UT Goose Creek (Greene Mitigation) Stream Enhancement Project

EEP Project No. 92709

2011 Monitoring Report: Year 3

Construction Completed: February 2005
Submission Date: April 2012

Submitted to: NCDENR-EEP
1652 Mail Service Center
Raleigh, NC 27699

Table of Contents

List of Appendices

Appendix D – Stream Survey Data

Appendix E – Hydrologic Data

SECTION 1
EXECUTIVE SUMMARY

SECTION 1
EXECUTIVE SUMMARY

The UT Goose Creek (Greene Mitigation) Stream Enhancement Project (Site) is located in Mecklenburg County, North Carolina just south of the Town of Mint Hill (Appendix A). The Site is located within the Southern Outer Piedmont Physiographic Region of the Yadkin River Basin (HUC 3040105) and has an approximate watershed of 3.15 square miles upstream from its confluence with the Rocky River. The Site enhancement components consisted of bank stabilization and habitat enhancement along 783 linear feet of UT Goose Creek. This project was conducted as a partial fulfillment of the off-site stream mitigation agreement between North Carolina Department of Transportation (NCDOT) and North Carolina Wildlife Resource Commission (NCWRC) for the I-485 outer loop project. The Site was constructed in February 2005 and transferred to EEP in 2007 for monitoring. Monitoring of the site was initiated in 2009. This report serves as the third year and final year of monitoring for the Site.

1.1 Goals and Objectives

The Site passes through forested areas, and residential and commercial developments. The construction of I-485 has resulted in a shift within the Site's watershed from a rural to an urbanized environment. Poor riparian zone management such as clearcutting, channelization, and impervious surface expansion within the watershed has had an adverse effect on the stability of the Site's streambanks, in-stream habitat, and water quality. The Goose Creek watershed is one of two remaining North Carolina habitats of the federally endangered Carolina Heelsplitter mussel (*Lasmigona decorate*). Due to the federal protected status this species, the entire Rocky River watershed was designated as a priority area for conservation and protection.

The following goals were established for the Site.

1. Enhance 783 linear feet of UT Goose Creek by grading banks, planting a riparian buffer, and reducing bank erosion.
2. Enhance the riparian zone adjacent to the stream with native forest species.
3. Restore degraded in-stream habitat via in-stream structures such as log and rock vanes.

Streambanks and riparian areas were stabilized using bare-root plantings and temporary and permanent seed mixes. Areas within the Site subject to construction grading and the overall understory were planted with native vegetation. Enhancement of the stream segments will help to improve streambank stability, water quality, and increase vegetation biodiversity. Appendix A provides detailed project activity, history, contact information, and watershed/site background for this project.

1.2 Vegetative Assessment

Due to the lapse in time between construction and the first monitoring year (2009), the vegetation plots established in 2005 were unable to be located. In 2009, JJG established three new vegetation monitoring plots in the approximate vicinity of the original plots established by NCWRC. Two 5m x 20m and one 10m x 10m plots were located within the enhancement areas. Woody vegetation within the established plots were assessed as planted or volunteer species in 2009. Largest specimens were recorded as planted relative to the smaller stems, which were recorded as natural recruited specimens. Vegetation assessments were conducted following the NCEEP 2004 Stem Counting Protocol which consists of counting woody stems within the established vegetation plots. The vegetation success criteria stated in the mitigation plan calls for a total of 256 stems per acre at the end of year three based on approximately 0.8 acres of land that was disturbed during construction. However, success criteria are based on planted stems per acre (USACE, 2003) due to the approximate size of the re-established vegetation plots (0.0247 acres) as follows:

- 320 stems per acre years 1 through 3
- 288 stems per acre year 4
- 260 stems per acre year 5

All the vegetation plots met the vegetation success threshold for the 2011 monitoring year (MY-3). The 2011 vegetation monitoring indicated an average survivability of 864 planted stems per acre with a mean of 3,617 stems per acre when including volunteers. The number of planted and naturally recruited species ranged from six (Plot 2) to 11 (Plot 3) and eight (Plot 2) to 22 (Plot 3), respectively. The 2011 monitoring effort was the third year of monitoring for the planted vegetation; however, the Site was planted in 2005; therefore the site is in the sixth growing season. The monitoring data indicates an average of 21 planted stems per plot. In conclusion, the riparian restoration project meets the requirements per the success criterion for the 2011 monitoring year. Please refer to Appendices B and C for vegetation plot photos and raw data tables.

1.3 Stream Assessment

Results from the 2011 stream monitoring effort indicate that stream pattern, profile, and dimension of Goose Creek is maintaining vertical and lateral stability with minimal problem areas. Areas along the stream enhancement reach noted with bare banks appear to be stabilized by the roots of larger trees established on the banks.

Stream dimension, pattern, profile, and substrate were evaluated within 688 linear feet of the Site. The average bankfull width (34.26 ft) of the surveyed cross-sections is within the range of the as-built widths reported (32-44 ft), and the average surveyed mean bankfull depth is 3.19 ft compared to the as-built typical (2.9 ft). The surveyed bankfull widths and depths lead to a mean Width/Depth ratio of 11.39. The upper section of the enhancement project was classified as a B4c and the lower section of the project was classified as a C4e. The channel's profile appears to be stable and was characterized

by well-defined riffle and pool features. The average water surface slope and average bankfull slope were determined to be 0.0070 ft/ft and 0.0060 ft/ft, respectively. There was significant decline in the d50 particle size of each cross section between 2011 and previous monitoring years. This suggests the particle distribution has shifted towards one of more fine sand and silt substrate material, although there was no evidence of increased aggradation from previous years. Further, the cross sectional areas of each cross section are consistent with previous monitoring events and show no notable decreases in area due to aggradation. Therefore, the discrepancy in particle distributions is likely due to derivation from the sampling protocol and/or the sampler's technique in collecting and assessing particles.

Near station 4+00 feet (ft), a debris jam has formed and has temporarily affected the profile. This profile adjustment is most likely temporary. It is anticipated that the debris jam and accumulated sediment will be flushed from the system during future rain events. Other areas that are of some concern include a stressed boulder toe with dislodged boulders and a failing vane structure at the end of the project that is no longer providing adequate bank protection. This structure has become dislodged and is redirecting flow from the thalweg to the outside meander bend. The change in flow vector is resulting in bank erosion, which is compromising bank stability. The structure may need to be adjusted to regain proper functionality or be removed.

A crest gauge is not located on-site; therefore, JJG referenced a local USGS gauge (station 0212467451) located on another tributary downstream of the Site with a similar drainage area (8.5 sq.mi.) to determine bankfull event occurrences within the Goose Creek watershed. According to the USGS gauge, one bankfull event or greater was recorded within the Goose Creek watershed during the 2011 monitoring year. Other indicators such as old wrack lines and staining were observed at the bankfull and greater elevations within the Site.

Overall, the Site appears to be maintaining vertical and lateral stability with minimal bank erosion and has met the success criteria for MY-2011. Please refer to Appendix D for detailed stream data tables and plots and Appendix B for the location of the longitudinal profile stations, cross-section stations, vegetation plots, photo points, and gauges.

1.4 Annual Monitoring Summary

In summary, the Site has met the stream and vegetation mitigation goals for monitoring year three. The 2011 vegetation plot monitoring results indicate that the planted and naturally recruited vegetation is doing well at the site. The pattern, profile, and dimension of the enhancement channel appear to be maintaining vertical and lateral stability with minimal bank erosion. A few problem areas were observed, such as poor streambank cover, minor structure instability, and debris jams. However, these areas do not appear to be advancing and are benefiting from deep rooted vegetation along the banks that are providing stability.

The background information provided in this report is referenced from the mitigation plan prepared by NCWRC (2005). Summary information/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 the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

SECTION 2
METHODOLOGY

SECTION 2
METHODOLOGY

2.1 Methodology

Methods employed for the Site were a combination of those established by standard regulatory guidance and procedures documents as well as previous monitoring reports completed by NCWRC. Survey data collected was performed via total station to establish the current longitudinal profile and cross-section elevations. Data recorded during this monitoring event were georeferenced using historically established positions to evaluate annual progress. Longitudinal stationing for the stream profile, cross-sectional surveys, and additional geomorphic assessments were performed following guidelines outlined in the *Stream Channel Reference Sites: An Illustrated Guide to Field Techniques* (Harrelson et al., 1994) and in the *Stream Restoration a Natural Channel Design Handbook* (Doll et al, 2003). Substrate analysis and particle size distribution were established using a modified Wolman pebble count (Rosgen 1996) at each cross-section location.

Vegetation monitoring for Year 3 was conducted following the NCEEP 2004 Stem Counting Protocol which consists of counting woody stems within the established vegetation plots. Plot locations are consistent with previous monitoring years and plot sizes consist of two 5m x 20m and one 10m x 10m. The taxonomic standard for vegetation follows *Flora of the Carolinas, Virginia, Georgia, and surrounding areas* (Weakley, 2007). Off-site bankfull events were documented using the USGS station 0212467451, Goose Creek at SR 1524 near Indian Trail, NC.

SECTION 3
REFERENCES

SECTION 3
REFERENCES

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E., 2003. Stream Restoration A Natural Channel Design Handbook.

Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

North Carolina Wildlife Resource Commission. 2005. As-Built Report for the Greene Mitigation on Goose Creek Mecklenburg County. Raleigh, NC.

Rosgen, D L. 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs,
CO.

US Army Corps of Engineers-Wilmington District, US Environmental Protection Agency, NC Wildlife Resource Commission, and NC Division of Water Quality. 2003. Stream Mitigation Guidelines. Wilmington, NC.

Weakley, A.S. 2008. *Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas* (Draft April 2008). University of North Carolina at Chapel Hill: Chapel Hill, NC.

