FINAL
ANNUAL MONITORING REPORT
GOLDSBORO HOUSING AUTHORITY

STREAM RESTORATION
WAYNE COUNTY, NORTH CAROLINA
(EEP Project Number 145, Contract No. 09070009)
Construction Completed October 2008

Monitoring Year 5 of 5 (2013)

Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

December 2013

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Prepared by:
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218 Snow Avenue
Raleigh, North Carolina 27603

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Axiom Environmental, Inc.

Ecosystem Enhancement PROGRAM

December 2013

Table of Contents

List of Figures

List of Tables

Appendices

Appendices (continued)

1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

The Goldsboro Housing Authority Mitigation Site (Site) is located in the northeast quadrant of the intersection of NC-581 and US-13 within the West Haven Apartments complex owned by the Goldsboro Housing Authority (GHA) in central Wayne County. As constructed the Site provides 799 stream mitigation units. The Site is located in United States Geological Survey (USGS) Hydrologic Unit 03020201200020 (North Carolina Division of Water Quality Subbasin 03-04-05) of the Neuse River Basin. The Site was identified to assist the North Carolina Ecosystem Enhancement Program in meeting mitigation goals. Primary activities at the Site included stream enhancement (levels I and II), creation of a Best Management Practice (BMP) constructed wetland, and replanting riparian areas with native vegetation. Project restoration efforts provided 799 Stream Mitigation Units and 1 Stormwater Wetland credit. 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 5 (2013) monitoring.

The primary components of the restoration project included the following.

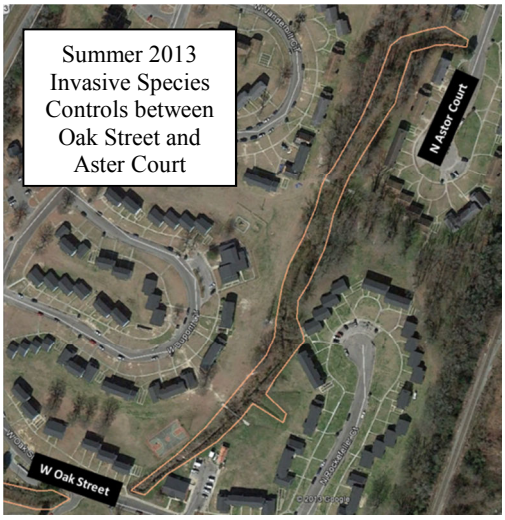
1. In keeping with the Neuse River Basinwide Management Plan developed by the North Carolina Division of Water Quality (NCDWQ), a major goal of the project is to reduce sediment and other water quality stressors, nitrogen in particular, to the receiving watershed. This was achieved via the following measures:
    a. Restore channel dimension throughout the Site to include bank resloping, benching, and provision of reference appropriate width-depth ratios to reduce near bank stress and attendant erosion, and to move bedload towards equilibrium, thereby preventing future bank instability related to potential bed aggradation and/or degradation.
    b. Replace the existing highly managed grass with an appropriate vegetated buffer providing root mass that will stabilize project banks, treating both overland and groundwater inputs.
    c. Install a large stormwater wetland adjacent to Unnamed Tributary to Borden Field Ditch (UTBFD) designed to receive and provide off-line treatment for a portion of storm flow that meets or exceeds a 1-inch storm event, which on average and over the long term is expected to occur several times per year. This will provide a significant sediment and biogeochemical sink for the inputs from the UTBFD watershed. The drainage area of the UTBFD is approximately 125 acres with approximately 50 acres of impervious surface. The existing Nitrogen load to the UTBFD at the location of the stormwater wetland is approximately 1229 pounds per year with an estimated potential reduction of 498 pounds per year as a result of BMP stormwater treatment. Calculations were provided in the design document and site plans permitted by NCDWQ. It is anticipated that the stormwater wetland will receive flow during several storm events each year, as the typical 1 inch storm event and the one year design storm are expected to overtop the weir by 1.8 or 2.7 feet, respectively.
2. Attenuate storm flows and excess hydrologic energies associated with this highly urban watershed via 1 a,b,c.
3. Enhance the natural aesthetic of the project corridor
4. Increase local awareness of natural resources in an urban setting and the conditions necessary for their improvement/enhancement.

Based on interagency guidelines (USACE 2003), success criteria dictate that survival of woody species planted at mitigation sites should be at a minimum density of 320 stems per acre at the end of the third monitoring year. Subsequently, 290 stems per acre must be surviving at the end of year 4 and 260 stems

per acre at the end of year 5. Based on the number of stems counted, average densities were measured at 648 planted stems per acre (excluding livestakes) surviving in year 5 (2013). All three vegetation plots met success criteria based on planted stems, ranging from 404 to 1052 planted stems per acre, with 3 to 7 planted species noted per plot. When considering all stems including natural recruits, stem densities ranged from 1255 to 2185 native woody stems per acre with 8 to 10 species noted per plot (13 species Site wide). Supplemental planting of the Site occurred on February 3, 2012 with 460 containerized trees as follows. These trees appear to be vigorous with a high survival rate. Areas planted are depicted on mapping in Appendix G.

Species	Quantity Planted
Scarlet Oak (*Quercus coccinea*)	75
River Birch (*Betula nigra*)	116
Green Ash (*Fraxinus pennsylvanica*)	111
Sugarberry (*Celtis laevigata*)	74
Shumard Oak (*Quercus shumardii*)	84

One dense Japanese honeysuckle (*Lonicera japonica*) population was identified on the outer rim of the stormwater BMP. This area is identified on Figure 2 (Appendix B). Invasive species controls, consisting of two herbicide treatments, occurred during the summer of 2013. Treatments targeted Chinese privet (*Ligustrum sinense*), callery pear (*Pyrus calleryana*), and tree of heaven (*Ailanthus altissima*) throughout the area between Oak Street and Aster Court (see photo to right). Treatments included cutting and applying herbicide to stumps of larger woody stems, and foliar application of herbicide to smaller material.



Success criteria for Site streams, to assure that project goals are being achieved, will primarily be based on indicators and trends describing the stability of the channel and success of the riparian buffer. In addition, a minimum of two bankfull events must be documented within the standard 5 year monitoring period. In order for the monitoring to be considered complete, the bankfull events must occur in separate monitoring years. Overall the reach has conserved the riffle cross-sectional area in the last few monitoring years and bank erosion is minimal to non-existent across the Site. However, there are a few depositional areas, which seem to be the result of trash and debris deposited in the channel or washed in during storm events. This was most notable in Cross-section 2 for Year 4 (2012) and Year 5 (2013), while Cross-section 3 indicated prior sediment deposition was mobilized in Year 5 (2013); these depositional areas were not accompanied by channel widening. Cross-section 4 had to be reset in Year 4 (2012) and exhibits a later shift as a result; however, the cross-sectional area was conserved. In addition, two bankfull events were documented to occur in Year 5 (2013) to date for a total of ten bankfull events during the monitoring period.

