Goose Creek (Greene Mitigation) Stream Enhancement Project

EEP Project No. 92709

2010 Monitoring Report: Year 2 of 5

Construction Completed: February 2005
Submission Date: March 2011

Prepared for:

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Ecosystem Enhancement PROGRAM

NCDENR

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SECTION 1
EXECUTIVE SUMMARY

SECTION 1
EXECUTIVE SUMMARY

The Goose Creek (Greene Mitigation) Stream Enhancement Project (Site) is located in Mecklenburg County, North Carolina just south of the Town of Mint Hill (Appendix 1.1). The Site drains approximately 3.15 square miles to the Rocky River, within the Southern Outer Piedmont Physiographic Region of the Yadkin River Basin (HUC 3040105). The Site consisted of bank stabilization and habitat enhancement along 783 linear feet of 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. This report serves as the second year of the five year monitoring plan for the Site.

1.1 Goals and Objectives

The Site runs through small farms containing pastures, forested areas, and housing and commercial developments. The construction of I-485 has resulted in a shift from a rural to an urban land-use watershed. Poor riparian zone management in the upstream reaches of the watershed due to land disturbing activities such as clearcutting, overgrazing of streambanks, channelization, and development have had an adverse effect on the stability of the 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*). As a result of concern for 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 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. The Site was planted with native riparian vegetation. Enhancement of the stream areas will help to improve streambank stability, water quality, and increase local vegetative biodiversity. Appendix 2 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, the vegetation plots previously established following construction in 2005 were not marked well enough to be located and assessed in 2009. Therefore, JJG established three new vegetation monitoring plots

100 m^2 (two 5m x 20m and one 10m x 10m) in size on-site within the enhancement areas in the approximate location of the original plots established by NCWRC. Planted stems were determined to be planted or volunteer in 2009 since the original flagging was missing. The largest trees were recorded as the planted specimens and the smaller stems were recorded as natural recruitment. 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, since JJG re-established 3 vegetation plots (0.0247 acres) in lieu of monitoring the previous plots due to the reasons previously stated, the following planted stems per acre requirements will be followed to determine vegetation success at the end of each monitoring year (USACE, 2003).

- 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 2010 monitoring year (MY-2). The 2010 vegetation monitoring indicated an average survivability of 1,592 planted stems per acre with a mean of 5,263 stems per acre when including volunteers. The number of planted species ranged from 8-14 across plots with 14-21 when including volunteers. MY-2009 was the first year of monitoring for the planted vegetation; however, the Site was planted in 2005 and therefore is in the fourth growing season. The monitoring data indicates an average of 39 stems per plot. In conclusion, the riparian restoration project meets the requirements per the success criterion for the 2010 monitoring year. Please refer to Appendix 3 for vegetation photos and raw data tables.

1.3 Stream Assessment

Results from the 2010 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. These areas will continue to be monitored closely for significant adjustments in the bank, bed features, and channel thalweg.

Stream dimension, pattern, profile, and substrate were evaluated within 688 linear feet of the Site. The average bankfull width (34.08 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 3.2 ft compared to the as-built typical (2.9 ft). The surveyed bankfull widths and depths lead to an average Width/Depth ratio of 11.25 and a sinuosity of 1.2, which typifies a Rosgen C/E-type stream. 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 the average bankfull slope were the same for the surveyed reach, 0.0060 ft/ft. The substrate analysis illustrated a diverse and stable substrate material and available habitat with little to no deposition of fine substrate occurring.

Near station 4+00 feet (ft), a debris jam that has formed has temporarily affected the profile. This change in the profile is not a significant change that appears to be permanent. The debris jam and accumulated sediment will probably be flushed out of the system with future rain events. Other areas that are being watched include a stressed boulder toe with dislodged boulders and a failed structure at the end of the project that is no longer providing adequate bank protection. This structure is not providing the intended protection as it has become dislodged, and the neighboring bank has exhibited bank erosion. The structure may need to be removed.