SECTION 4
APPENDICES

Appendix A – Project Vicinity Map and Background Tables

Appendix B – Visual Assessment Data

Appendix C – Vegetation Plot Data

Appendix D – Stream Survey Data

Appendix E – Hydrologic Data

APPENDIX A
PROJECT VICINITY MAP AND BACKGROUND TABLES

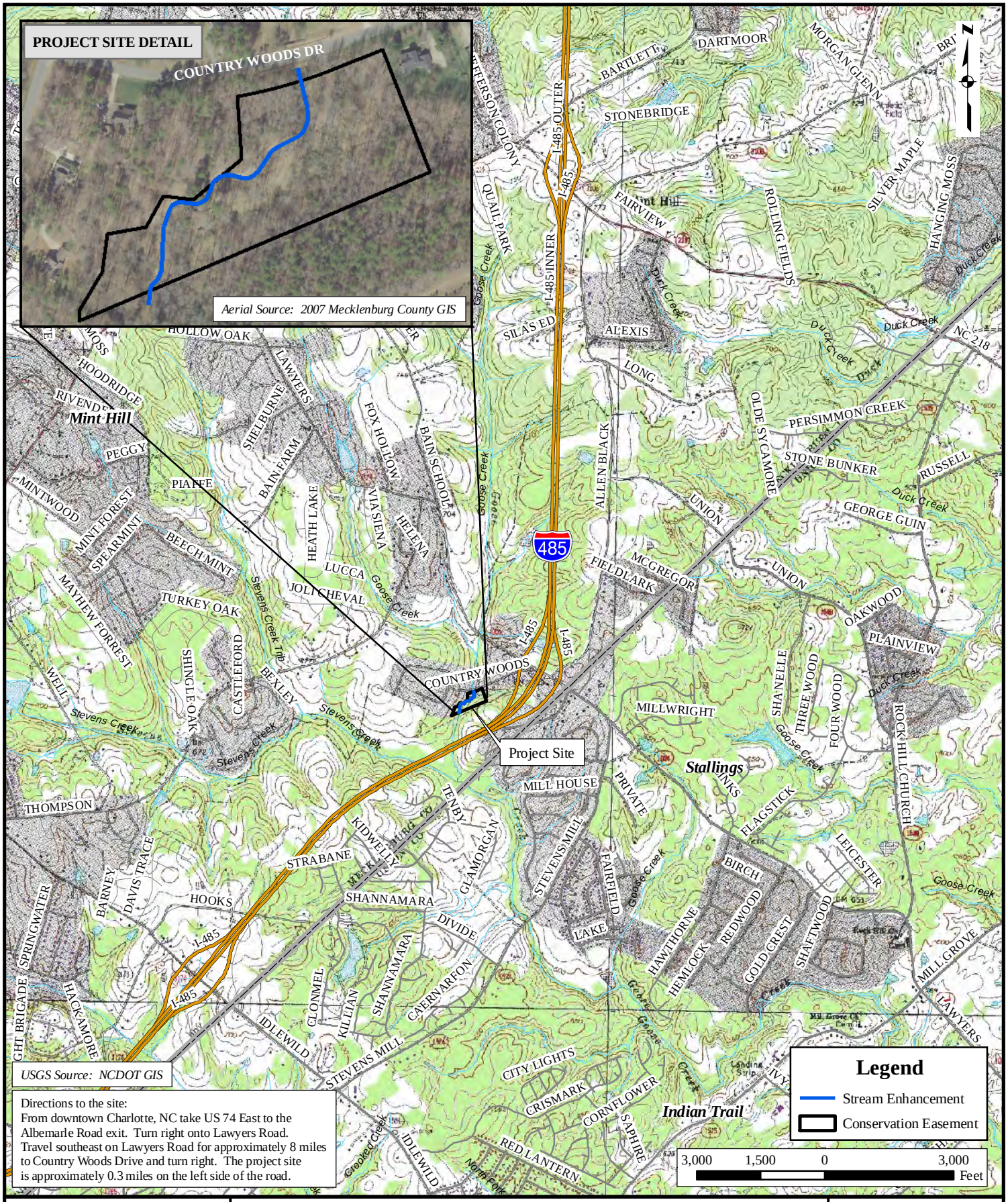


Figure 1 - Vicinity Map
UT Goose Creek (Greene Mitigation Site)/EEP Project No. 92709
Mecklenburg County, North Carolina
Monitoring Year 3
Submittal Date: April 2012

Appendix A. Project Vicinity Map and Background Tables
Table 1: Project Components and Mitigation Credits
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

Mitigation Credits						
	Stream	**Riparian Wetland**	**Non-riparian Wetland**	**Buffer**	**Nitrogen Nutrient Offset**	**Phosphorous Nutrient Offset**
Type	EII	N/A	N/A	N/A	N/A	N/A
Totals	261.0 SMU	N/A	N/A	N/A	N/A	N/A

Project Components						
Project Component/Reach ID	**Stationing (ft)**	**Existing Footage/ Acreage**	**Approach**	**Restoration or Restoration Equivalent**	**Restoration Footage or Acres**	**Mitigation Ratio**
Reach 1-UT Goose	0+00 – 7+83	783 lf	EII	Enhancement	783 lf	3:1

Component Summations						
Restoration Level	**Stream (linear feet)**	**Riparian Wetland (acres)**		**Non-riparian Wetland (acres)**	**Buffer (square feet)**	**Upland (acres)**
		Riverine	**Non-Riverine**			
Restoration (R)	N/A	N/A	N/A	N/A	N/A	N/A
Enhancement (E)	N/A	N/A	N/A	N/A	N/A	N/A
Enahncement I (E)	783	N/A	N/A	N/A	N/A	N/A
Enhancement II (E)	N/A	N/A	N/A	N/A	N/A	N/A
Creation (C)	N/A	N/A	N/A	N/A	N/A	N/A
Preservation (P)	N/A	N/A	N/A	N/A	N/A	N/A
HQ Preservation (P)	N/A	N/A	N/A	N/A	N/A	N/A
Totals	**783**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

BMP Elements			
Element	**Location**	**Purpose/Function**	**Notes**
N/A	N/A	N/A	N/A

BMP Elements
BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP - Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spreader; NI = Natural Infiltration Area; FB = Forested Buffer; SMU = Stream Mitigation Units
*Enhancement and Preservation reaches were not stationed.

Appendix A. Project Vicinity Map and Background Tables
Table 2: Project Activity and Reporting History
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

Elapsed Time Since Grading Complete: 6 Years 11 Months
Elapsed Time Since Planting Complete: 6 Years 11 Months
Number of Reporting Years: 3

Activity or Report	Data Collection Completed	Actual Completion or Delivery
Restoration Plan	N/A	2003
Final Design-90%	N/A	N/A
Construction	N/A	Feb-05
Temporary S&E mix applied to entire project area*	N/A	Feb-05
Permanent seed mix applied to reach	N/A	Feb-05
Mitigation Plan/ As-Built (Year 0 Monitoring)	N/A	Mar-05
Year 1 Monitoring	Nov-09	Dec-09
Year 2 Monitoring	Apr-2010 and Sept-2010	Dec-10
Year 3 Monitoring	Jun-11	Jan-12
Year 4 Monitoring	N/A	N/A
Year 5 Monitoring	N/A	N/A

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

Appendix A. Project Vicinity Map and Background Tables
Table 3: Project Contacts Table
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

Designer	NCWRC-Division of Inland Fisheries 1721 Mail Service Center Raleigh, NC 27699
Contractor's Name	Todd Hodges Construction Patterson, NC
Planting Contractor	Unknown
Seeding Contractor	Unknown
Monitoring Performers	Jordan, Jones and Goulding 6801 Governor's Lake Pkwy. Norcross, GA 30071
Stream Monitoring, POC	Alison Nichols 704-301-7563
Vegetation Monitoring, POC	

Appendix A. Project Vicinity Map and Background Tables
Table 4 Project Baseline Information and Attributes
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

Project Information			
Project Name	UT Goose Creek (Greene Mitigation)		
Project County	Mecklenburg County, North Carolina		
Project Area (acres)	4.4 acres		
Project Coordinates	35º 8' 40.96" N 80º 38' 10.77." W		
Project Watershed Summary Information			
Physiographic Region	Piedmont		
River Basin	Yadkin		
USGS HUC for Project (8 digit)	03040105		
USGS HUC for Project (14 digit)	03040105030020		
DWQ Sub-basin	03-07-12		
Project Drainage Area (acres)	2,016		
Project Drainage Area Percentage of Impervious Area*	10%		
CGIA Land Use Classification	1.01.01.03		
Reach Summary Information			
Parameters	**Reach 1**	**Reach 2**	**Reach 3**
Length of reach (linear feet)	783	N/A	N/A
Valley classification	II	N/A	N/A
Drainage area (acres)	2,016	N/A	N/A
NCDWQ stream identification score	N/A	N/A	N/A
NCDWQ Water Quality Classification	C	N/A	N/A
Morphological Description (stream type)	Perennial	N/A	N/A
Evolutionaly trend	F4/G4 to F4/B4c to C4/E4	N/A	N/A
Underlying mapped soils	Monacan, Lignum gravelly silt loam, Georgeville silt loam	N/A	N/A
Drainage Class	spd, spd, wd	N/A	N/A
Soil Hydric status	hydric, hydric, non-hydric	N/A	N/A
Slope	0.008	N/A	N/A
FEMA classification	100 year floodplain	N/A	N/A
Native vegetation community	bottomland hardwood	N/A	N/A
Percent composition of exotic invasive vegetation	U	N/A	N/A
Wetland Summary Information**			
Parameters	**Wetland 1**	**Wetland 2**	**Wetland 3**
Size of Wetland (acres)			
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)			
Mapped Soil Series			
Drainage class			
Soil Hydric Status			
Source of Hydrology			
Hydrologic impairment			
Native vegetation community			
Percent composition of exotic invasive vegetation			
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States - Section 404	Yes	Yes	NWP 27, 8/2004
Waters of the United States - Section 401	No	N/A	N/A
Endangered Species Act	No	N/A	N/A
Historic Preservation Act	No	N/A	N/A
Costal Zone Managemetn Act (CZMA)/Costal Area	No	N/A	N/A
FEMA Floodplain Compliance	Yes	U	N/A
Essential Fisheries Habitat	No	N/A	N/A

*At the time of project completion.

**Wetland mitigation was not included for this restoration project.

"N/A": items do not apply / "-": items are unavailable / "U": items are unknown

spd = somewhat poorly drained; wd = well drained

APPENDIX B
VISUAL ASSESSMENT DATA

Figure 2	**Current Condition Plan View (CCPV)**
Table 5	**Visual Stream Morphology Stability Assessment Table**
Table 6	**Vegetation Condition Assessment Table**
Photos	**Stream Station Photos**
Photos	**Vegetation Plot Photos**

Ecosystem Enhancement Program	EEP PROJECT NO. 92709 MECKLENBURG COUNTY, NORTH CAROLINA MONITORING YEAR 3	JJG	**NC ECOSYSTEM ENHANCEMENT PROGRAM** **GOOSE CREEK (GREENE MITIGATION SITE)** CURRENT CONDITION PLAN VIEW	APRIL 2011 1"=100' Figure 2A

COUNTRY WOODS DR

Direction of flow

N

Start Longitudinal Profile

Goose Creek

XS 1

XS 2

XS 3

XS 4

3

2

1

End of Longitudinal Profile

50 25 0 50 100 Feet

LEGEND

- Cross-Section (XS)
- Vegetation Plots
- Structures
- Boulder Toe
- USGS Blueline Stream
- 2' Contour

2011 CURRENT CONDITIONS

In-Stream Structure Condition

- Failing
- Stressed
- Stable

Bank/Bed Condition

- Bare Bank
- Bank Scour

Boulder Toe Condition

- Failing
- Stressed
- Stable

Ecosystem Enhancement PROGRAM

EEP PROJECT NO. 92709
MECKLENBURG COUNTY, NORTH CAROLINA
MONITORING YEAR 3

JJG

NC ECOSYSTEM ENHANCEMENT PROGRAM
GOOSE CREEK (GREENE MITIGATION SITE)

CURRENT CONDITION PLAN VIEW

APRIL 2011
1"=50'

Figure 2B

Appendix B. Visual Assessment Data
Table 5. Visual Stream Morphology Stability Assessment Table
Main Channel (783 lf)
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	9	8			113%			
	3. Meander Pool Condition	Depth Sufficient	6	6			100%			
		Lenth Appropriate	6	6			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	6			67%			
		Thalweg centering at downstream of meander bend (Glide)	6	6			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			2	94	94%	1	2	98%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	2	94	94%	1	2	99%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	7	8			88%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	7	8			88%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	8	8			100%			

Appendix B
Table 6: Vegetation Condition Assessment Table
UT Goose Creek (Greene Mitigation)/EEP Project No. 92709
Monitoring Year 3 of 5

Planted Acreage **U**

Vegetation Category	Definitions	Mapping Threshold (acres)	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	0	0	0%
Low Stem Density Areas	Woody stem densities clearly below tart levels based on MY3, 4, or 5 stem count criteria.	0.1	0	0	0%
		Total	**0**	**0**	**0%**
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0	0	0	**0%**

Easement Acreage **4.4 ac**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Planted Acreage
Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale).	1000	0	0	0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

Photo Point 1: View Downstream Left Bank
(MY 1 - 11/2009)

Photo Point 1: View Downstream Left Bank
(MY 3 - 6/2011)

Photo Point 1: View Downstream Right Bank
(MY 1 - 11/2009)

Photo Point 1: View Downstream Right Bank
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Photo Point 2: View Upstream
(MY 1 - 11/2009)

Photo Point 2: View Upstream
(MY 3 - 6/2011)

Photo Point 2: View Downstream
(MY 1 - 11/2009)

Photo Point 2: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Photo Point 3: View Upstream
(MY 1 - 11/2009)

Photo Point 3: View Upstream
(MY 3 - 6/2011)

Photo Point 3: View Downstream
(MY 1 - 11/2009)