Two stream areas of concern were noted within the Site as outlined in the following table (Figure 2, Appendix B).

Stream Areas of Concern

Map Identifier	Feature/Issue	Probable Cause
Area of Concern 1	Aggradation at an upstream bend	Sediment deposition from culvert outlet
Area of Concern 2	Aggradation at a pool near veg plot 2	Sediment and trash deposition from the surrounding community

In summary, the Site achieved success criteria for vegetation and stream attributes in the Fifth Monitoring Year (2013). 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

2.1 Vegetation Assessment

Following Site construction, three plots (20-meters by 5-meters) were established and monumented with metal rebar at all plot corners. Plots were surveyed on September 17, 2013 for the year 5 (2013) monitoring season. Sampling was conducted as outlined in the *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (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). The locations of vegetation monitoring plots are depicted on Figure 2 in Appendix B.

2.2 Stream Assessment

Four permanent cross-sections were established after construction was completed. Measurements of each cross-section include points at all breaks in slope including top of bank, bankfull, and thalweg. Riffle cross-sections are classified using the Applied Fluvial Morphology (Rosgen 1996) stream classification system. Cross-section plots and data are included in Appendix D; the locations of cross-sections are depicted on Figure 2 in Appendix B.

3.0 REFERENCES

Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation, Version 4.0. (online). Available: http://cvs.bio.unc.edu/methods.htm

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology (Publisher). Pagosa Springs, Colorado.

United States Army Corps of Engineers (USACE), United States Environmental Protection Agency (USEPA), North Carolina Wildlife Resources Commission (NCWRC), Natural Resources Conservation Service (NRCS), and North Carolina Division of Water Quality (NCDWQ). 2003. Stream Mitigation Guidelines. 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.

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Weather Underground. 2013. Station KNCGOLDS7 in Goldsboro, North Carolina. (online). Available: http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=KNCGOLDS7 [October 2, 2013]. Weather Underground.

APPENDIX A

PROJECT VICINITY MAP AND BACKGROUND TABLES

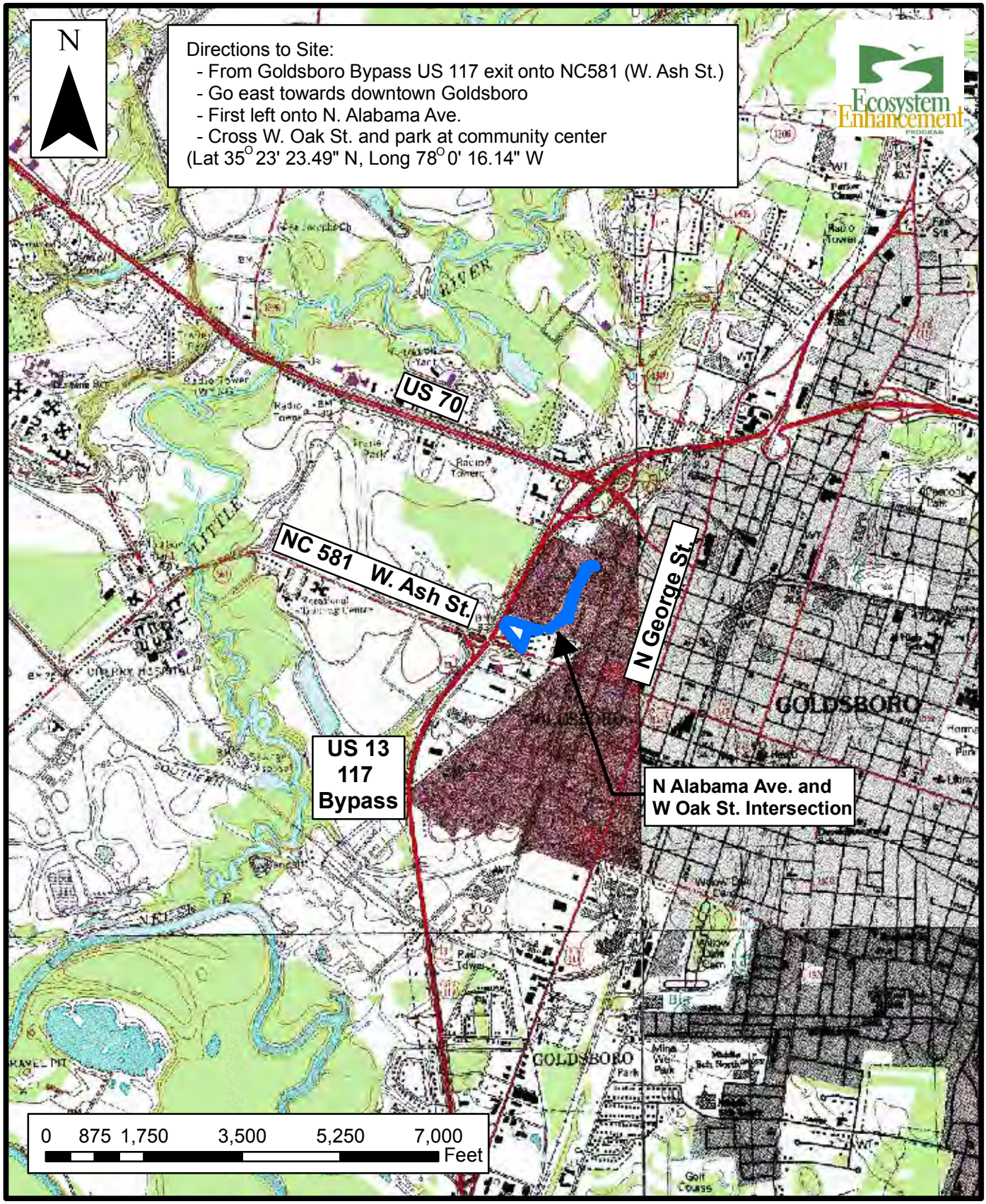
Figure 1. Site Location

Table 1. Site Restoration Structures and Objectives

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Attributes Table



20 Enterprise St. #7
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(919) 215-1693
(919) 341-3839 (fax)

SITE LOCATION
GOLDSBORO HOUSING AUTHORITY - EEP #145
STREAM RESTORATION PROJECT
Wayne County, North Carolina

