2 Stem Density Per Plot Type**

Plots	Average Stem Density/Acre	Performance Criteria	Meets Criteria
Headwater (1 and 6)	870	260 stems/acre at Year 5, 210 stems/acre at Year 7, and Stream Success	Yes
Riparian Buffer (2-5 and 7)	558	260 stems/acre at Year 5	Yes

### 3.2 Visual Assessment

Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project. One area of encroachment was noted in MY1 along R3 right bank slope (~0.12 acres). An active farm field along the easement has led to farm equipment encroachment. No trees have been damaged, and the area will be marked with additional easement signs in MY2 to discourage further encroachment. Table 2 details the average stem density per plot based on the number of years required for monitoring and associated performance criteria.

Two areas of low stem density were observed in MY1. Low stem densities in these areas (~1.07 acres) are due to low planting densities at as-built, mortality due to high hydrology, and dense herbaceous vegetation. Extremely soft and wet soil conditions during construction and planting made areas of W1 and W2 unsafe for the contractor to plant bare roots. During MY2, both wetlands will be re-planted with wet tolerant species approved by the IRT prior to planting if species deviate from the approved mitigation plan plant list.

A large population of golden bamboo (*Phyllostachys aurea*) existed along the left floodplain of R2 prior to construction. Construction activities included bamboo removal in this area by ripping the roots/rhizomes, cut stump herbicide treatments, and foliar spray of re-sprouts. Herbicide treatments used 50 percent glyphosate for cut/stump and three percent for foliar spray. Foliar spray treatments of bamboo were continued during MY1, and the dates can be found in the table below. This area will continue to be monitored closely and any treatments will be documented in future monitoring reports.

**Table 3: Herbicide Treatment Table**

Monitoring Year	Invasive Targeted	Invasive Treatment	Date Treatment Conducted	Herbicide Used
1	Golden Bamboo	Foliar	7/1/2021	Rodeo (5%)
	Golden Bamboo	Foliar	8/17/2021	Rodeo (20%)

Monitoring of reaches R1 and R5 was conducted by visual assessment to determine if a preponderance of evidence indicated coastal headwater stream channel formation. Data collected is included in Appendix E and with the report submitted to USACE. All coastal headwater reaches are meeting the requirements for coastal headwater channel formation and will continue to be evaluated during MY2.



# Appendix A:

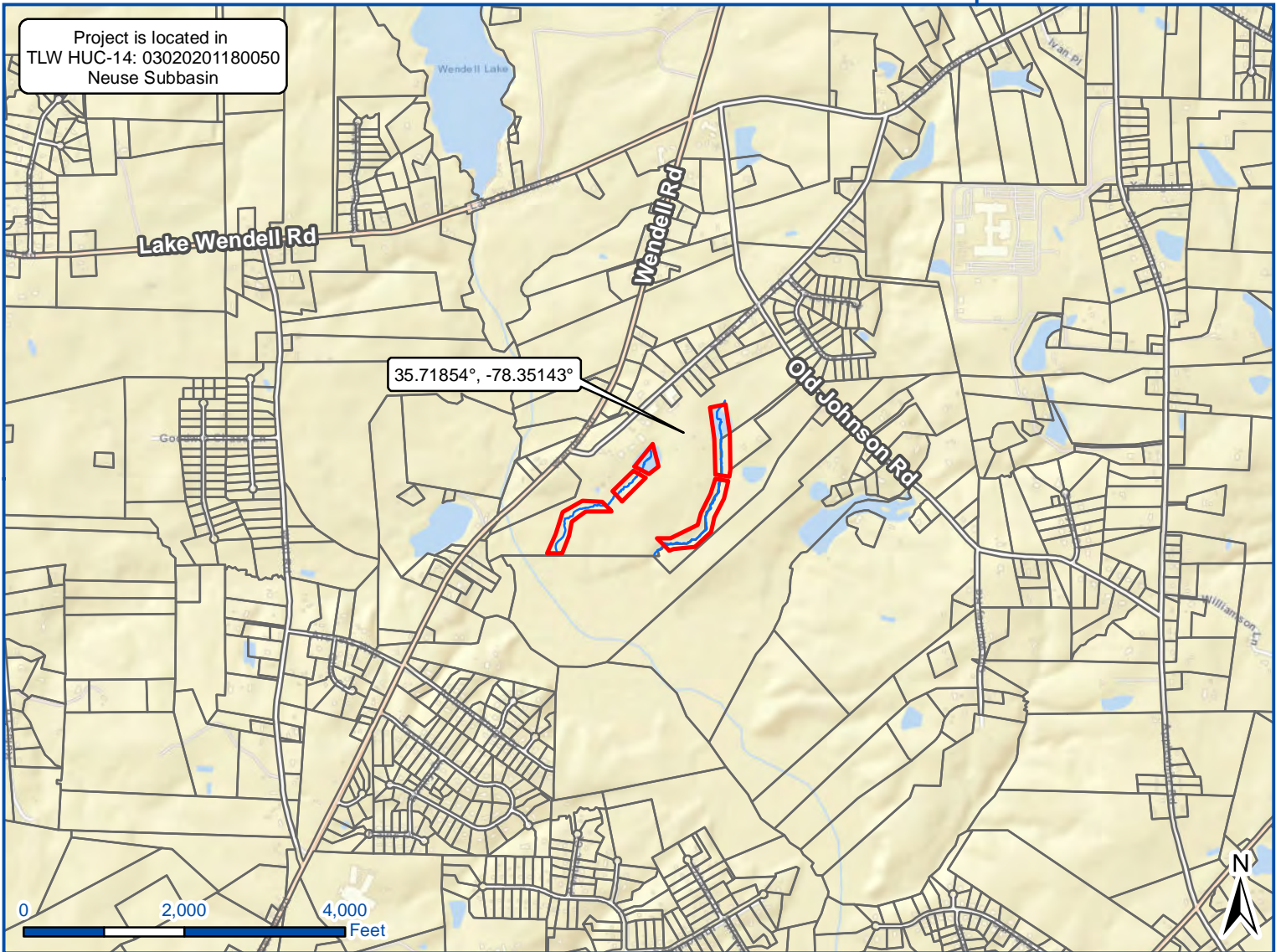
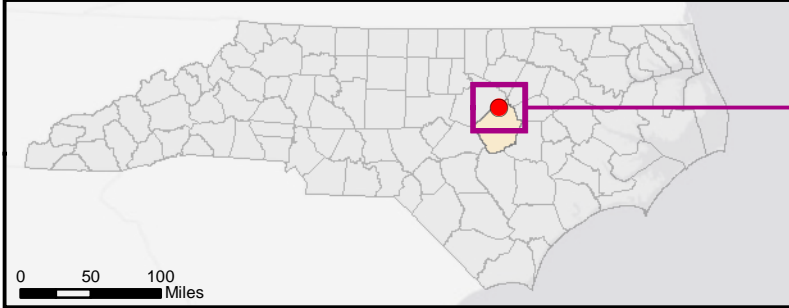
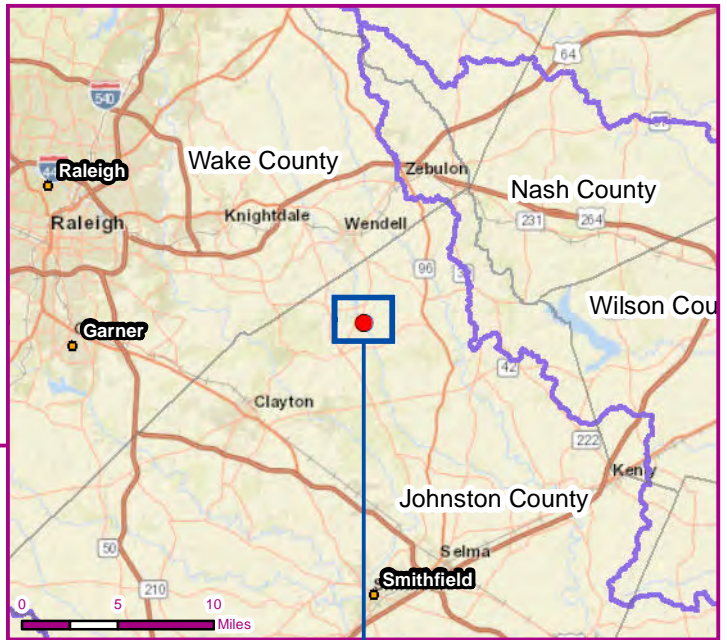
# Background Tables and Figures