Photo Point 3: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Photo Point 4: View Upstream
(MY 1 - 11/2009)

Photo Point 4: View Upstream
(MY 3 - 6/2011)

Photo Point 4: View Downstream
(MY 1 - 11/2009)

Photo Point 4: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Photo Point 5: View Upstream
(MY 1 - 11/2009)

Photo Point 5: View Upstream
(MY 3 - 6/2011)

Photo Point 5: View Downstream
(MY 1 - 11/2009)

Photo Point 5: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Photo Point 6: View Upstream
(MY 1 - 11/2009)

Photo Point 6: View Upstream
(MY 3 - 6/2011)

Photo Point 6: View Downstream
(MY 1 - 11/2009)

Photo Point 6: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Photo Point 7: View Upstream
(MY 1 - 11/2009)

Photo Point 7: View Upstream
(MY 3 - 6/2011)

Photo Point 7: View Downstream
(MY 1 - 11/2009)

Photo Point 7: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Photo Point 8: View Upstream
(MY 1 - 11/2009)

Photo Point 8: View Upstream
(MY 3 - 6/2011)

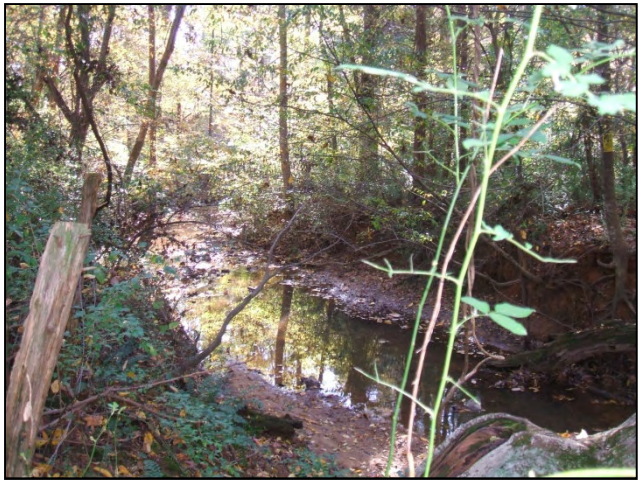


Photo Point 8: View Downstream
(MY 1 - 11/2009)

Photo Point 8: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Cross Section 1: View Upstream
(MY 1 - 11/2009)

Cross Section 1: View Upstream
(MY 3 - 6/2011)

Cross Section 1: View Downstream
(MY 1 - 11/2009)

Cross Section 1: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

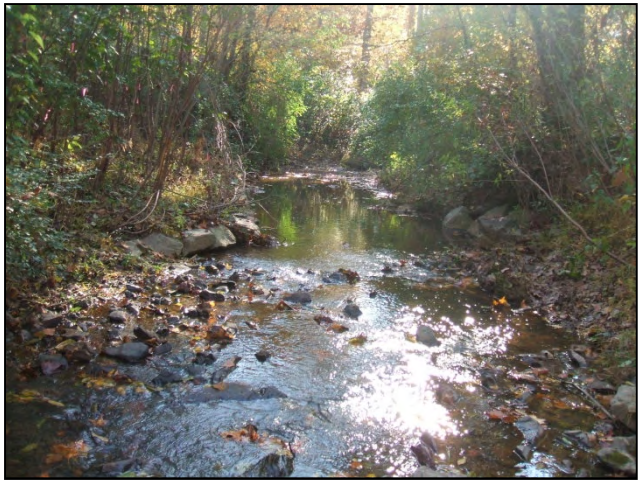
Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Cross Section 2: View Upstream
(MY 1 - 11/2009)

Cross Section 2: View Upstream
(MY 3 - 6/2011)



Cross Section 2: View Downstream
(MY 1 - 11/2009)

Cross Section 2: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Cross Section 3: View Upstream
(MY 1 - 11/2009)

Cross Section 3: View Upstream
(MY 3 - 6/2011)

Cross Section 3: View Downstream
(MY 1 - 11/2009)

Cross Section 3: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Cross Section 4: View Upstream
(MY 1 - 11/2009)

Cross Section 4: View Upstream
(MY 3 - 6/2011)

Cross Section 4: View Downstream
(MY 1 - 11/2009)

Cross Section 4: View Downstream
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Stream Station & Cross Section Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Vegetation Plot 1
(MY 1 - 10/2009)

Vegetation Plot 1
(MY 3 - 6/2011)

Vegetation Plot 1
(MY 1 - 10/2009)

Vegetation Plot 1
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Vegetation Plot Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Vegetation Plot 2
(MY 1 - 10/2009)

Vegetation Plot 2
(MY 3 - 6/2011)

Vegetation Plot 2
(MY 1 - 10/2009)

Vegetation Plot 2
(MY 3- 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Vegetation Plot Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

Vegetation Plot 3
(MY 1 - 10/2009)

Vegetation Plot 3
(MY 3 - 6/2011)

Vegetation Plot 3
(MY 1 - 10/2009)

Vegetation Plot 3
(MY 3 - 6/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B – Visual Assessment Data
Vegetation Plot Photos
UT Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
Monitoring Year 3

Prepared By:

JJG

APPENDIX C
VEGETATION PLOT DATA

Table 7	**Vegetation Plot Mitigation Success Summary Table**
Table 8	**Not Included - UT Goose Creek is monitored on the 2004 NCEEP Stem Count Protocol**
Table 9	**Stem Count Total and Planted by Plat and Species**

Appendix C
Table 7 Vegetation Plot Mitigation Success
UT Goose Creek (Greene Mitigation)/EEP Project No. 92709
Monitoring Year 3

Vegetation Plot ID	Vegetation Survival Threshold Met (Y/N)
Plot 1	Y
Plot 2	Y
Plot 3	Y

Appendix C
Table 9: Stem Count Total and Planted by Plot and Species
UT Goose Creek (Greene Mitigation)/EEP Project No. 92709
Monitoring Year 3 of 5

			Current Data (MY3-2011)						Annual Means							
			Plot 1		Plot 2		Plot 3		Current Mean		MY0-2005*		MY1-2009		MY1-2010	
Species	**Common Name**	**Type**	P	T	P	T	P	T	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**
Acer negundo	boxelder	T		4	1			1	**1**	**3**			**1**	**3**	**1**	**2**
Acer rubrum	red maple	T	1	5	1	2			**1**	**4**	**3**	**3**	**2**	**3**	**2**	**4**
Alnus serrulata	tag alder	T			7		9	9	**8**	**9**	**27**	**27**	**10**	**12**	**10**	**11**
Baccharis halimifolia	groundsel tree	T							**N/A**	**N/A**						**1**
Betula nigra	river birch	T							**N/A**	**N/A**					**1**	**1**
Carpinus caroliniana	american hornbeam	T	1	12	1	6	3	12	**2**	**10**	**2**	**2**	**6**	**28**	**6**	**35**
Carya ovata	shagbark hickory	T		1					**N/A**	**1**						**1**
Cephalanthus occidentalis	buttonbush	S					2	2	**1**	**2**	**6**	**6**				
Cercis canadensis	eastern redbud	T		1				3	**N/A**	**2**						
Cornus amomum	silky dogwood	S						1	**N/A**	**1**	**43**	**43**	**2**	**2**	**2**	**2**
Elaeagnus umbellata	autumn olive	S		8		10		10	**N/A**	**9**						
Fagus grandifolia	american beech	T							**N/A**	**N/A**	**9**	**9**				
Fraxinus pennsylvanica	green ash	T	1	2				1	**1**	**2**			**2**	**3**	**2**	**5**
Juglans nigra	black walnut	T							**N/A**	**N/A**	**25**	**25**				
Juniperus virginiana	eastern red cedar	T	1	2			1	1	**1**	**2**	**3**	**3**	**1**	**3**	**1**	**4**
*Ligustrum vulgare****	common privet	S		12				4	**N/A**	**8**						
Lindera benzoin	spicebush	S		3				5	**N/A**	**4**						**5**
Lirodendron tulipifera	tulip poplar	T		3	1	4	4	10	**3**	**6**	**3**	**3**			**6**	**5**
Liquidambar styraciflua	sweet gum	T		3		35		36	**N/A**	**25**				**20**		**24**
Morus rubra	red mulberry	T						4	**N/A**	**4**						**4**
Platanus occidentalis	sycamore	T	1	3	7		1	1	**3**	**2**			**6**	**8**	**6**	**8**
Pinus taeda	loblolly pine	T		2					**N/A**	**2**				**10**		**8**
Pinus sp.	pine species	T							**N/A**	**N/A**	**7**	**7**				
Prunus serotina	black cherry	T					2	2	**2**	**2**	**1**	**1**			**2**	**2**
Quercus alba	white oak	T						1	**N/A**	**1**			**1**	**7**	**1**	**7**
Quercus lyrata	overcup oak	T					1	1	**1**	**1**			**2**	**2**	**2**	**2**
Quercus palustris	pin oak	T							**N/A**	**N/A**	**1**	**1**				
Quercus phellos	willow oak	T					1	1	**1**	**1**					**2**	**3**
Quercus sp.	oak species	T							**N/A**	**N/A**	**2**	**2**				
Rhus glabra	smooth sumac	S		2					**N/A**	**2**						**1**
Salix nigra	black willow	S	6	12			1	1	**4**	**7**	**1**	**1**	**15**	**15**	**10**	**12**
Salix sericea	silky willow	S		3		8		1	**N/A**	**4**	**54**	**54**			**4**	**4**
Sambucus canadensis	elderberry	S					2	3	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**
Ulmus alata	winged elm	T							**N/A**	**N/A**						**5**
Unknown sp.									**N/A**	**N/A**	**4**	**4**			**1**	**1**
Plot Area (acres)			**0.0247**								******					
Species Count			**6**	**17**	**6**	**6**	**11**	**22**	**8**	**15**	**17**		**10**	**18**	**10**	**18**
Stem Count			**11**	**78**	**18**	**65**	**27**	**110**	**19**	**84**	**195**		**41**	**125**	**39**	**130**
Stems per Acre			**445.3**	**3158**	**728.7**	**2632**	**1093**	**4453**	**756**	**3414**	**2324**		**1673**	**5074**	**1592**	**5263**

Type=**S**hrub or **T**ree
P = Planted
T = Total
*Data was collected by another monitoring firm-no volunteer stems were included in data
**Plot sizes varied from 0.017 acre to 0.040 acre

APPENDIX D
STREAM SURVEY DATA

Figures 3a-3d	**Cross-sections with Annual Overlays**
Figure 4	**Longitudinal Profiles with Annual Overlays**
Figures 5a-5d	**Pebble Count Plots with Annual Overlays**
Tables 10a,b	**Baseline – Stream Data Summary Tables**
Table 11a	**Monitoring – Cross-Section Morphology Data Table**
Table 11b	**Monitoring – Stream Reach Morphology Data Table**

*Raw data tables have been provided electronically.