Dwn. By: WGL	FIGURE
Date: June 2009	1
Project: 08-001	

Table 1. Site Restoration Structures and Objectives
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)

Project Component or Reach ID	Restoration Level	Approach	Footage or Acreage	Stationing *	Ratio	Mitigation Units	BMP Elements **	Comment
UTBFD-Reach1^	EII	P2	275	3+75 – 6+50	2.0	138		Systemic change to dimension and planted buffer
UTBFD-Reach2	-	P4	200	8+25 – 10+25	0.0	0		Primarily stabilized via hardening with rip rap above Oak Street due to need to protect adjacent housing
UTBFD-Reach3^	EII	P2/P3	275	10+25 – 13+00	2.0	138		Combination of P2/P3. Systemic dimensional enhancement with planted buffer.
UTBFD-Reach4	EI	P2	200	13+00 - 15+00	1.5	133		Alignment change. Systemic enhancement to dimension, modest enhancement to pattern and profile. Obstacle avoidance and removal of pattern jeopardizing stability
UTBFD-Reach5^	EII	P3	675	15+00 - 21+75	2.0	338		Systemic change to dimension and planted buffer
UTBFD-Reach6	EII	P2	133	21+75 - 23+08	2.5	53		Alignment change. Systemic enhancement to dimension, pattern and profile. Obstacle avoidance and removal of pattern jeopardizing stability. Buffer is heavily constrained
BMP	-	-	1.09 acre	At confluence			SW	Large stormwater wetland intercepting storm flow from 123 acre UT. 498 pound per year Nitrogen reduction calculated in sealed, permitted Mitigation Plan.

*Stationing is from bottom to top; **SW = Stormwater Wetland; ^Given that the change to the channel dimension was systemic, a buffer was installed and the Site included a large stormwater practice, a ratio of 2.0 was assigned at baseline.

Component Summations				
Restoration Level	**Stream (lf)**	**Ratio**	**Mitigation Units**	**BMP**
Enhancement I	200	1.5	133	
Enhancement II	1225	2.0	613	
Enhancement II	133	2.5	53	
				1 SW
Totals	1558		799	1 SW

Table 2. Project Activity and Reporting History
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)

Activity or Report	Data Collection Completion	Actual Completion or Delivery
Restoration Plan	--	June 2006
Construction Completion	NA	October 2008
BMP Planting	NA	November 2008
Streamside/Buffer Planting	NA	November 2008
Mitigation Plan / Asbuilt (Year 0 Monitoring Baseline)	October 2008	July 2009
Year 1 Annual Monitoring	September 2009	October 2009
Year 2 Annual Monitoring	September 2010	October 2010
Year 3 Annual Monitoring	August 2011	November 2011
Supplemental Planting (460 Plants)	NA	February 2012
Year 4 Annual Monitoring	August 2012	October 2012
Invasive Species Management (Two Applications)	NA	Summer 2013
Year 5 Annual Monitoring	September 2013	October 2013

Table 3. Project Contacts Table
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)

Designer	Dewberry & Davis, Inc. 2301 Rexwoods Drive Raleigh, North Carolina 27607 Sheila Reeves (919) 8819939
Construction Contractor	Appalachian Environmental Services 1165 W. Main St. Sylva, North Carolina 28779 Mickey Henson (828) 5861973
Planting Contractor	Habitat Assessment and Restoration Program, Inc. 9305D Monroe Rd. Charlotte, North Carolina 28270 Alan Peoples (704) 9750881
Year 1-5 (2009-2013) Monitoring Performer	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis (919) 215-1693

Table 4. Project Attribute Table
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)

Project County	Wayne County, North Carolina
Physiographic Region	Coastal Plain
Ecoregion	Southeastern Floodplains and Low Terraces
River Basin	Neuse
USGS 14digit HUC	03020201200020
NCDWQ Subbasin	030405
Within EEP Watershed Plan?	No
WRC Class	Warm
% of project easement fenced	~ 45%
Beaver activity observed during the design phase?	No
Drainage Area	UTBFD at outfall: 0.40 square miles UT at confluence with UTBFD: 0.17 square miles
Restored/Enhanced stream lengths (linear feet)	1558
Perennial or Intermittent	Perennial
Watershed type	Developed
Watershed distribution	40% Commercial 38% Residential 14% Industrial 10% Open Space
Watershed impervious cover	~ 35 percent
Stream Order	UTBFD: First and Second UT to UTBFD: First
Rosgen Classification of Asbuilt	E5/C5type
Dominant Soil Types	Norfolk, Johns, Lumbee, Wickham
Reference Site ID	UT to Little River (REF1) and unspecified stream in Moores Crossroads, NC (REF2)
NCDWQ Classification	Not classified, drains to Borden Field Ditch (275723, C,NSW)
303d listed?	No
Upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	Not Applicable
Total acreage of easement	~ 4.7 acres
Total planted acreage as part of the restoration	~ 4.7 acres
Rosgen classification of preexisting	F5/G5
Rosgen classification of asbuilt	C5/E5
Valley type	VIII
Valley slope	.26.46 %
Cowardin classification	R3UB2
Trout waters designation	No
Species of concern, endangered, etc.?	No