Figure 1: Site Location Map


Figure 2: Current Condition Plan View

**Legend**

- Conservation Easement
- Project Location
- Stream
- HUC-8
- Johnston Co Parcels
- NC Counties
- NC Cities
- Johnston County

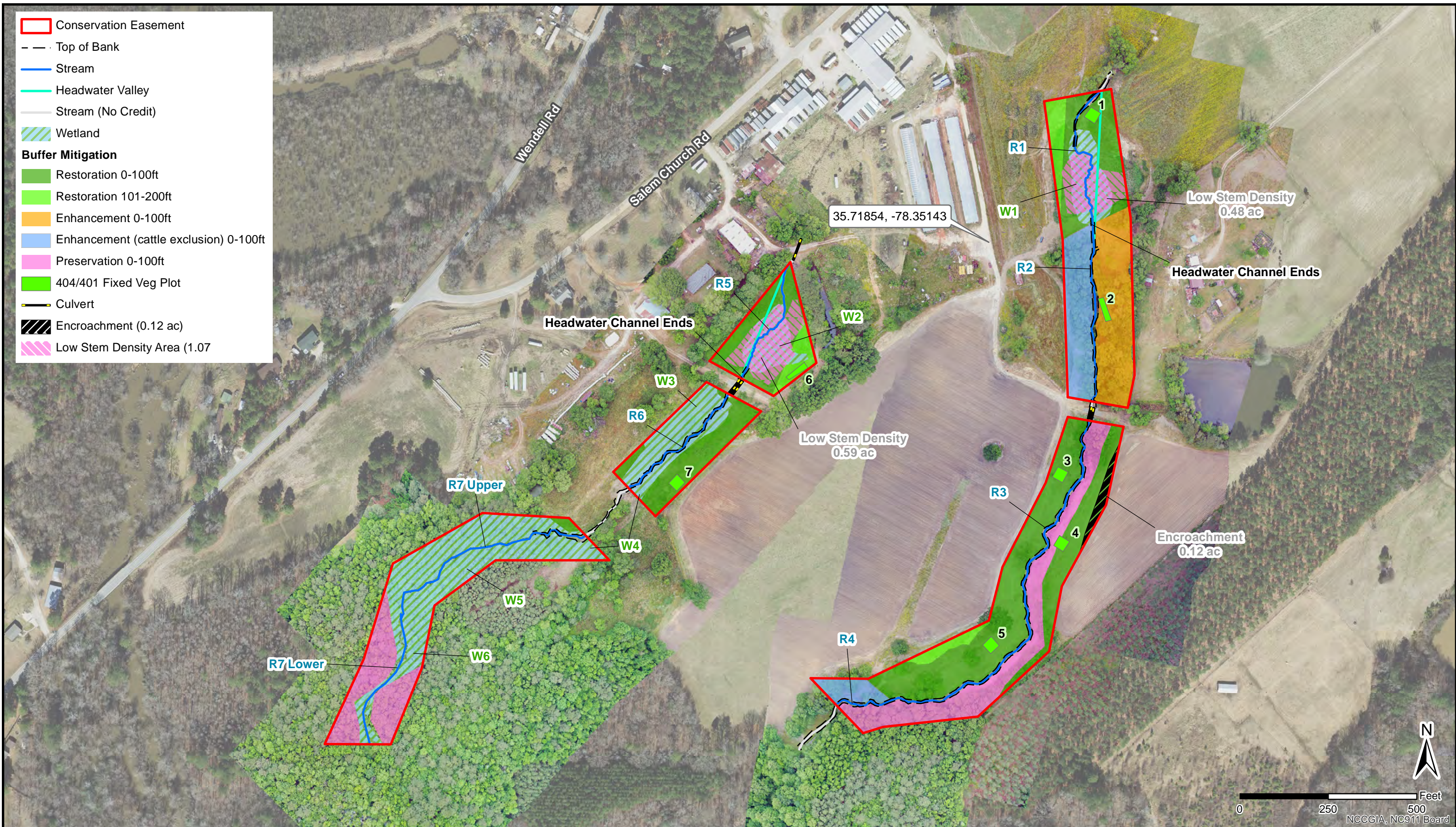


Project is located in  
TLW HUC-14: 03020201180050  
Neuse Subbasin

 <b>WATER &amp; LAND™ SOLUTIONS</b>	<b>Odells House Mitigation Project</b> Neuse 03020201 Johnston County, NC	Project Location Map	Figure <span style="font-size: 2em; font-weight: bold;">1</span>
	Map Projection: NAD 83 2011 State Plane North Carolina FIPS 3200 FT US	Date: 6/15/2021	

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community







# Appendix B:

# Vegetation Assessment Data

Red-line Plant List  
Vegetation Performance Standards Summary Table  
Vegetation Plot Counts and Densities Table

Odell's House Mitigation Project Red-line Planting List				
Species	Common Name	Stems	% Planted	Mitigation Plan %
<i>Fraxinus pennsylvanica</i>	Green Ash	228	3.00%	3%
<i>Betula nigra</i>	River birch	608	8.00%	12%
<i>Quercus michauxii</i>	Swamp chestnut oak	608	8.00%	10%
<i>Quercus pagoda</i>	Cherrybark oak	532	7.00%	10%
<i>Platanus occidentalis</i>	American sycamore	684	9.00%	12%
<i>Quercus nigra</i>	Water Oak	532	7.00%	10%
<i>Liriodendron tulipifera</i>	Tulip Poplar	684	9.00%	12%
<i>Quercus phellos</i>	Willow Oak	532	7.00%	10%
<i>Diospyros virginiana</i>	Persimmon	456	6.00%	4%
<i>Carpinus caroliniana</i>	Ironwood	456	6.00%	3%
<i>Hamamelis virginiana</i>	Witch Hazel	456	6.00%	3%
<i>Asimina triloba</i>	Pawpaw	456	6.00%	4%
<i>Lindera benzoin</i>	Spicebush	456	6.00%	4%
<i>Alnus serulatta</i>	Tag Alder	456	6.00%	0%
<i>Corylus americana</i>	Hazelnut	456	6.00%	3%
<b>Total</b>		<b>7,600</b>	<b>100%</b>	

\* changes from mitigation plan in red

\*Tag Alder was not planted within potential Nutrient Buffer Areas

Riparian Buffer Live Stake Plantings – Streambanks (Proposed 2' to 3' Spacing @ Meander Bends and 6' to 8' Spacing @ Riffle Sections)			
<i>Sambucus canadensis</i>	Elderberry	20%	FACW
<i>Salix sericea</i>	Silky Willow	30%	OBL
<i>Salix nigra</i>	Black Willow	10%	OBL
<i>Cornus amomum</i>	Silky Dogwood	40%	FACW
<b>Note:</b> Final species selection may change due to refinement or availability at the time of planting. Species substitutions will be coordinated between WLS and planting contractor prior to the procurement of plant stock and documented in the as-built report.			