Appendix D. Stream Survey Data
Figure 3a: Cross-Section Plots and Raw Data
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

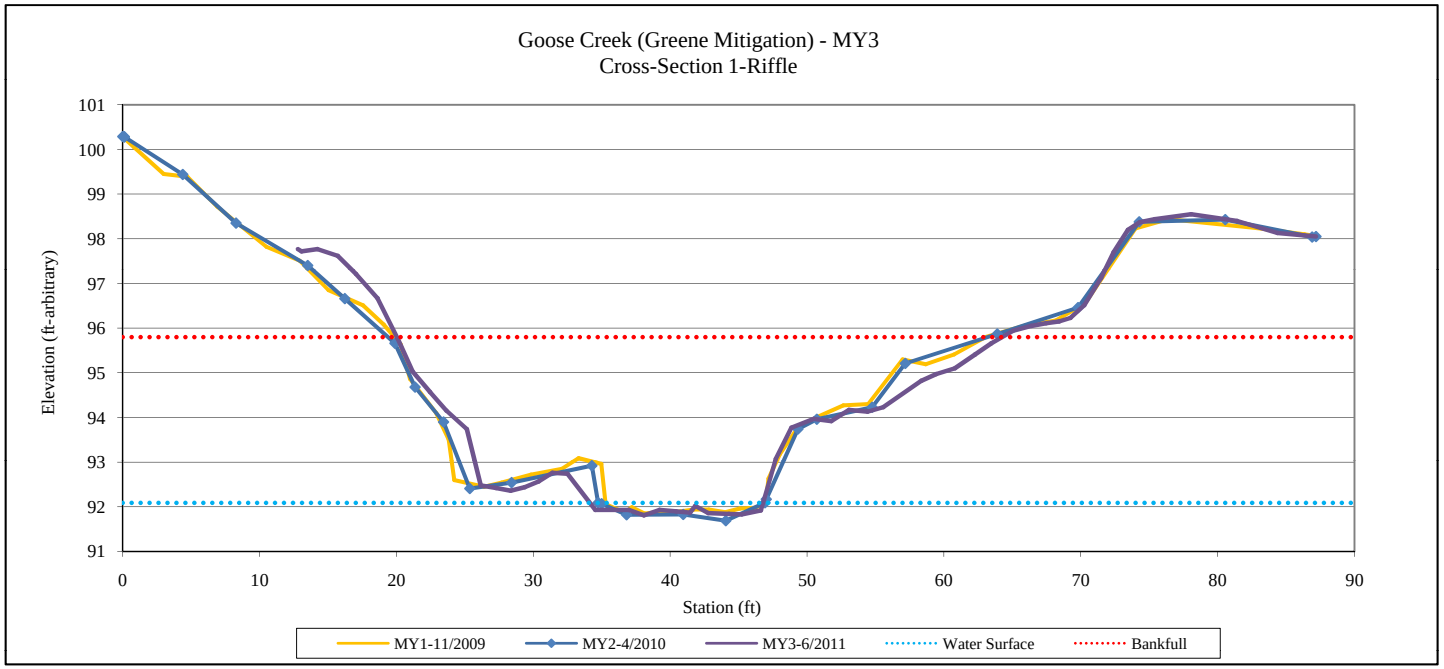
Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-1, Riffle, 0+51**
Survey Date	**6/2011**

SUMMARY DATA	
Bankfull Elevation (ft)	95.80
Bankfull Cross-Sectional Area (ft^2)	108.98
Bankfull Width (ft)	44.22
Flood Prone Area Elevation (ft)	99.79
Flood Prone Width (ft)	74.39
Bankfull Mean Depth (ft)	2.46
Bankfull Max Depth (ft)	3.99
W/D Ratio	17.98
Entrenchment Ratio	1.68
Bank Height Ratio	2.00

XS-1: View Upstream

XS-1: View Downstream

Station	Elevation	Notes
12.8	97.77	xs1-lpt
13.07	97.72	xs-1
14.23	97.77	xs-1
15.71	97.62	xs-1
17.06	97.21	xs-1
18.62	96.67	xs-1
20.07	95.78	xs-1
21.18	95.03	xs-1
22.46	94.57	xs-1
23.66	94.15	xs-1
25.15	93.74	xs-1
26.16	92.48	xs-1
27.29	92.42	xs-1
28.35	92.36	xs-1
29.38	92.44	xs-1
30.4	92.57	xs-1
31.4	92.76	xs-1
32.5	92.74	xs-1
34.53	91.93	xs1-lew
36.99	91.93	xs-1
38.09	91.81	xs-1
39.23	91.93	xs-1
40.44	91.9	xs-1
41.46	91.87	xs-1
41.84	92.02	ws
42.79	91.86	xs-1
44.29	91.84	xs-1
45.23	91.83	xs-1
46.63	91.92	xs1-rew
47.72	93.07	xs-1
48.87	93.77	xs-1



Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
50.49	93.97	xs-1	60.8	95.1	xs-1	68.42	96.15	xs-1	74.32	98.37	xs-1
51.78	93.92	xs-1	62.27	95.41	xs-1	69.26	96.23	xs-1	75.41	98.44	xs-1
53.07	94.17	xs-1	63.47	95.66	xs-1	70.26	96.51	xs-1	78.07	98.55	xs-1
54.43	94.13	xs-1	65.04	95.94	xs-1	71.49	97.12	xs-1	81.42	98.4	xs-1
55.58	94.23	xs-1	66.4	96.05	xs-1	72.41	97.7	xs-1	84.37	98.13	xs-1
58.36	94.82	xs-1	66.4	96.05	xs-1	72.41	97.7	xs-1	87.19	98.05	xs1-rpt
59.45	94.97	xs-1	67.48	96.11	xs-1	73.45	98.2	xs-1			

Appendix D. Stream Survey Data
Figure 3b: Cross-Section Plots and Raw Data
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

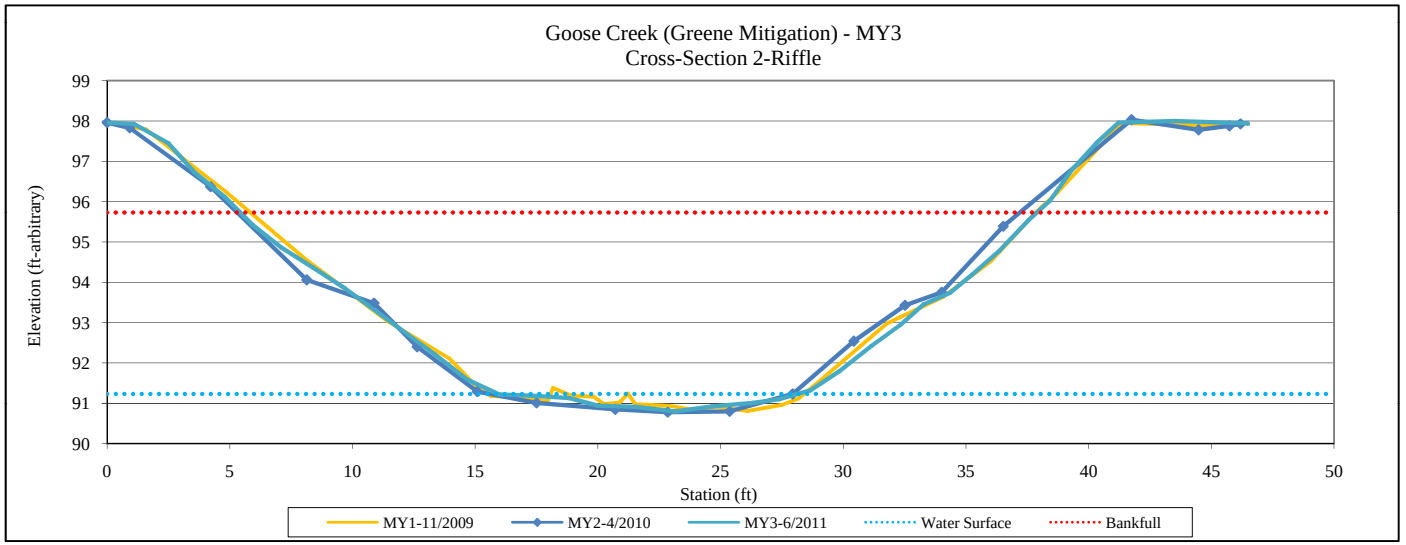
Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-2, Riffle, 1+95**
Survey Date	**6/2011**

SUMMARY DATA	
Bankfull Elevation (ft)	95.73
Bankfull Cross-Sectional Area (ft^2)	106.24
Bankfull Width (ft)	32.32
Flood Prone Area Elevation (ft)	100.66
Flood Prone Width (ft)	>100
Bankfull Mean Depth (ft)	3.29
Bankfull Max Depth (ft)	4.93
W/D Ratio	9.82
Entrenchment Ratio	1.44
Bank Height Ratio	2.00

XS-2: View Upstream

XS-2: View Downstream

Station	Elevation	Notes
0.00	97.96	notes
1.10	97.93	xs2-lpt
2.50	97.45	xs-2
3.56	96.73	xs-2
4.81	96.11	xs-2
5.92	95.43	xs-2
7.08	94.87	xs-2
8.40	94.36	xs-2
9.70	93.85	xs-2
13.36	92.21	xs-2
14.67	91.59	xs-2
15.98	91.22	xs-2
17.55	91.18	xs-2
18.84	91.13	xs2-lew
20.00	90.94	xs-2
21.58	90.91	xs-2
23.15	90.80	xs-2
24.65	90.92	xs-2
26.31	91.01	xs-2
27.40	91.10	xs-2
28.66	91.32	xs2-rew
29.85	91.8	xs-2
31.15	92.42	xs-2
32.34	92.95	xs-2
33.27	93.45	xs-2
34.35	93.74	xs-2
35.27	94.2	xs-2
36.36	94.78	xs-2
37.54	95.53	xs-2
38.44	96.03	xs-2



Station	Elevation	Notes
39.34	96.80	xs-2
40.33	97.46	xs-2
41.23	97.96	xs-2
43.51	98.00	xs-2
46.19	97.95	xs-2
46.47	97.95	xs-2
46.49	97.93	xs2-rpt

Appendix D. Stream Survey Data
Figure 3a: Cross-Section Plots and Raw Data
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

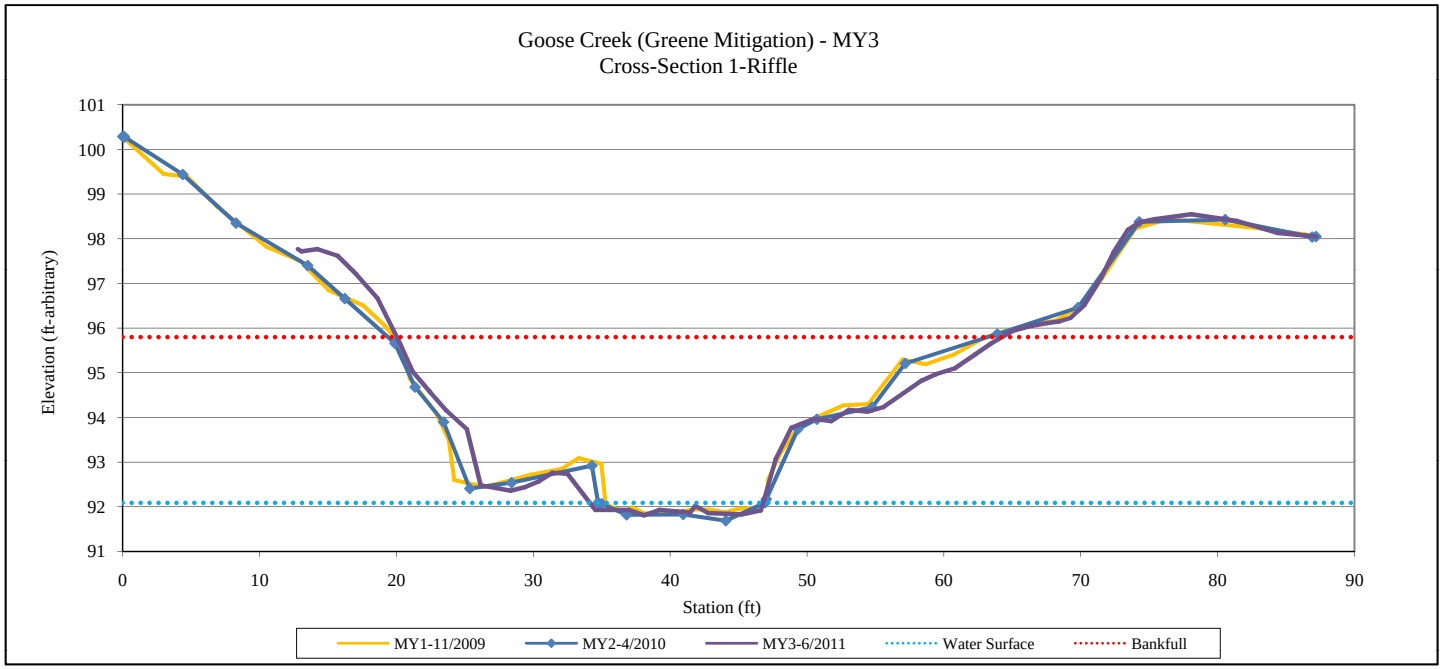
Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-1, Riffle, 0+51**
Survey Date	**6/2011**