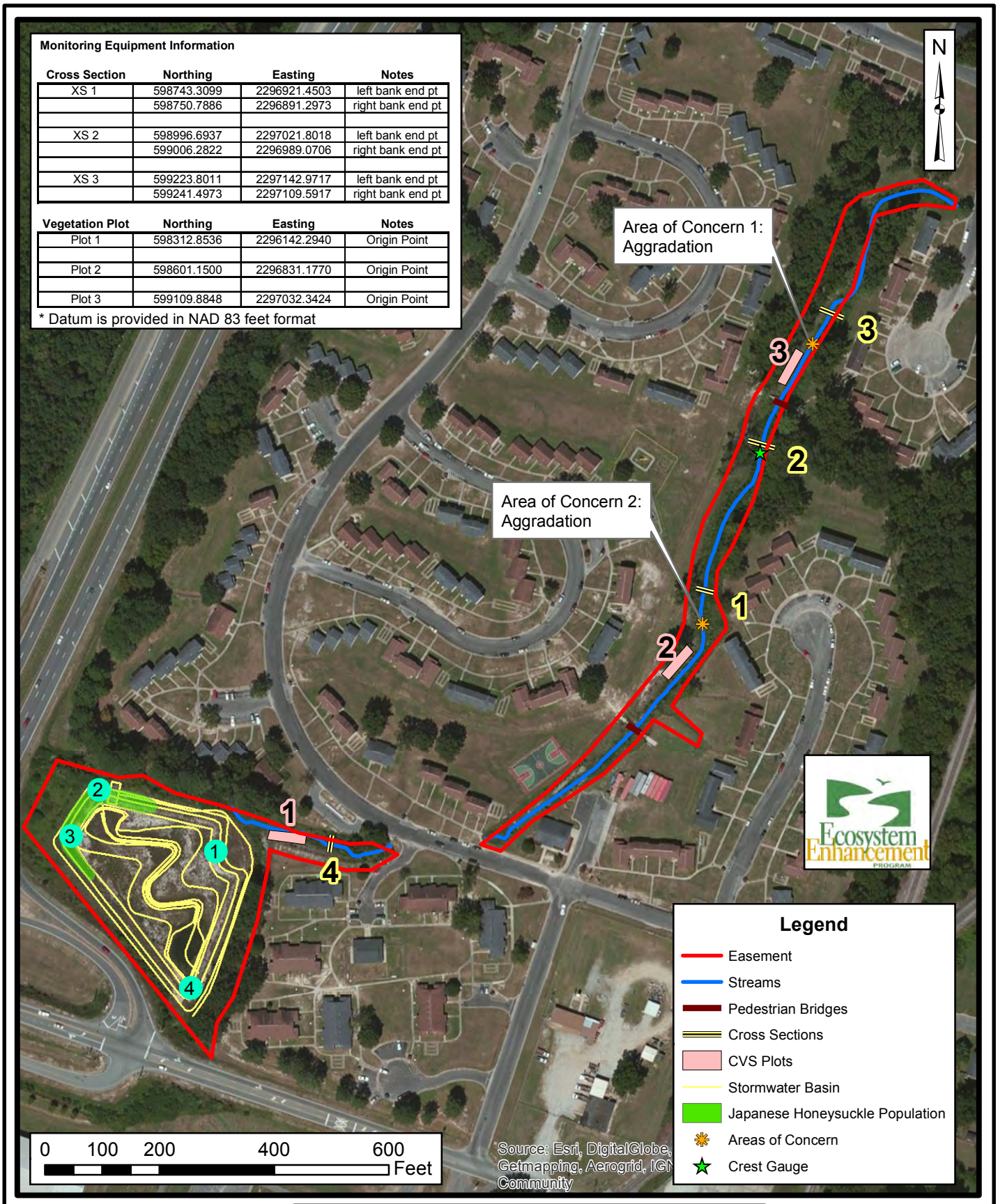
APPENDIX B

VISUAL ASSESSMENT DATA

Figure 2. Current Conditions Plan View

Figure 3. Asset Map

Vegetation Monitoring Plot Photos



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

CURRENT CONDITIONS PLAN VIEW
GOLDSBORO HOUSING AUTHORITY - EEP #145
STREAM RESTORATION PROJECT
Wayne County, North Carolina

Dwn. By:	CLF/KRJ
Date:	Oct. 2013
Project:	12-004.08

FIGURE 2

Table 1. Site Restoration Structures and Objectives
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)

Project Component or Reach ID	Restoration Level	Approach	Footage or Acreage	Stationing *	Ratio	Mitigation Units	BMP Elements **	Comment
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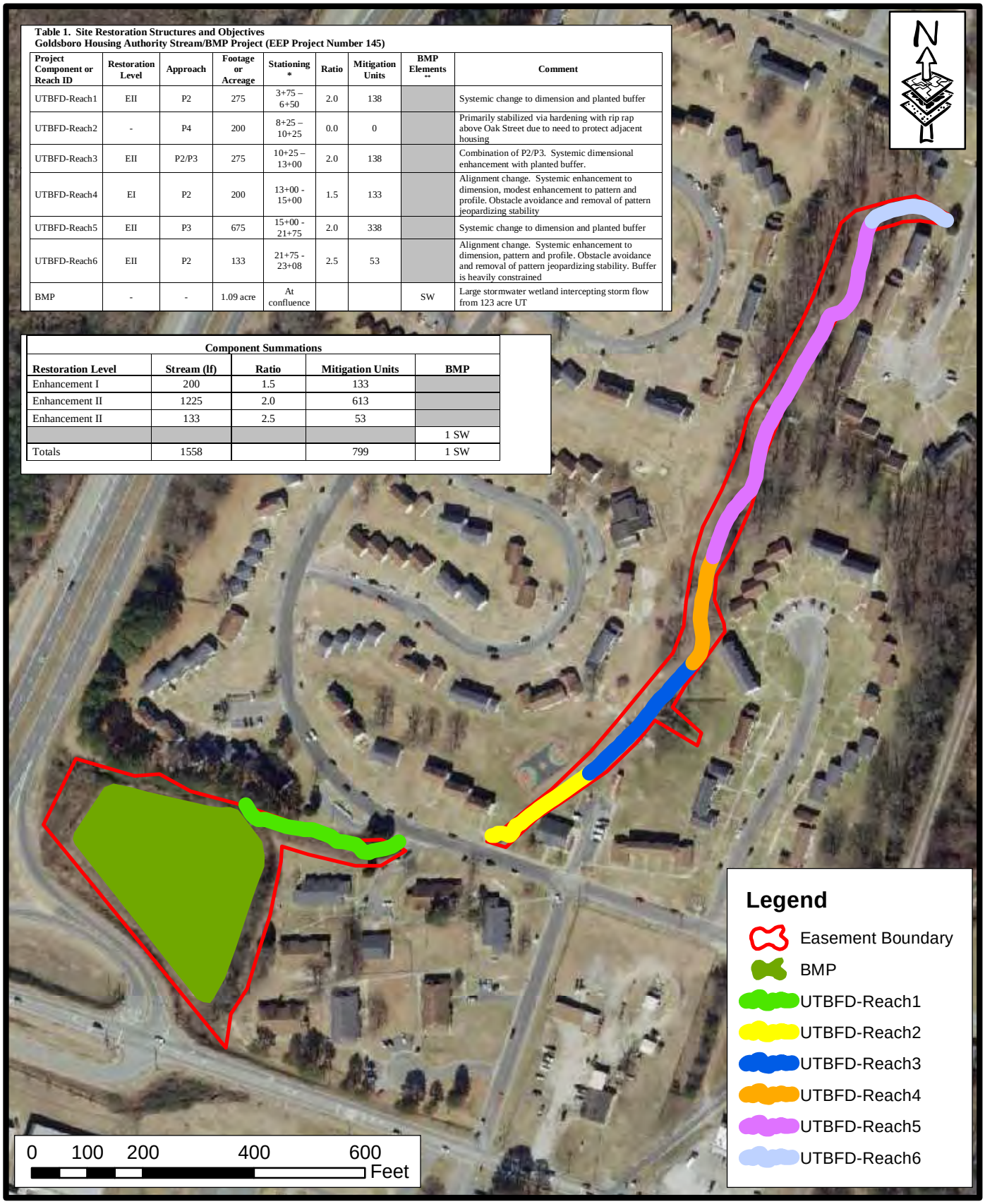