**Vegetation Plot Counts and Densities Table**

Planted Acreage	11.17
Date of Initial Plant	2021-03-03
Date(s) of Supplemental Plant(s)	#N/A
Date(s) Mowing	#N/A
Date of Current Survey	2021-11-10
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 F		Veg Plot 6 F		Veg Plot 7 F		
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted
Species Included in Approved Mitigation Plan	<i>Asimina triloba</i>	pawpaw	Tree	FAC		1		1			2	2	1	1					
	<i>Betula nigra</i>	river birch	Tree	FACW	1	1	2	2	1	1					8	8	1	1	
	<i>Carpinus caroliniana</i>	American hornbeam	Tree	FAC	1	1					2	2							
	<i>Corylus americana</i>	American hazelnut	Shrub	FACU			1	1							1	1	1	1	
	<i>Diospyros virginiana</i>	common persimmon	Tree	FAC	2	2											1	1	
	<i>Fraxinus pennsylvanica</i>	green ash	Tree	FACW	1	1									4	4			
	<i>Hamamelis virginiana</i>	American witchhazel	Tree	FACU	1	1	2	2	1	1	1	1							
	<i>Lindera benzoin</i>	northern spicebush	Tree	FAC	1	1	1	1					1	1					
	<i>Liriodendron tulipifera</i>	tuliptree	Tree	FACU	1	1	2	2	4	4	3	3	5	5				2	2
	<i>Platanus occidentalis</i>	American sycamore	Tree	FACW	3	3	2	2	4	4	1	1	2	2	5	5	3	3	
	<i>Quercus michauxii</i>	swamp chestnut oak	Tree	FACW	1	1	2	2							4	4	1	1	
	<i>Quercus nigra</i>	water oak	Tree	FAC	1	1			1	1			1	1	3	3			
	<i>Quercus pagoda</i>	cherrybark oak	Tree	FACW	1	1	2	2	1	1	3	3	1	1			2	2	
	<i>Quercus phellos</i>	willow oak	Tree	FAC					2	2	3	3	1	1	4	4	2	2	
Sum	Performance Standard				14	14	15	15	14	14	15	15	12	12	29	29	13	13	
Mitigation Plan Performance Standard	Current Year Stem Count				14	14	15	15	14	14	15	15	12	12	29	29	13	13	
	Stems/Acre				567	567	607	607	567	567	607	607	486	486	1174	1174	526	526	
	Species Count				11	11	9	9	7	7	7	7	7	7	7	7	8	8	
	Dominant Species Composition (%)				21	21	13	13	29	29	20	20	42	42	28	28	23	23	
	Average Plot Height				2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	% Invasives				0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Post Mitigation Plan Performance Standard	Current Year Stem Count				14	14	15	15	14	14	15	15	12	12	29	29	13	13	
	Stems/Acre				567	567	607	607	567	567	607	607	486	486	1174	1174	526	526	
	Species Count				11	11	9	9	7	7	7	7	7	7	7	7	8	8	
	Dominant Species Composition (%)				21	21	13	13	29	29	20	20	42	42	28	28	23	23	
	Average Plot Height				2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	% Invasives				0	0	0	0	0	0	0	0	0	0	0	0	0	0	

- 1) Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
- 2) The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded), species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
- 3) The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.



Vegetation Performance Standards Summary Table												
	Veg Plot 1 F				Veg Plot 2 F				Veg Plot 3 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	567	2	11	0	607	2	9	0	567	2	7	0
Monitoring Year 0	688	2	12	0	648	2	9	0	607	2	7	0
	Veg Plot 4 F				Veg Plot 5 F				Veg Plot 6 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	607	2	7	0	486	2	7	0	1174	2	7	0
Monitoring Year 0	769	2	8	0	607	2	8	0	1214	2	8	0
	Veg Plot 7 F											
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives								
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	526	2	8	0								
Monitoring Year 0	850	2	10	0								

\*Each monitoring year represents a different plot for the random vegetation plot "groups". Random plots are denoted with an R, and fixed plots with an F.

Appendix C:  
Vegetation Monitoring  
Plot Photos and  
Encroachment Area Photos





3/23/21, 11:45 AM  
Johnston

Fixed Veg Plot 1 (MY-00)



11/11/21, 8:38 AM  
Johnston County

Fixed Veg Plot 1 (MY-01)



3/23/21, 1:12 PM  
Johnston

Fixed Veg Plot 2 (MY-00)



11/11/21 9:14 AM  
Johnston County

Fixed Veg Plot 2 (MY-02)





3/23/21, 2:18 PM  
Johnston

Fixed Veg Plot 3 (MY-00)



11/9/21 3:59 PM  
Johnston County

Fixed Veg Plot 3 (MY-01)



3/23/21, 2:41 PM  
Johnston

Fixed Veg Plot 4 (MY-00)



11/9/21, 3:50 PM  
Johnston County

Fixed Veg Plot 4 (MY-01)





3/23/21, 3:05 PM  
Johnston

Fixed Veg Plot 5 (MY-00)



11/9/21 3:40 PM  
Johnston County

Fixed Veg Plot 5 (MY-01)



3/23/21 9:13 AM  
Johnston County

Fixed Veg Plot 6 (MY-00)



11/9/21, 2:44 PM  
Johnston County

Fixed Veg Plot 6 (MY-01)





Fixed Veg Plot 7 (MY-00)



Fixed Veg Plot 7 (MY-07)



Encroachment Area, R3, Facing South (MY-01)