SUMMARY DATA	
Bankfull Elevation (ft)	95.80
Bankfull Cross-Sectional Area (ft^2)	108.98
Bankfull Width (ft)	44.22
Flood Prone Area Elevation (ft)	99.79
Flood Prone Width (ft)	74.39
Bankfull Mean Depth (ft)	2.46
Bankfull Max Depth (ft)	3.99
W/D Ratio	17.98
Entrenchment Ratio	1.68
Bank Height Ratio	2.00

XS-1: View Upstream

XS-1: View Downstream

Station	Elevation	Notes
12.8	97.77	xs1-lpt
13.07	97.72	xs-1
14.23	97.77	xs-1
15.71	97.62	xs-1
17.06	97.21	xs-1
18.62	96.67	xs-1
20.07	95.78	xs-1
21.18	95.03	xs-1
22.46	94.57	xs-1
23.66	94.15	xs-1
25.15	93.74	xs-1
26.16	92.48	xs-1
27.29	92.42	xs-1
28.35	92.36	xs-1
29.38	92.44	xs-1
30.4	92.57	xs-1
31.4	92.76	xs-1
32.5	92.74	xs-1
34.53	91.93	xs1-lew
36.99	91.93	xs-1
38.09	91.81	xs-1
39.23	91.93	xs-1
40.44	91.9	xs-1
41.46	91.87	xs-1
41.84	92.02	ws
42.79	91.86	xs-1
44.29	91.84	xs-1
45.23	91.83	xs-1
46.63	91.92	xs1-rew
47.72	93.07	xs-1
48.87	93.77	xs-1



Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
50.49	93.97	xs-1	60.8	95.1	xs-1	68.42	96.15	xs-1	74.32	98.37	xs-1
51.78	93.92	xs-1	62.27	95.41	xs-1	69.26	96.23	xs-1	75.41	98.44	xs-1
53.07	94.17	xs-1	63.47	95.66	xs-1	70.26	96.51	xs-1	78.07	98.55	xs-1
54.43	94.13	xs-1	65.04	95.94	xs-1	71.49	97.12	xs-1	81.42	98.4	xs-1
55.58	94.23	xs-1	66.4	96.05	xs-1	72.41	97.7	xs-1	84.37	98.13	xs-1
58.36	94.82	xs-1	66.4	96.05	xs-1	72.41	97.7	xs-1	87.19	98.05	xs1-rpt
59.45	94.97	xs-1	67.48	96.11	xs-1	73.45	98.2	xs-1			

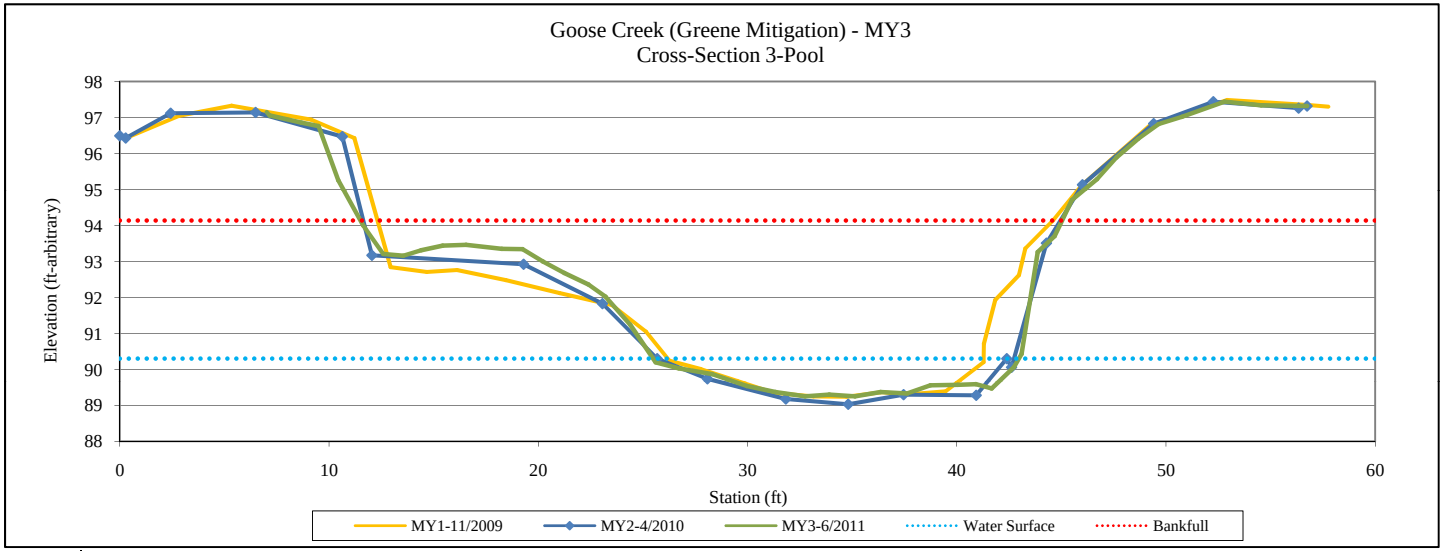
Appendix D. Stream Survey Data
Figure 3c: Cross-Section Plots and Raw Data
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-3, Pool, 3+95**
Survey Date	**6/2011**

SUMMARY DATA	
Bankfull Elevation (ft)	94.14
Bankfull Cross-Sectional Area (ft^2)	101.01
Bankfull Width (ft)	33.15
Flood Prone Area Elevation (ft)	99.03
Flood Prone Width (ft)	N/A
Bankfull Mean Depth (ft)	3.05
Bankfull Max Depth (ft)	4.89
W/D Ratio	10.87
Entrenchment Ratio	N/A
Bank Height Ratio	2.00

XS-3: View Upstream

XS-3: View Downstream



Station	Elevation	Notes
7.02	97.15	xs3-lpt
7.16	97.06	xs-3
8.67	96.86	xs-3
9.50	96.76	xs-3
10.44	95.26	xs-3
11.63	94.00	xs-3
12.59	93.21	xs-3
13.55	93.16	xs-3
14.40	93.31	xs-3
15.43	93.44	xs-3
16.55	93.46	xs-3
18.25	93.35	xs-3
19.25	93.34	xs-3
20.22	93.00	xs-3
21.24	92.68	xs-3
22.40	92.36	xs-3
23.22	92.02	xs-3
24.39	91.25	xs-3
25.61	90.2	xs-3
26.72	90.03	xs3-lew
28.31	89.87	xs-3
29.96	89.54	xs-3
31.33	89.37	xs-3
32.75	89.25	xs-3
33.91	89.3	xs-3

Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
35.14	89.25	xs-3	41.67	89.47	xs-3	46.71	95.29	xs-3	54.55	97.34	xs-3
36.36	89.37	xs-3	42.73	90.06	xs3-rew	47.63	95.89	xs-3	56.75	97.32	xs3-rpt
37.62	89.33	xs-3	43.10	90.43	xs-3	48.67	96.41	xs-3			
38.74	89.56	xs-3	43.87	93.26	xs-3	49.65	96.82	xs-3			
40.05	89.57	xs-3	44.67	93.70	xs-3	50.76	97.02	xs-3			
40.91	89.59	xs-3	45.51	94.71	xs-3	52.80	97.44	xs-3			

Appendix D. Stream Survey Data
Figure 3d: Cross-Section Plots and Raw Data
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

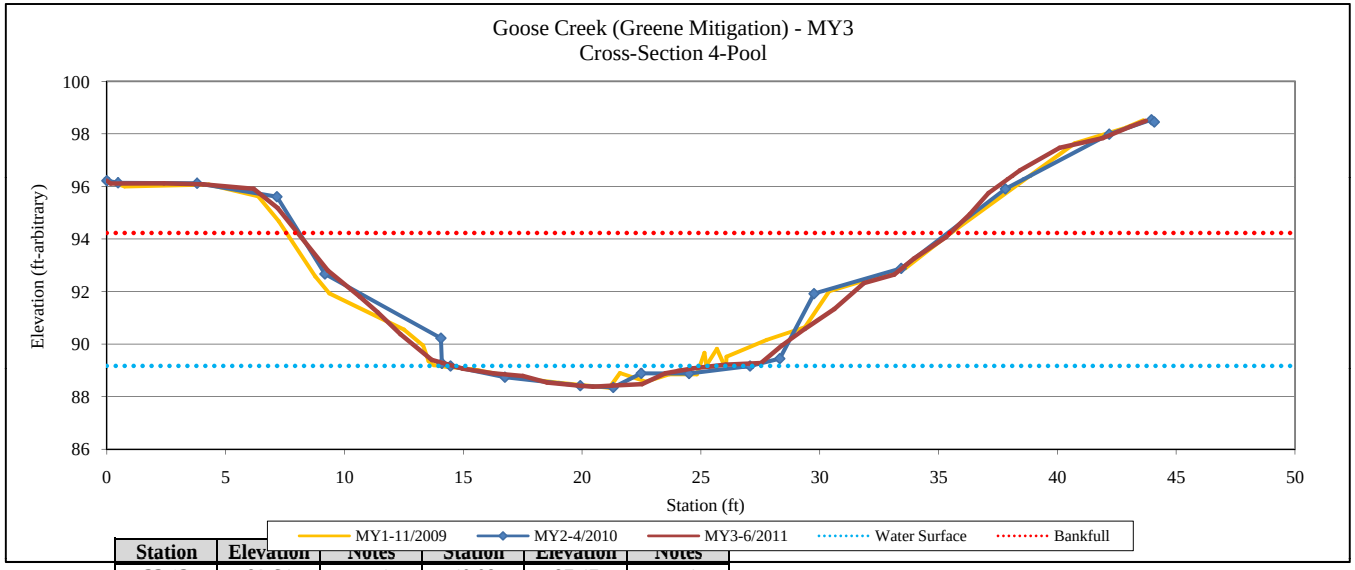
Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-4, Pool, 5+39**
Survey Date	**6/2011**

SUMMARY DATA	
Bankfull Elevation (ft)	94.23
Bankfull Cross-Sectional Area (ft^2)	108.26
Bankfull Width (ft)	27.34
Flood Prone Area Elevation (ft)	100.08
Flood Prone Width (ft)	43.72
Bankfull Mean Depth (ft)	3.96
Bankfull Max Depth (ft)	5.85
W/D Ratio	6.90
Entrenchment Ratio	N/A
Bank Height Ratio	2.00