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ASSET MAP
GOLDSBORO HOUSING AUTHORITY - EEP #145
STREAM RESTORATION PROJECT
Wayne County, North Carolina

Dwn. By: KRJ
Date: Dec 2012
Project: 12-004.08

FIGURE 3

Goldsboro Housing Authority
Year 5 (2013) Annual Monitoring
Vegetation Plot Photos (taken September 17, 2013)

APPENDIX C

VEGETATION ASSESSMENT DATA

Table 5. Vegetation Plot Mitigation Success Summary

CVS Summary Data Tables

Table 6. Vegetation Metadata Table

Table 7. Total and Planted Stems by Plot and Species

Table 5. Vegetation Plot Mitigation Success Summary Table
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	Yes	100%
2	Yes	
3	Yes	

Table 6. Vegetation Metadata Table
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)

Report Prepared By	Corri Faquin
Date Prepared	9/26/2013 14:23
database name	Axiom-EEP-2013-A-v2.3.1-FINAL.mdb
database location	S:\CVS database\2013
computer name	KEENAN-PC
file size	43888640
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.
ALL 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	145
project Name	Goldsboro Housing Authority
Description	Stream Restoration
River Basin	Neuse
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	3

Table 7. Total and Planted Stems by Plot and Species
EEP Project Code 145. Project Name: Goldsboro Housing Authority

			Current Plot Data (MY5 2013)									Annual Means																
			E145-AXE-0001			E145-AXE-0002			E145-AXE-0003			MY5 (2013)			MY4 (2012)			MY3 (2011)			MY2 (2010)			MY1 (2009)			MY0 (2009)		
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
Acer rubrum	red maple	Tree																		1			1					
Baccharis halimifolia	eastern baccharis	Shrub						4			6			10			8			8			7					
Betula nigra	river birch	Tree	22	22	22	1	1	1	1	1	1	24	24	24	25	25	25	22	22	35	22	22	45	14	14	32	16	16	16
Celtis laevigata	sugarberry	Tree	1	1	1	2	2	3				3	3	4	3	3	3									1			
Fraxinus pennsylvanica	green ash	Tree	1	1	1	1	1	1				2	2	2	2	2	2												
Juniperus virginiana	eastern redcedar	Tree						5			1			6			1			3								
Ligustrum sinense	Chinese privet	Exotic									1			1														
Liquidambar styraciflua	sweetgum	Tree			6			14			9			29			18			30			9			24			9
Morella cerifera	wax myrtle	shrub	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
Pinus taeda	loblolly pine	Tree			12									12			8			6			2					
Platanus occidentalis	American sycamore	Tree				3	3	3	8	8	8	11	11	11	12	12	12	13	13	13	15	15	15	16	16	16	18	18	18
Prunus serotina	black cherry	Tree			2			18			4			24			13			50			29			62			
Quercus	oak	Tree																											1
Quercus coccinea	scarlet oak	Tree	1	1	1							1	1	1															
Quercus phellos	willow oak	Tree															1										3	3	3
Quercus rubra	northern red oak	Tree				1	1	1				1	1	1	1	1	1												
Salix	willow	Shrub or Tree																		3									
Salix nigra	black willow	Tree				3	3	3				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5
Sambucus canadensis	Common Elderberry	Shrub																										4	4
		Stem count	26	26	46	12	12	54	10	10	31	48	48	131	49	49	98	41	41	155	43	43	114	36	36	141	44	48	60
		size (ares)	1			1			1			3			3			3			3			3			3		
		size (ACRES)	0.02			0.02			0.02			0.07			0.07			0.07			0.07			0.07			0.07		
		Species count	5	5	8	7	7	11	3	3	8	8	8	14	7	7	13	4	4	11	4	4	9	4	4	7	5	6	8
		Stems per ACRE	1052	1052	1862	485.6	485.6	2185	404.7	404.7	1255	647.5	647.5	1767	661	661	1322	553.1	553.1	2091	580	580	1538	485.6	485.6	1902	593.5	647.5	809.4

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

APPENDIX D

STREAM SURVEY DATA

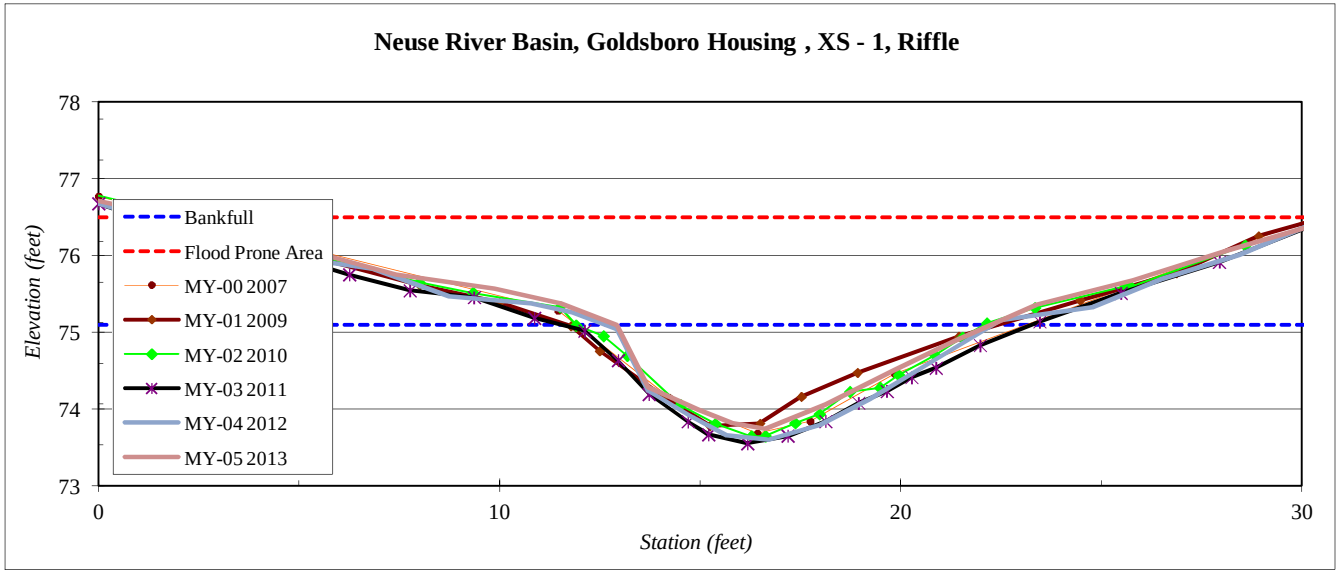
Cross-section Plots

River Basin:	Neuse
Watershed:	Goldsboro Housing
XS ID	XS - 1, Riffle
Drainage Area (sq mi):	0.2
Date:	2/22/2013
Field Crew:	Perkinson, Jernigan