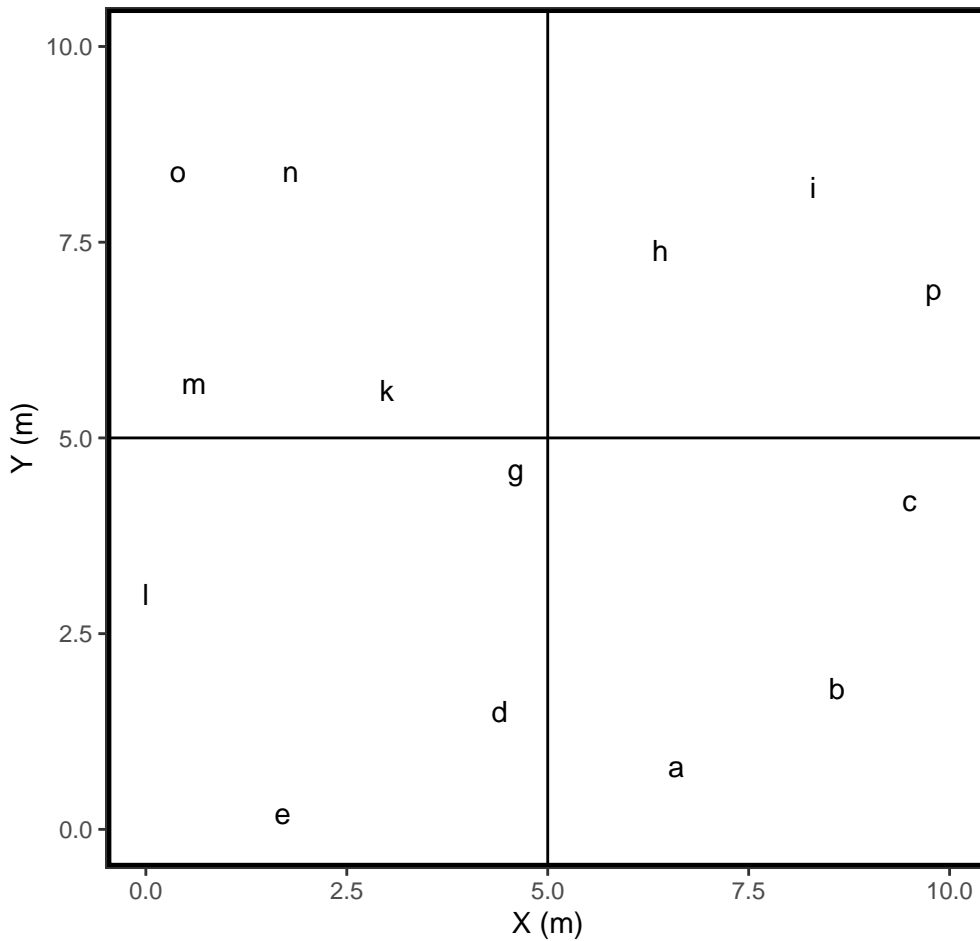


Encroachment Area, R3, Facing North (MY-01)