XS-4: View Upstream

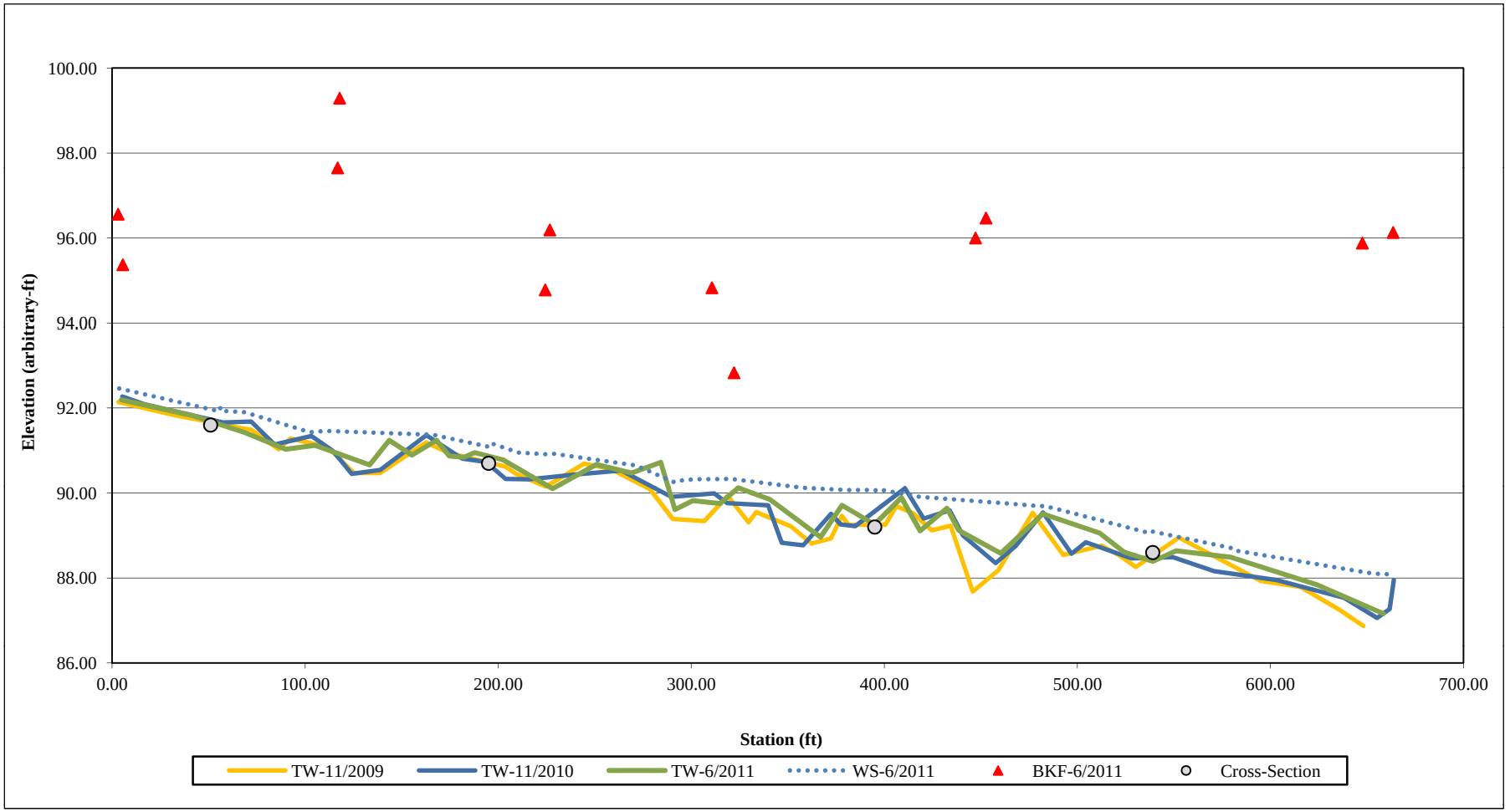
XS-4: View Downstream

Station	Elevation	Notes
0.00	96.22	xs4-lpt
0.16	96.11	xs-4
2.40	96.12	xs-4
4.05	96.08	xs-4
6.18	95.91	xs-4
7.19	95.18	xs-4
9.30	92.80	xs-4
10.64	91.81	xs-4
11.39	91.22	xs-4
12.36	90.38	xs-4
13.68	89.40	xs-4
14.97	89.07	xs-4
16.25	88.89	xs-4
17.50	88.79	xs-4
18.52	88.54	xs-4
19.99	88.41	xs-4
20.46	88.38	xs-4
21.26	88.42	xs-4
22.52	88.48	xs-4
23.51	88.89	xs-4
24.67	89.08	xs4-rew
26.05	89.22	xs-4
27.53	89.28	xs-4
28.41	89.95	xs-4
29.37	90.58	xs-4
30.62	91.34	xs-4
31.86	92.32	xs-4



Station	Elevation	Notes	Station	Elevation	Notes
33.13	92.64	xs-4	40.09	97.47	xs-4
33.96	93.25	xs-4	41.92	97.84	xs-4
35.31	94.07	xs-4	43.05	98.27	xs-4
36.32	94.95	xs-4	43.72	98.5	xs4-rpt
37.11	95.75	xs-4			
38.42	96.61	xs-4			

Appendix D
Figure 4. Longitudinal Profiles with Annual Overlays
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
2011 Monitoring Year
Monitoring Year 3

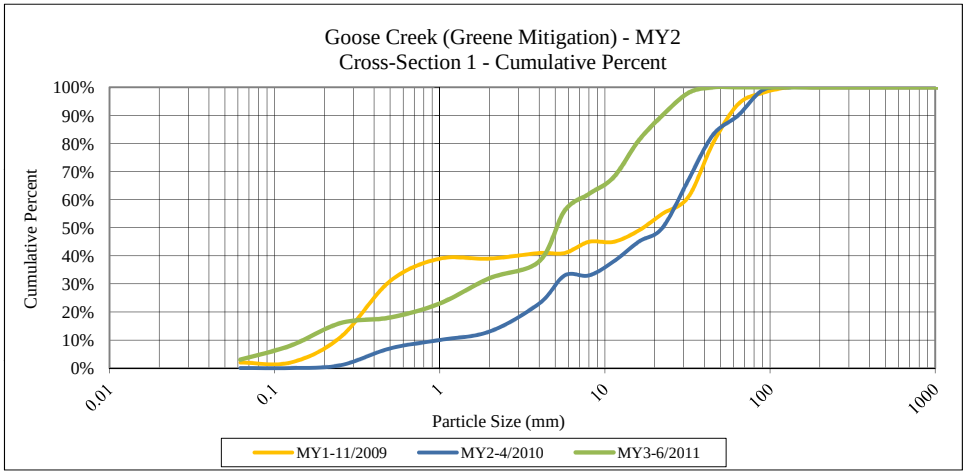


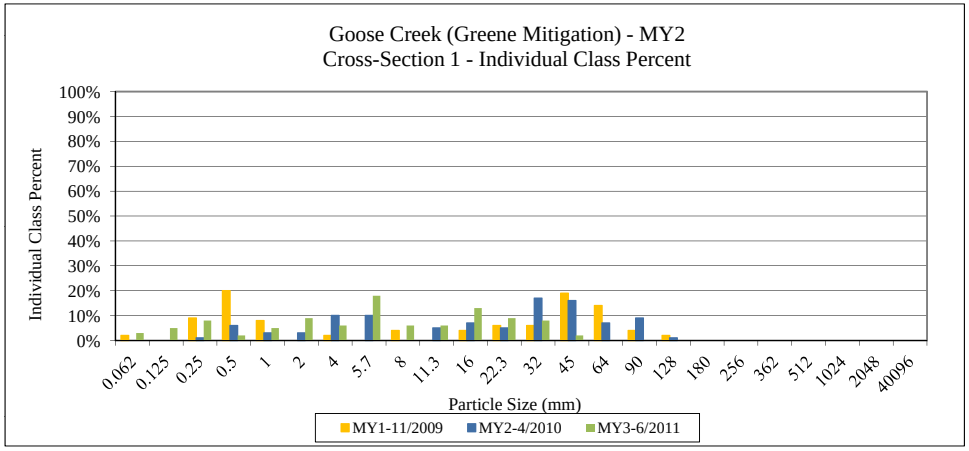
Appendix D. Stream Survey Data
Figure 5a: Pebble Count Plots with Annual Overlays
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3 of 5

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-1, Riffle, 0+51**
Survey Date	**6/2011**

Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	3	3%	3%
Sand	very fine sand	0.125	5	5%	8%
	fine sand	0.250	8	8%	16%
	medium sand	0.50	2	2%	18%
	coarse sand	1.00	5	5%	23%
	very coarse sand	2.0	9	9%	32%
Gravel	very fine gravel	4.0	6	6%	38%
	fine gravel	5.7	18	18%	56%
	fine gravel	8.0	6	6%	62%
	medium gravel	11.3	6	6%	68%
	medium gravel	16.0	13	13%	81%
	course gravel	22.3	9	9%	90%
	course gravel	32.0	8	8%	98%
	very coarse gravel	45	2	2%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	5.13
D84	18.10
D95	28.36



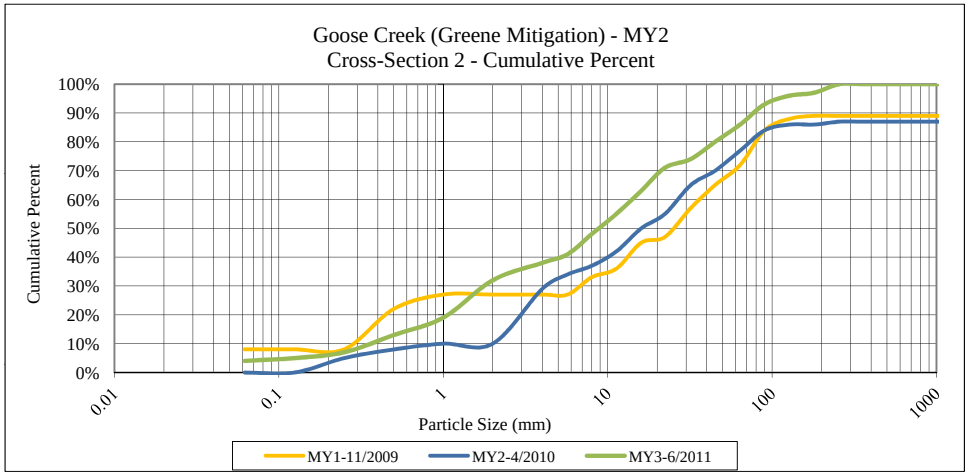


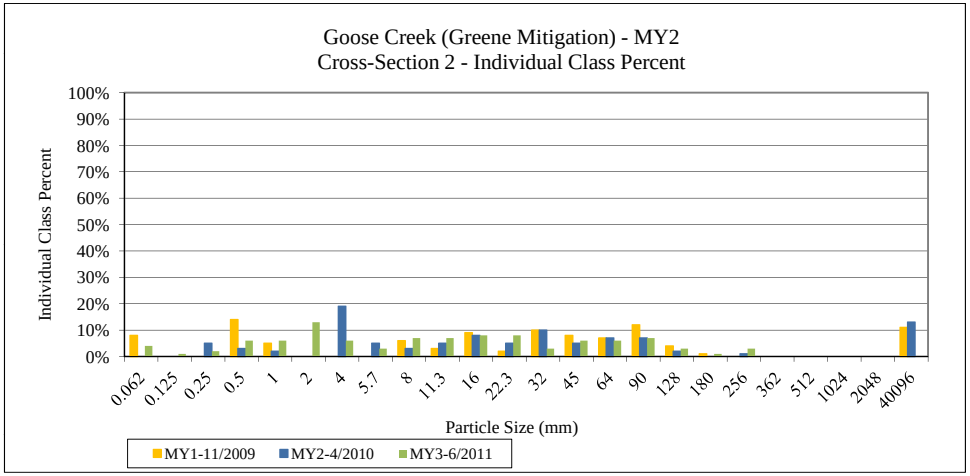
Appendix D. Stream Survey Data
Figure 5b: Pebble Count Plots with Annual Overlays
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3 of 5

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-2, Riffle, 1+95**
Survey Date	**6/2011**

Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	4	4%	4%
Sand	very fine sand	0.125	1	1%	5%
	fine sand	0.250	2	2%	7%
	medium sand	0.50	6	6%	13%
	coarse sand	1.00	6	6%	19%
	very coarse sand	2.0	13	13%	32%
Gravel	very fine gravel	4.0	6	6%	38%
	fine gravel	5.7	3	3%	41%
	fine gravel	8.0	7	7%	48%
	medium gravel	11.3	7	7%	55%
	medium gravel	16.0	8	8%	63%
	course gravel	22.3	8	8%	71%
	course gravel	32.0	3	3%	74%
	very coarse gravel	45	6	6%	80%
	very coarse gravel	64	6	6%	86%
Cobble	small cobble	90	7	7%	93%
	medium cobble	128	3	3%	96%
	large cobble	180	1	1%	97%
	very large cobble	256	3	3%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	8.94
D84	57.67
D95	115.33