Station	Elevation
0.0	76.7
3.2	76.4
7.4	75.7
9.9	75.6
11.5	75.4
12.9	75.1
13.7	74.3
15.0	74.0
15.8	73.8
16.6	73.7
18.1	74.1
19.8	74.5
21.3	74.9
23.4	75.4
25.8	75.7
28.2	76.1
31.2	76.5

SUMMARY DATA	
Bankfull Elevation:	75.1
Bankfull Cross-Sectional Area:	7.5
Bankfull Width:	9.3
Flood Prone Area Elevation:	76.5
Flood Prone Width:	25.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.8
W / D Ratio:	11.5
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.0

Stream Type	E/C

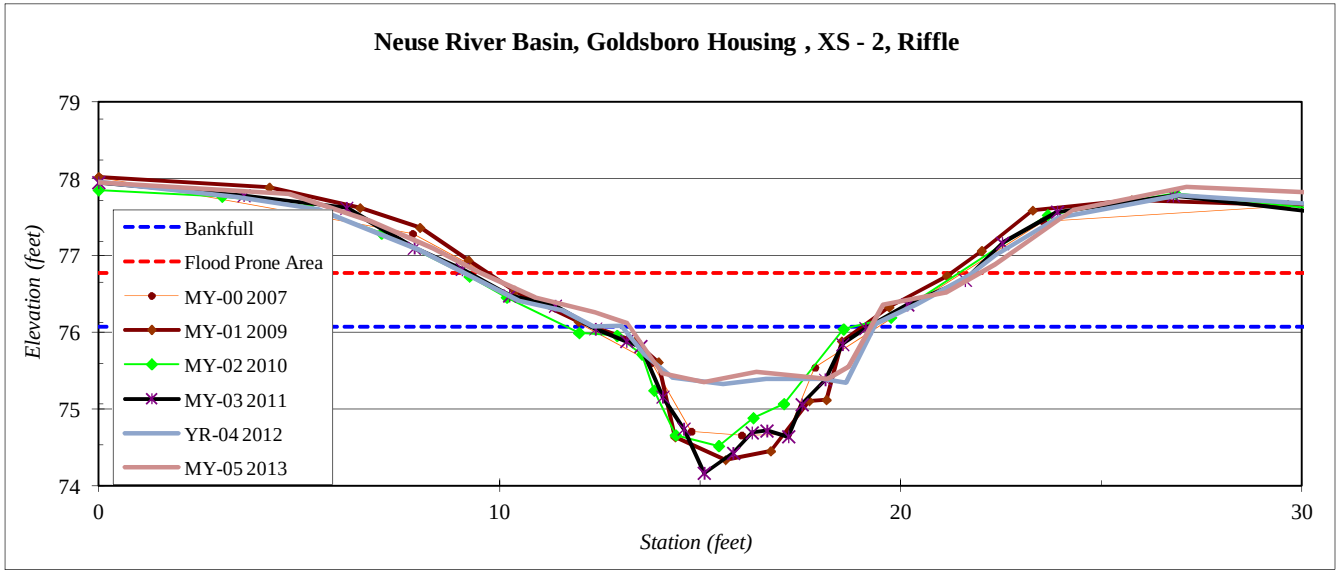


River Basin:	Neuse
Watershed:	Goldsboro Housing
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	0.2
Date:	2/22/2013
Field Crew:	Perkinson, Jernigan

Station	Elevation
0.0	77.9
4.8	77.8
6.8	77.4
8.3	77.1
9.5	76.8
10.9	76.4
12.4	76.3
13.2	76.1
14.0	75.5
15.1	75.3
16.4	75.5
18.2	75.4
18.7	75.5
19.6	76.4
21.1	76.5
22.4	76.9
24.3	77.6
27.1	77.9
32.1	77.8
34.7	77.9

SUMMARY DATA	
Bankfull Elevation:	76.1
Bankfull Cross-Sectional Area:	3.4
Bankfull Width:	6.0
Flood Prone Area Elevation:	76.8
Flood Prone Width:	13.0
Max Depth at Bankfull:	0.7
Mean Depth at Bankfull:	0.6
W / D Ratio:	10.6
Entrenchment Ratio:	2.2
Bank Height Ratio:	1.0