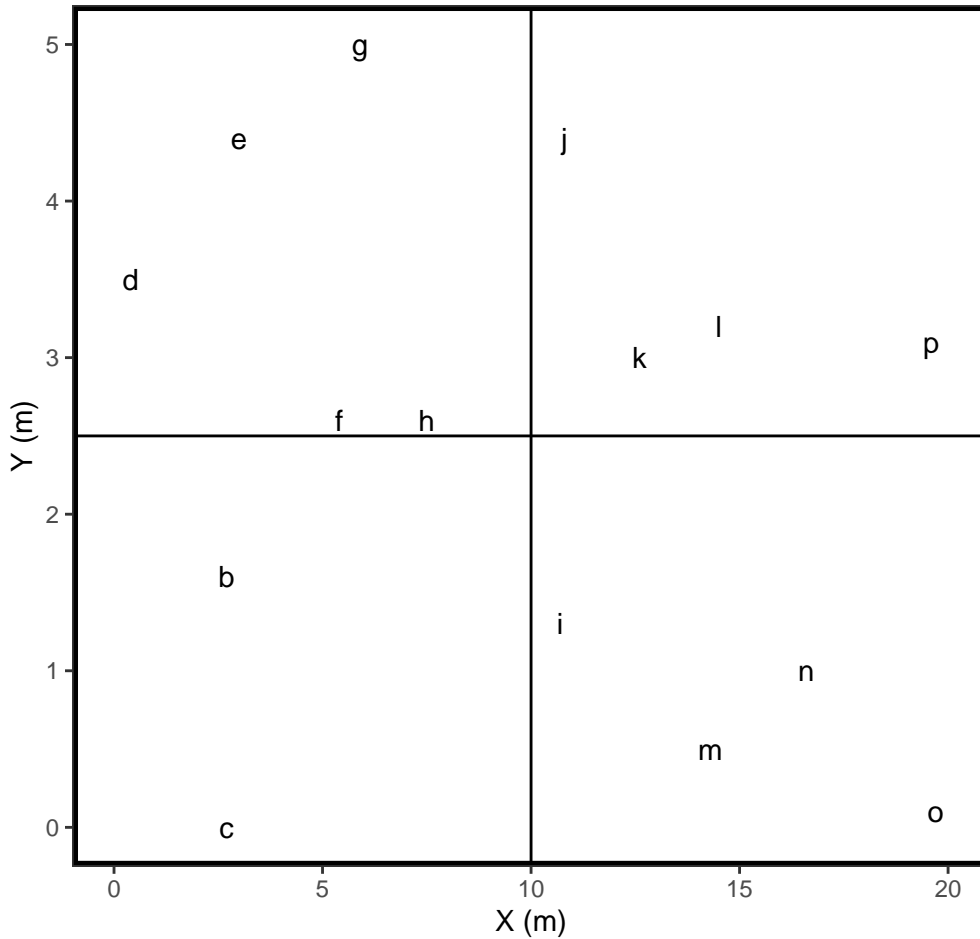


Appendix D:  
Vegetation Monitoring  
Plot Maps

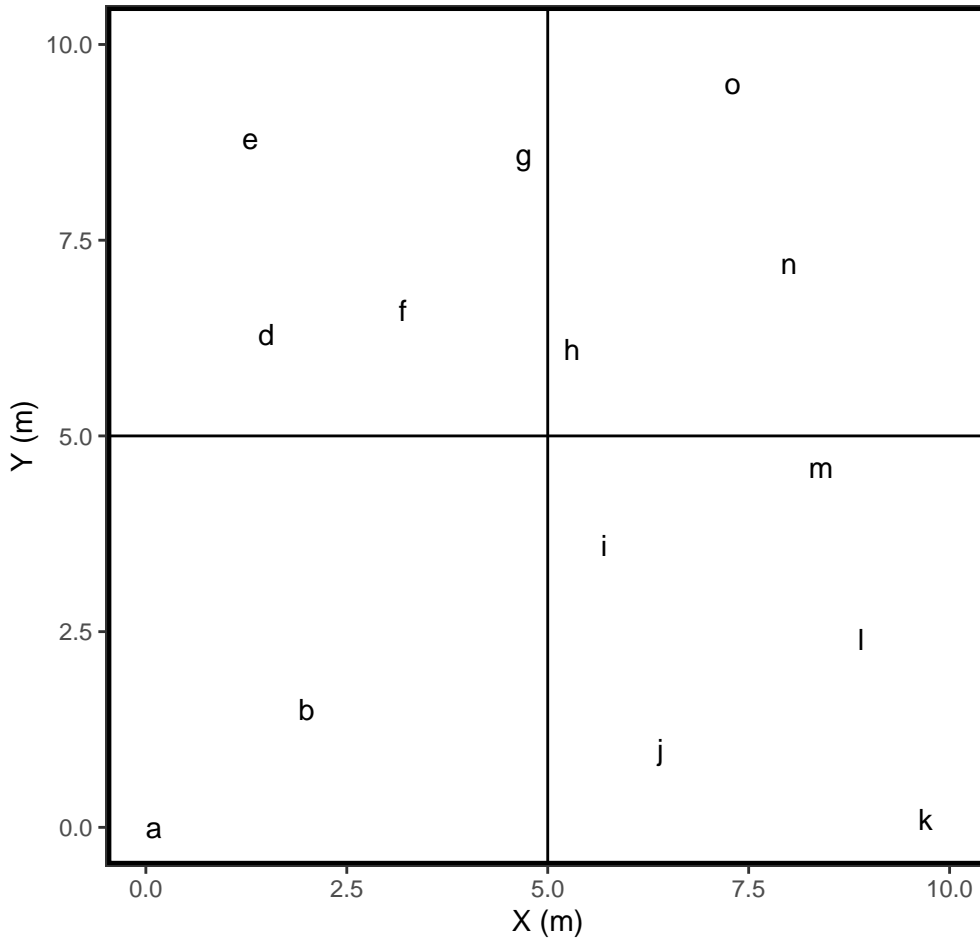
Plot 1