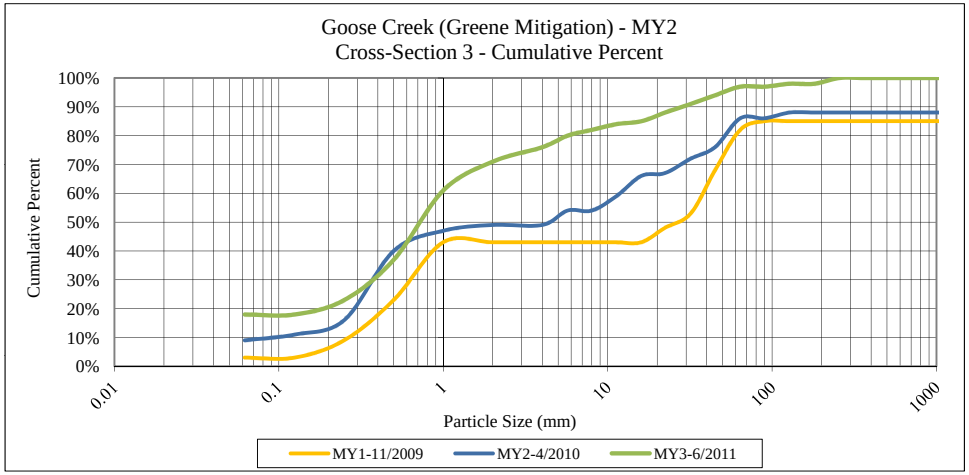


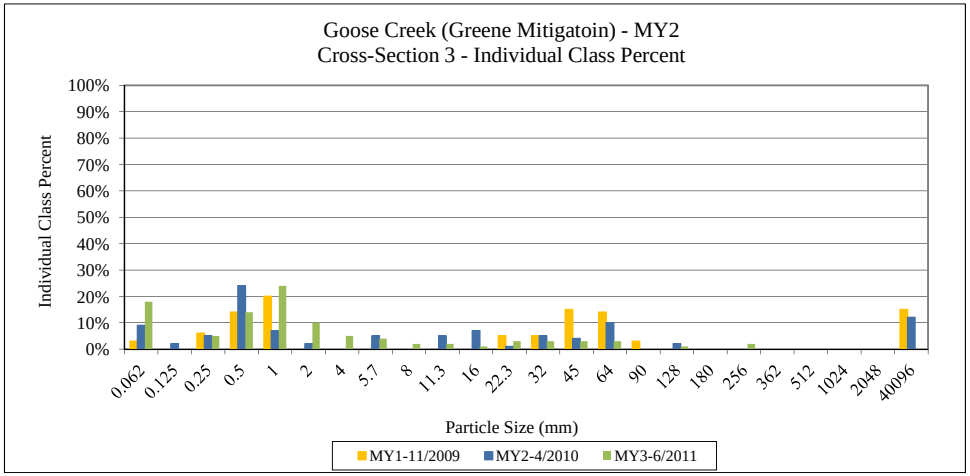
Appendix D. Stream Survey Data
Figure 5c: Pebble Count Plots with Annual Overlays
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3 of 5

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-3, Pool, 3+95**
Survey Date	**6/2011**

Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	18	18%	18%
Sand	very fine sand	0.125	0	0%	18%
	fine sand	0.250	5	5%	23%
	medium sand	0.50	14	14%	37%
	coarse sand	1.00	24	24%	61%
	very coarse sand	2.0	10	10%	71%
Gravel	very fine gravel	4.0	5	5%	76%
	fine gravel	5.7	4	4%	80%
	fine gravel	8.0	2	2%	82%
	medium gravel	11.3	2	2%	84%
	medium gravel	16.0	1	1%	85%
	course gravel	22.3	3	3%	88%
	course gravel	32.0	3	3%	91%
	very coarse gravel	45	3	3%	94%
	very coarse gravel	64	3	3%	97%
Cobble	small cobble	90	0	0%	97%
	medium cobble	128	1	1%	98%
	large cobble	180	0	0%	98%
	very large cobble	256	2	2%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.77
D84	11.30
D95	51.33



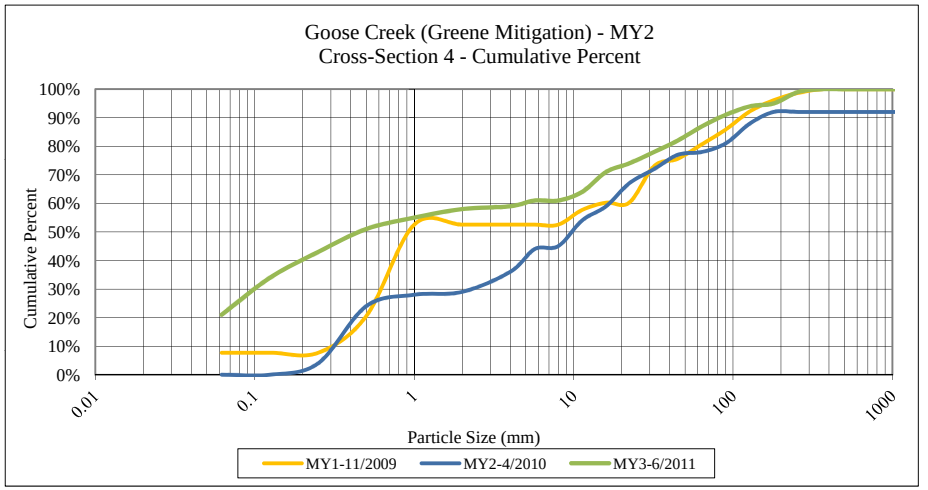


Appendix D. Stream Survey Data
Figure 5d: Pebble Count Plots with Annual Overlays
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3 of 5

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-4, Pool, 5+39**
Survey Date	**6/2011**

Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	21	21%	21%
Sand	very fine sand	0.125	13	13%	34%
	fine sand	0.250	9	9%	43%
	medium sand	0.50	8	8%	51%
	coarse sand	1.00	4	4%	55%
	very coarse sand	2.0	3	3%	58%
Gravel	very fine gravel	4.0	1	1%	59%
	fine gravel	5.7	2	2%	61%
	fine gravel	8.0	0	0%	61%
	medium gravel	11.3	3	3%	64%
	medium gravel	16.0	7	7%	71%
	course gravel	22.3	3	3%	74%
	course gravel	32.0	4	4%	78%
	very coarse gravel	45	4	4%	82%
	very coarse gravel	64	5	5%	87%
Cobble	small cobble	90	4	4%	91%
	medium cobble	128	3	3%	94%
	large cobble	180	1	1%	95%
	very large cobble	256	4	4%	99%
Boulder	small boulder	362	1	1%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.47
D84	52.60
D95	180.00



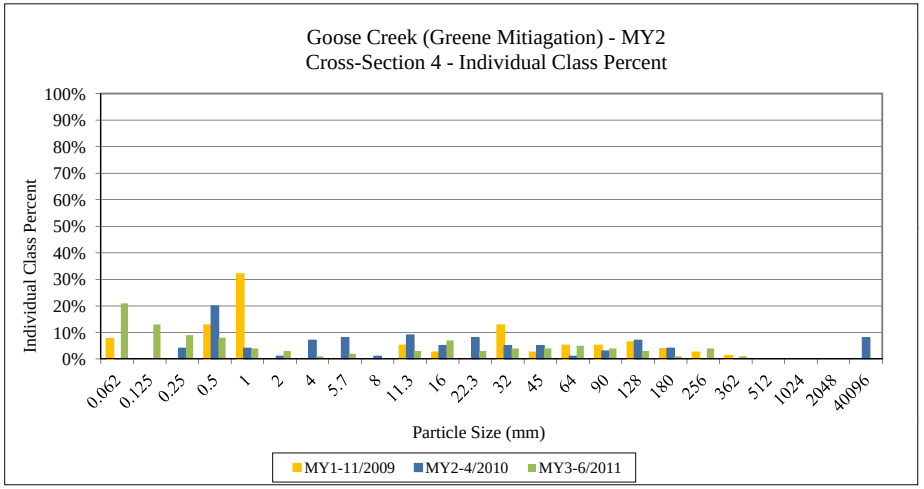


Table 10a. Baseline Stream Data Summary

UT Goose Creek (Greene Mitigation)/EEP Project No.92709

Main Channel (783lf)

Parameter	Pre-Existing Condition						Reference Reach Data						Design			Baseline					
Dimension and Substrate - Riffle	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	22.6	25.2	23.6	29.5	3.7	3	20.0	23.9	23.8	28.0	3.4	4	20.0	-	23.0	28.0	33.9	32.3	43.1	6.5	4
Floodprone Width (ft)	24.0	32.7	37.0	37.0	7.5	3	24.0	50.0	38.0	100.0	34.0	4	100.0	-	100.0	46.4	65.8	65.8	85.2	27.4	2
Bankfull Mean Depth (ft)	-	-	-	-	-	3	1.6	2.0	2.1	2.1	0.2	4	2.0	-	2.0	2.4	3.2	3.2	3.8	0.6	4
Bankfull Max Depth (ft)	2.4	3.0	3.3	3.4	0.5	3	2.2	2.6	2.6	3.1	0.4	4	2.3	-	2.3	3.9	4.9	4.9	5.9	0.8	4
Bankfull Cross-Sectional Area (ft^2)	47.1	51.5	53.2	54.2	3.9	3	40.3	46.6	46.2	53.5	5.5	4	46.0	-	50.0	100.9	104.9	105.7	107.2	2.9	4
Width/Depth Ratio	10.3	12.5	10.8	16.4	3.4	3	10.0	12.4	11.2	17.2	3.3	4	12.0	-	>12	7.3	11.3	10.0	17.8	4.5	4
Entrenchment Ratio	1.1	1.3	1.3	1.6	0.3	3	1.1	2.3	1.5	5.0	1.8	4	2.2	-	>2.2	1.5	1.7	1.7	2.0	0.4	2
Bank Height Ratio	-	-	-	-	-	3	1.3	-	-	1.8	-	-	1.0	-	1.0	1.3	1.5	1.5	1.7	0.2	4
Profile																					
Riffle Length (ft)	18.0	54.4	75.5	133.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Riffle Slope (ft/ft)	0.4	1.1	1.5	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Length (ft)	8.0	56.0	58.0	108.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Spacing (ft)	41.0	93.7	105.0	169.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern																					
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rc:Bankfull width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transport Parameters																					
Reach Shear Stress (competency) lb/ft^2	-	-	-	-	-	-							-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankful	-	-	-	-	-	-							-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m^2	-	-	-	-	-	-							-	-	-	-	-	-	-	-	-
Additional Reach Parameters																					
Rosgen Classification	F4/G4						B4c						B4c/F4			B4c/F4					
Bankful Velocity (fps)	4.3	3.9	3.8	3.7	N/A	N/A							4.4	-	4.1	2.0	1.9	1.9	1.9	0.1	4
Bankful Discharge (cfs)	203	203	203	203	N/A	N/A															
Valley Length (ft)	632						-														
Channel Thalweg Length (ft)	-	-	-	-	-	-	-	-	-	-	-		-	-	-	783					
Sinuosity (ft)	-	1.1	-	-	-	-	-	-	-	-	-	-	1.2	-	1.4	1.2					
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0100	-	0.0080					
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Bankful Floodplain Area (acres)	-	-	-	-			-	-	-	-	-		-	-	-	-	-	-	-	-	-
% of Reach with Eroding Banks	-	-	-	-			-	-	-	-	-										
Channel Stability or Habitat Metric	-	-	-	-			-	-	-	-	-										
Biological or Other	-	-	-	-			-	-	-	-	-										