Stream Type	E

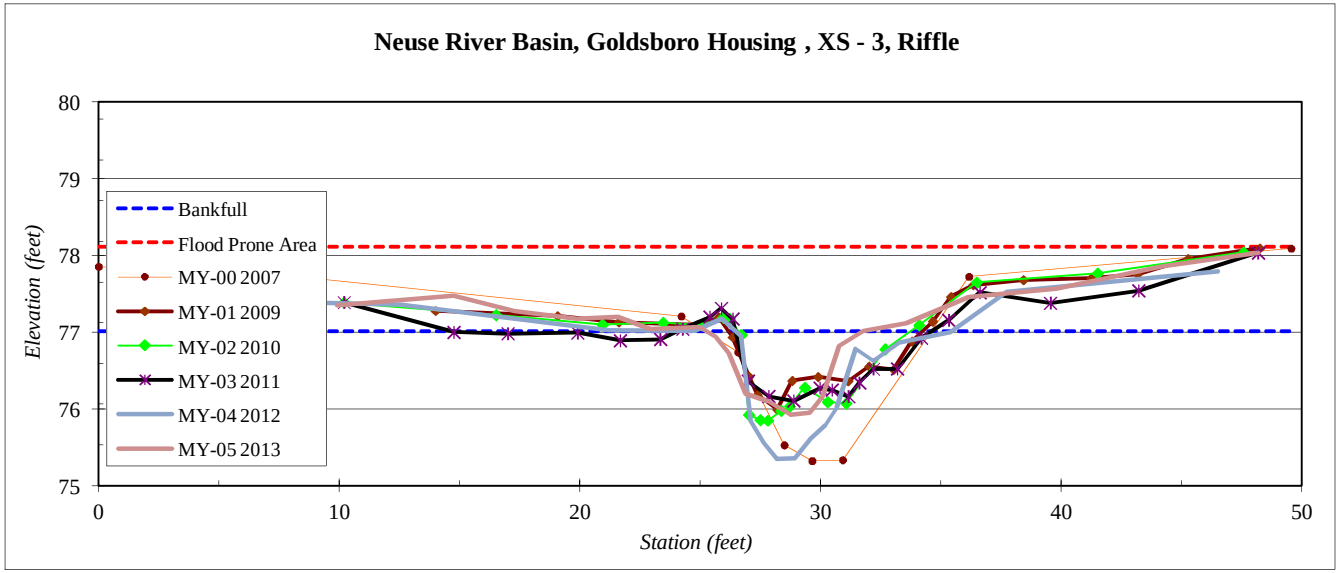


River Basin:	Neuse
Watershed:	Goldsboro Housing
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	0.2
Date:	2/22/2013
Field Crew:	Perkinson, Jernigan

Station	Elevation
9.9	77.3
14.8	77.5
17.3	77.3
19.9	77.2
21.6	77.2
22.9	77.0
24.9	77.1
25.7	76.9
26.2	76.7
26.9	76.2
27.8	76.1
28.7	75.9
29.5	75.9
29.6	76.0
30.1	76.2
30.8	76.8
31.8	77.0
33.6	77.1
36.2	77.5
39.8	77.6
44.2	77.9
48.2	78.0

SUMMARY DATA	
Bankfull Elevation:	77.0
Bankfull Cross-Sectional Area:	4.1
Bankfull Width:	6.6
Flood Prone Area Elevation:	78.1
Flood Prone Width:	50.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.6
W / D Ratio:	10.6
Entrenchment Ratio:	7.6
Bank Height Ratio:	1.0

Stream Type	C/E

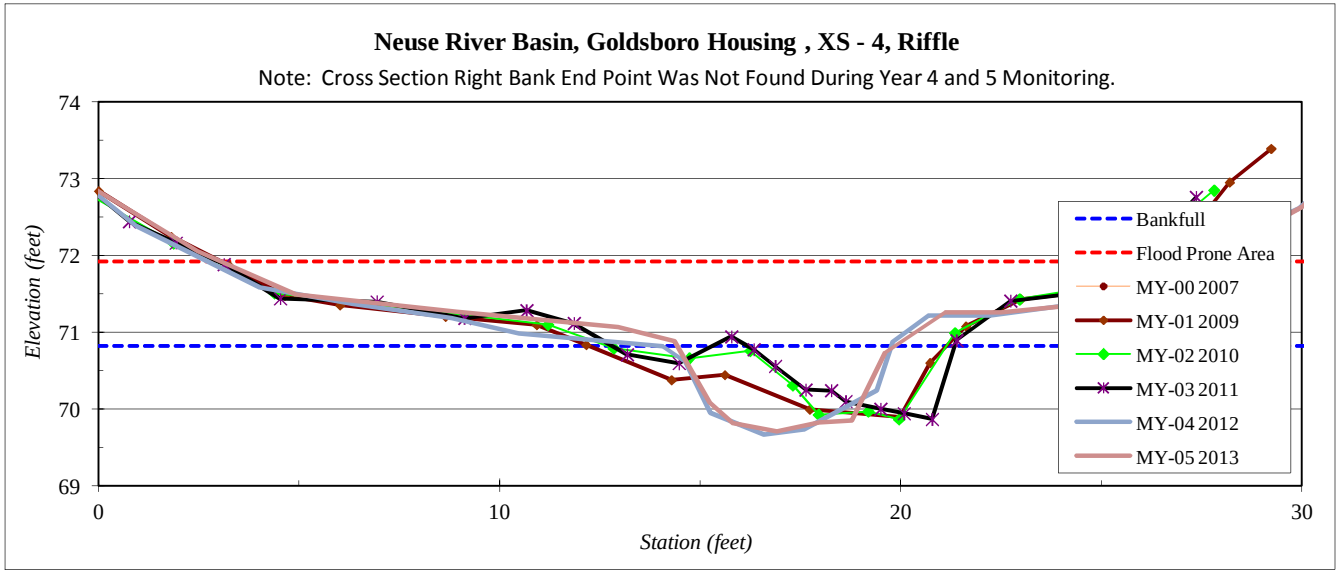


River Basin:	Neuse
Watershed:	Goldsboro Housing
XS ID	XS - 4, Riffle
Drainage Area (sq mi):	0.2
Date:	2/22/2013
Field Crew:	Perkinson, Jernigan

Station	Elevation
-0.2	72.9
2.5	72.0
4.9	71.5
8.9	71.3
13.0	71.1
14.4	70.9
15.2	70.1
15.8	69.8
16.9	69.7
18.0	69.8
18.8	69.8
19.6	70.7
21.1	71.3
22.5	71.3
24.1	71.3
26.9	71.8
28.8	72.3
30.0	72.6
32.6	74.0
34.6	74.9

SUMMARY DATA	
Bankfull Elevation:	70.8
Bankfull Cross-Sectional Area:	4.3
Bankfull Width:	5.5
Flood Prone Area Elevation:	71.9
Flood Prone Width:	23.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.8
W / D Ratio:	7.0
Entrenchment Ratio:	4.2
Bank Height Ratio:	1.0

Stream Type	C/E



APPENDIX E

HYDROLOGIC DATA

Table 8. Verification of Bankfull Events

Table 8. Verification of Bankfull Events

Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
July 11, 2009	Between May 5-11, 2009	Total of 4.74 inches* of rain reported to fall over 7 days	--
November 12, 2009	November 12, 2009	Overbank resulting from a total of 4.47 inches* of rain reported to fall over 3 days as the result of Tropical Storm Ida	--
February 9, 2010	February 5, 2010	Visual observations of overbank event including crest gauge, wrack lines, and wrack in saplings from a 1.95-inch* rainfall event on February 5, 2009 that occurred after numerous rainfall events within the 3 weeks prior to that date that totaled 4.43 inches.	1-2
September 28, 2010	September 26-27, 2010	Rainfall data totaling 3.99 inches* over a period of two days.	--
February 2, 2011	February 2, 2011	Visual observations of overbank event including crest gauge, wrack lines, and wrack in saplings from a 2.58-inch* rainfall event on February 2, 2011 that occurred after a 1.89-inch rainfall event the week before.	3
July 21, 2011	April 16, 2011	Visual observations of overbank event including crest gauge, wrack lines, and wrack in saplings from a 2.25-inch* rainfall event on April 16, 2011 that occurred after a total of 2.25 inches of rain that fell the ten days before.	--
August 31, 2011	August 25, 2011	Visual observations of stream overbanking as a result from 6.12-inch* rainfall from Hurricane Irene	4
August 23, 2012	July 24, 2012	Total of 4.52 inches* of rain reported to fall over 5 days	--
October 2, 2013	June 26, 2013	Total of 8 inches** of rain reported to fall between June 22-July2, 2013	--
October 2, 2013	September 22, 2013	Total of 2.5 inches** of rain reported to fall over 2 days	--