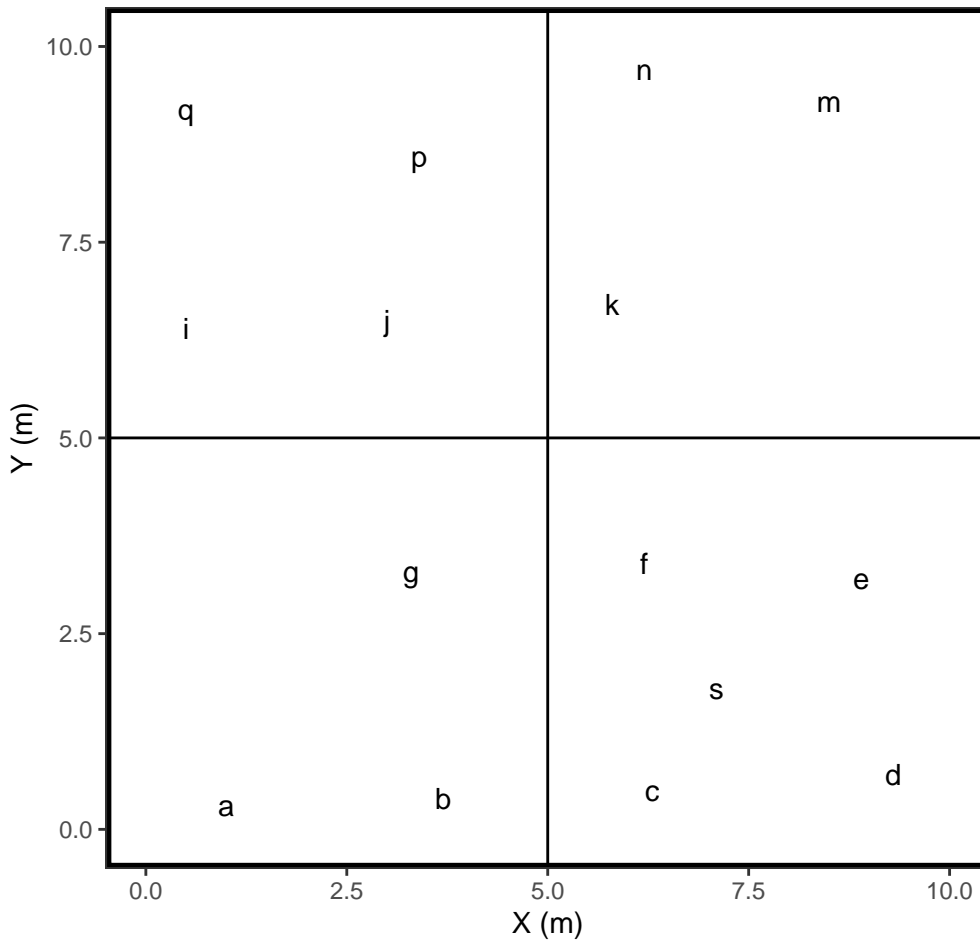
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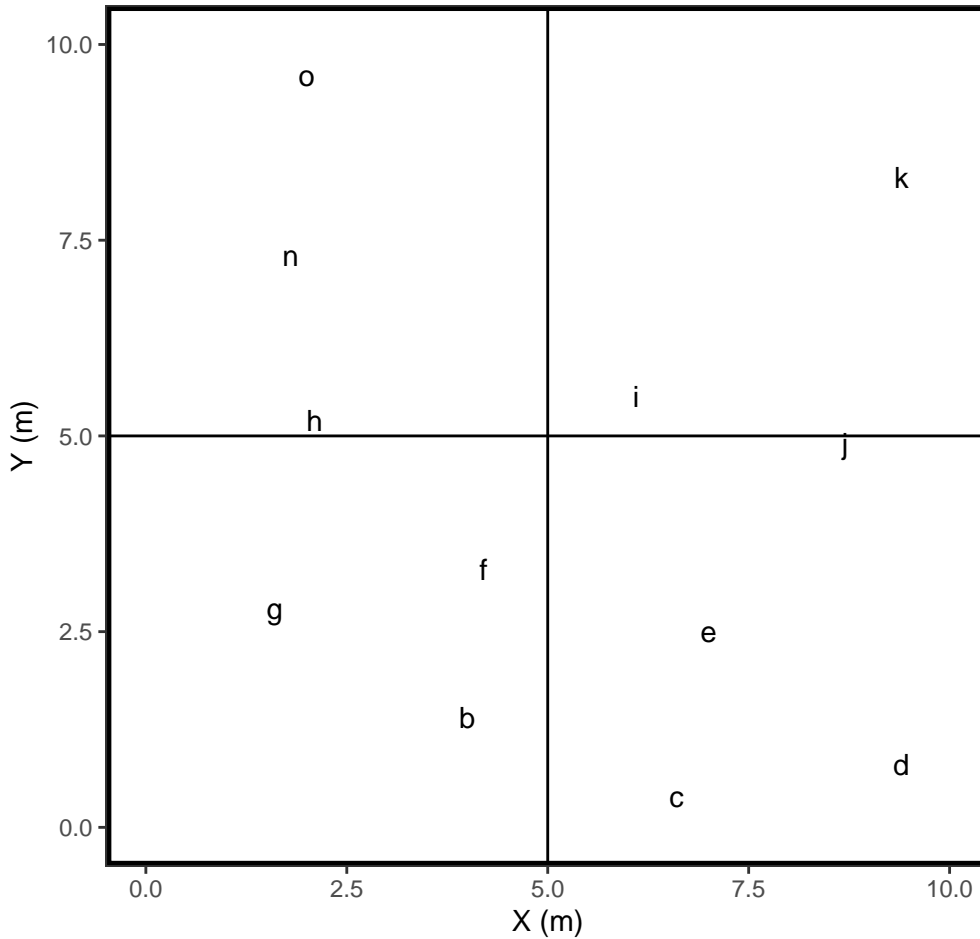
Plot 3