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank and Hydrologic Containment Parameter Distributions)																														
UT Goose Creek (Greene Mitigation)/EEP Project No.92709																														
Main Channel (783 lf)																														
Parameter	**Pre-Existing Condition**							**Reference Reach Data**							**Design**							**As-built/Baseline**								
Ri%/Ru%/P%/G%/S%	U	U	49%	U	U			U	U	U	U	U			U	U	U	U	U	U	U	U	U	37%	U	U			
SC% / Sa% / G% / C% / B% / Be%	1%	25%	46%	18%	2%	9%		3%	23%	59%	12%	0%	3%																	
d16 / d35 / d50 / d84 / d95 (mm)	1.0487	3.249	8.2853	97.17	204.47	-	-	0.705	3.69	10.4	55.9	146.4	-	-																
Entrenchment Class<1.5/1.5-1.99/2.0-4.9/5.0-9.9/>10	1.25								1.5															> 2.2					
Incision Class <1.2/1.2-1.49/1.5-1.99/>2.0	U	U	U	U				U	U	U	U													U	U	U	U			

"N/A": items do not apply / "-": items are unavailable / "U": items are unknown

Table 11a: Morphologic and Hydraulic Monitoring Summary										
UT Goose Creek (Greene Mitigation)/EEP Project No.92709										
Main Channel (783lf)										
PARAMETER	**Cross-Section 1 (Riffle)**					**Cross-Section 2 (Pool)**				
DIMENSION	**Baseline**	**MY2-2010**	**MY3-2011**	**MY4-2012**	**MY5-2013**	**Baseline**	**MY2-2010**	**MY3-2011**	**MY4-2012**	**MY5-2013**
Bankfull Width (ft)	43.1	43.8	44.2			32.3	31.9	32.3		
Floodprone Width (ft)	85.2	85.2	74.4			46.4	46.4	46.5		
Bankfull Mean Depth	2.4	2.5	2.5			3.3	3.3	3.3		
Bankfull Max Depth (ft)	3.9	4.1	4.0			5.0	5.0	4.9		
Bankfull Cross-sectional Area (ft^2)	104.5	108.0	109.0			106.8	105.2	106.2		
Bankfull Width/Depth Ratio	17.8	17.8	18.0			9.7	9.7	9.8		
Bankfull Entrenchment Ratio	2.0	1.9	1.7			1.5	1.5	1.4		
Bankfull Bankheight Ratio	1.7	2.0	2.0			1.4	2.0	2.0		
Cross Sectional Area between end pins (ft^2)	-	410.3	228.5			-	185.3	186.7		
d50 (mm)	17.1	22.6	5.1			20.6	16.0	8.9		
PARAMETER	**Cross-Section 3 (Pool)**					**Cross-Section 4 (Riffle)**				
DIMENSION	**Baseline**	**MY2-2010**	**MY3-2011**	**MY4-2012**	**MY5-2013**	**Baseline**	**MY2-2010**	**MY3-2011**	**MY4-2012**	**MY5-2013**
Bankfull Width (ft)	32.3	33.3	33.2			28.0	27.3	27.3		
Floodprone Width (ft)	-	56.7	49.7			-	44.1	43.7		
Bankfull Mean Depth	3.1	3.2	3.1			3.8	3.8	4.0		
Bankfull Max Depth (ft)	4.9	5.1	4.9			5.9	5.9	5.9		
Bankfull Cross-sectional Area (ft^2)	100.9	106.7	101.0			107.2	104.5	108.3		
Bankfull Width/Depth Ratio	10.4	10.4	10.9			7.3	7.1	6.9		
Bankfull Entrenchment Ratio	-	1.7	1.5			-	1.6	1.6		
Bankfull Bankheight Ratio	1.7	2.0	2.0			1.3	2.0	2.0		
Cross Sectional Area between end pins (ft^2)	-	225.4	221.5			-	256.4	260.5		
d50 (mm)	26.4	4.3	0.8			80.4	9.8	0.5		

"N/A": items do not apply / "-": items are unavailable / "U": items are unknown

Table 11b. Monitoring Data - Stream Reach Data Summary
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Main Channel (783lf)

Parameter	Baseline						MY 2 2010						MY 3 2011					
DIMENSION	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	27.96	33.91	32.27	43.12	6.47	4	27.27	34.08	32.61	43.82	6.99	4	27.34	34.26	32.74	44.22	7.12	4
Floodprone Width (ft)	46.41	65.82	65.82	85.22	-	2	46.41	65.82	65.82	85.22	-	2	46.49	60.44	60.44	74.39	19.73	4
Bankfull Mean Depth (ft)	2.42	3.17	3.22	3.83	0.58	4	2.46	3.20	3.25	3.83	0.56	4	2.46	3.19	3.17	3.96	0.62	4
Bankfull Max Depth (ft)	3.94	4.93	4.94	5.89	0.80	4	4.11	5.01	5.03	5.88	0.73	4	3.99	4.92	4.91	5.85	0.76	4
Bankfull Cross Sectional Area (ft2)	100.89	104.85	105.68	107.15	2.89	4	104.53	106.10	105.95	107.95	1.53	4	101.01	106.12	107.25	108.98	3.60	4
Width/Depth Ratio	7.30	11.30	10.05	17.82	4.54	4	7.12	11.25	10.04	17.81	4.59	4	6.90	11.39	10.35	17.98	4.70	4
Entrenchment Ratio	1.45	1.72	1.72	1.98	-	2	1.46	1.70	1.70	1.94	-	2	1.44	1.56	1.56	1.68	0.17	4
Bank Height Ratio	1.31	1.52	1.54	1.67	0.17	4	2.00	2.00	2.00	2.00	0.00	4	2.00	2.00	2.00	2.00	0.00	4
PROFILE	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Riffle Length (ft)	9.01	25.62	-	63.05	-	-	7.53	21.85	-	55.00	-	-	6.93	34.12	-	73.12	-	-
Riffle Slope (ft/ft)	0.00	0.0152	-	0.0472	-	-	0.0068	0.0166	-	0.0403	-	-	0.0099	0.02829	-	0.07975	-	-
Pool Length (ft)	38.84	41.10	-	72.62	-	-	48.97	60.27	-	98.70	-	-	12.31	30.98	-	53.88	-	-
Pool Max depth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Spacing (ft)	45.6	85.57	-	94.57	-	-	74.59	132.98	-	197.39	-	-	10.78	45.67	-	130.08	-	-
PATTERN	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ADDITIONAL REACH PARAMETERS	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Rosgen Classification	B4c/C4						B4c/C4						B4c/C4					
Channel Thalweg length (ft)	783						783						783					
Sinuosity (ft)	1.23						1.23						1.23					
Water Surface Slope (Channel) (ft/ft)	0.0065						0.006						0.007					
BF slope (ft/ft)	0.0069						0.006						0.006					
Ri%/Ru%/P%/G%/S%	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-	
SC%/Sa%/G%/C%/B%/Be%																		
d16 / d35 / d50 / d84 / d95																		
% of reach with eroding banks	-						-						-					
Channel Stability or Habitat Metric	-						-						-					
Biological or Other	-						-						-					

"N/A": items do not apply / "-": items are unavailable / "U": items are unknown

APPENDIX E
HYDROLOGIC DATA

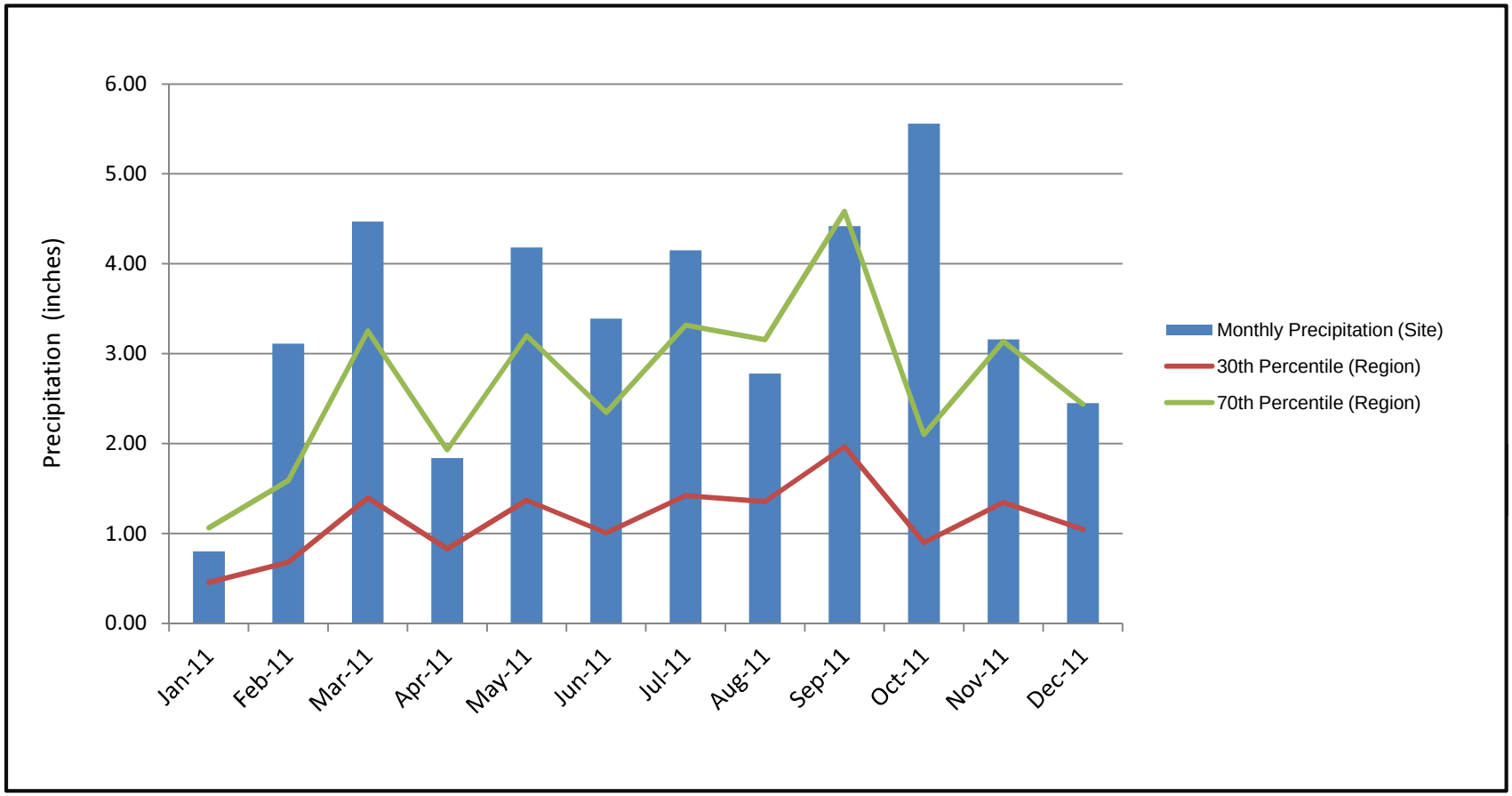
Table 12 **Verification of Bankfull Events**

Figure 6 **Monthly Rainfall Data**

Appendix E. Hydrologic Data
Table 12: Appendix E Verification of Bankfull Events
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3

Date of Collection	Date of Occurrence	Method	Photo # (if available)
11/18/09	11/11/2009-11/12/2009	Visual/USGS	N/A
9/2010	8/2010	Visual/USGS	N/A
8/2011	8/5/2011	Visual/USGS Data	N/A

Appendix E. Hydrologic Data
Figure 6: Monthly Rainfall Data
UT Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 3



*Regional rainfall data referenced from NC Cronos Database Divisonal Data for the Southern Piedmont of North Carolina - Data Period January 2011 through December 2011.
Monthly precipitation referenced from the USGS 351218080331345 CRN-29 rain gage Real-Time daily data, January 2011 through December 2011.