* Reported at the Goldsboro Airport (Weather Underground 2012)

**Reported in Goldsboro, NC Station KNCGOLDS7 (Weather Underground 2013)

Bankfull Event Photos 1-2

Bankfull Event Photo 3

Bankfull Event Photo 4

APPENDIX F

BMP ASSESSMENT DATA

Fixed Photo Stations

Goldsboro Housing Authority Stream/BMP Project
(EEP Project Number 145)
Fixed-Station Photographs

Taken September 17, 2013

APPENDIX G

SUPPLEMENTAL PLANTING

NOTES:
Vehicle access to staging areas from West Oak Steet.
Gator/4-wheeler access from staging area to project areaa
and planting areas.
Project area NOT fenced.
Gator access to planting areas along edge of project area.

k

Legend

- Site Entry Points
- Staging Area
- Site Access
- Planting_Zones_EAST
- Planting_EAST_easements

0 100 200 400 Feet

Supplemental Planting
SITE ACCESS

Goldsboro Housing - EEP #145

October 2010

APPENDIX H

ADDITIONAL SITE PHOTOGRAPHS

Preconstruction Site Photographs

Asbuilt Site Photographs

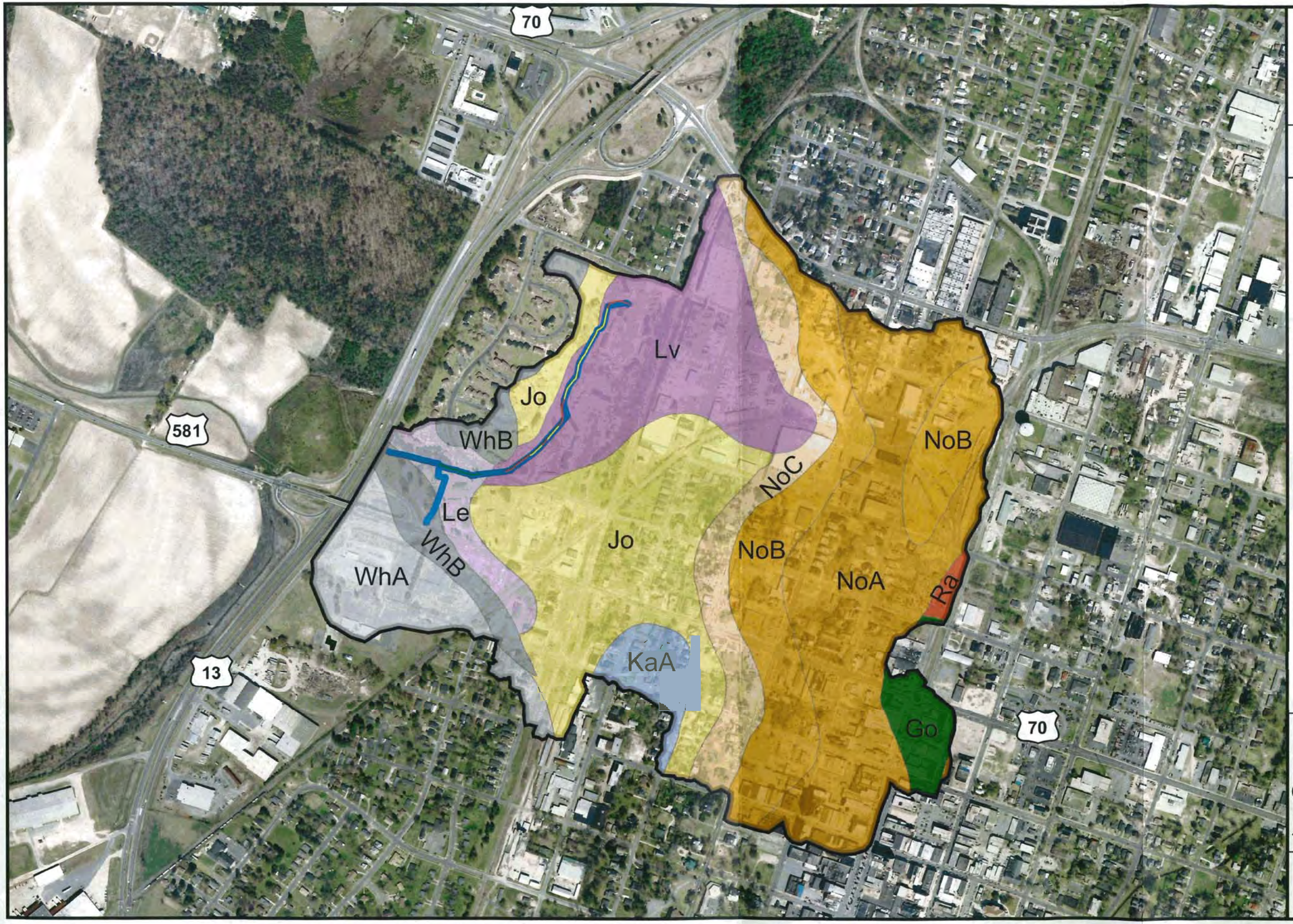
Preconstruction Site Photographs

Asbuilt Site Photographs

APPENDIX I

ADDITIONAL SITE MAPPING

Soils Map from 2006 Restoration Plan



GOLDSBORO HOUSING AUTHORITY STREAM RESTORATION PROJECT

Project Watershed Soils Map

Legend

UTBFD

UT

Soils - Project Watershed

DSL Name

- Go
- Jo
- KaA
- Le
- Lv
- NoA
- NoB
- NoC
- Ra
- WhA
- WhB

Stream Priority

Priority

- Enhancement
- Priority 2
- Priority 3

N

0 300 600 Feet

1 inch equals 600 feet

Dewberry
2301 REXWOODS DR.
SUITE 200
RALEIGH, NC 27607