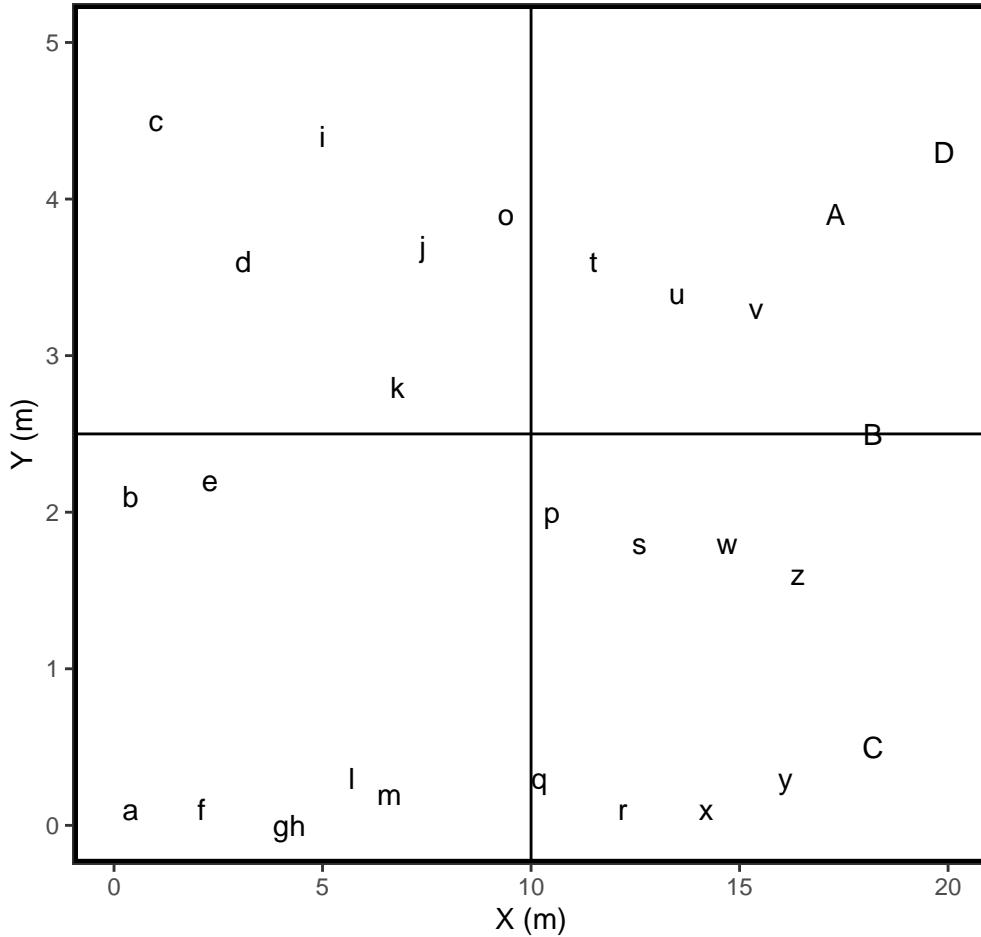
Plot 4



Plot 5

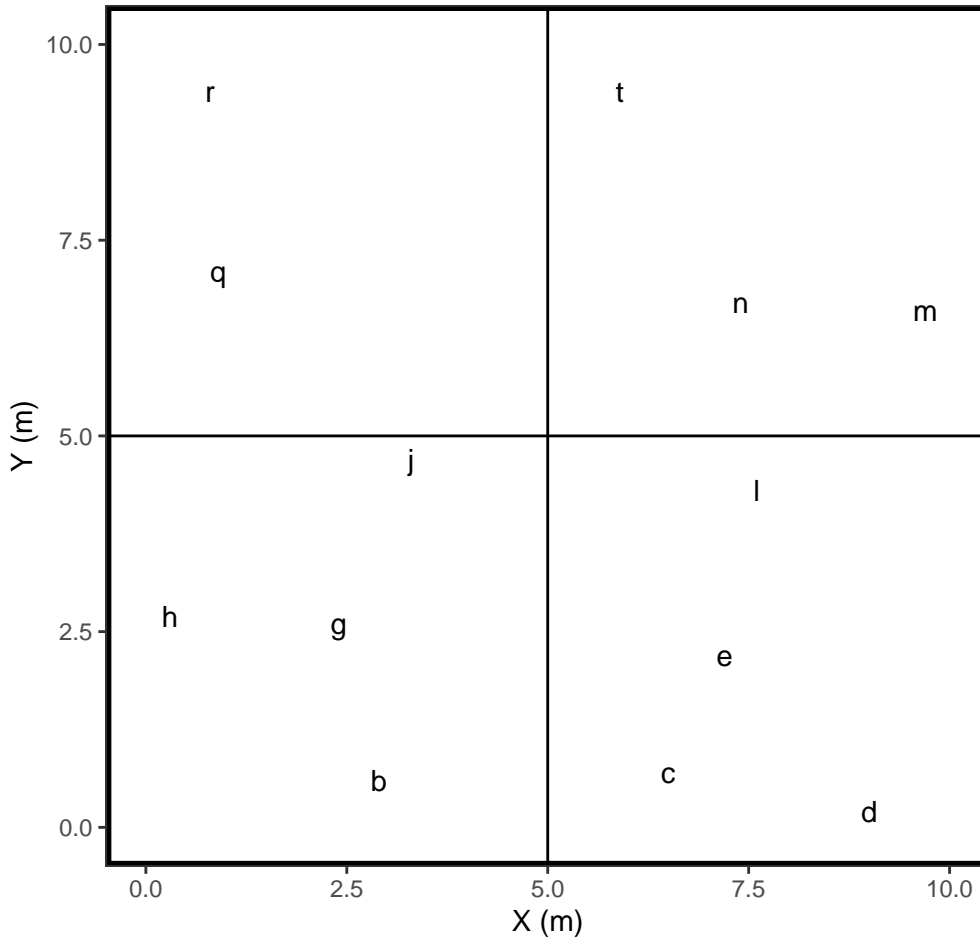


Plot 6





Plot 7



Appendix E:  
Headwater Stream  
Channel Formation Table

Headwater Stream Channel Formation Table Odells House Mitigation Project				
Channel Forming Indicators - R1	MY1	MY2	MY3	MY4
Scour (indicating sediment transport by flowing water)	No			
Sediment deposition (accumulations of sediment and/or formation of ripples)	No			
Sediment sorting (sediment sorting indicated by grain-size distribution within primary flow path)	No			
Multiple observed flow events (must be documented by gauge data and/or photographs)	Yes			
Destruction of terrestrial vegetation	No			
Presence of litter and debris	No			
Wracking (deposits of drift material indicating surface water flow)	No			
Vegetation matted down, bent, or absent (herbaceous or otherwise)	No			
Leaf litter disturbed or washed away	No			
Channel Forming Indicators - R5	MY1	MY2	MY3	MY4
Scour (indicating sediment transport by flowing water)	Yes			
Sediment deposition (accumulations of sediment and/or formation of ripples)	No			
Sediment sorting (sediment sorting indicated by grain-size distribution within primary flow path)	No			
Multiple observed flow events (must be documented by gauge data and/or photographs)	Yes			
Destruction of terrestrial vegetation	Yes			
Presence of litter and debris	No			
Wracking (deposits of drift material indicating surface water flow)	No			
Vegetation matted down, bent, or absent (herbaceous or otherwise)	Yes			
Leaf litter disturbed or washed away	No			