A crest gauge is not located on-site; therefore, JJG referenced a local USGS gauge (station 0212467451) located downstream of the Site with a similar drainage area (8.5 sq.mi.) to determine bankfull event occurrences. According to the USGS gauge, more than one bankfull event or greater was recorded within the Goose Creek watershed during the 2010 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-2010. Please refer to Appendix 4 for detailed stream data tables and plots and Appendix 1.2 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 2. The 2010 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 the debris jam mentioned above. However, these areas of stream instability do not appear to be advancing and have roots from larger trees growing along the bank that are providing bank stability. These areas will continue to be monitored closely for shifts in 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. Geomorphic and stream 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). Vegetation assessments were conducted following the NCEEP 2004 Stem Counting Protocol which consists of counting woody stems within the established vegetation plots. JJG used the *Flora of the Carolinas, Virginia, Georgia, and surrounding areas* by Alan S. Weakley as the taxonomic standard for vegetation nomenclature for this report. 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 1 - General Figures and Plan Views

Appendix 2 - General Project Tables

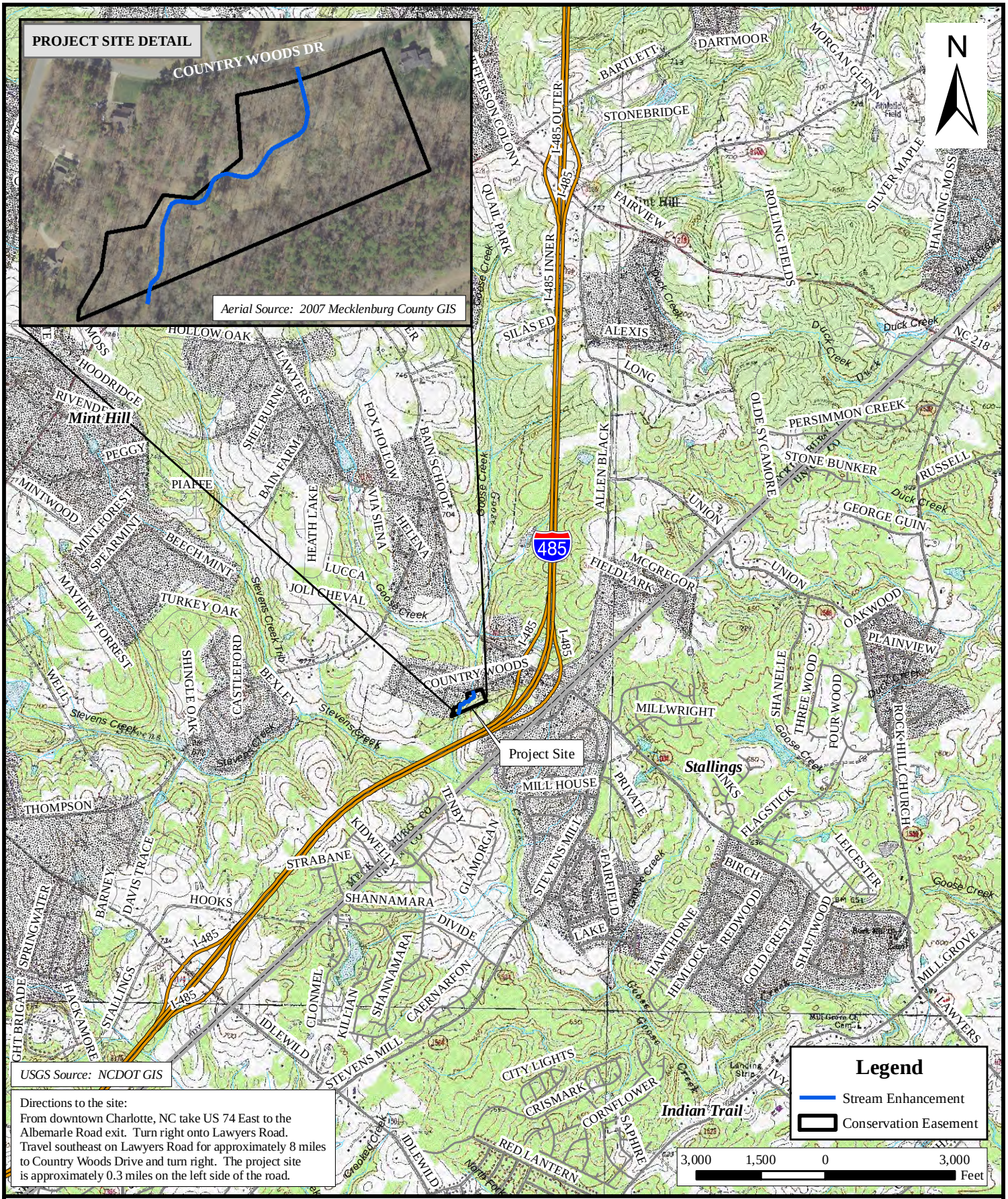
Appendix 3 - Vegetation Assessment Data

Appendix 4 – Stream Assessment Data

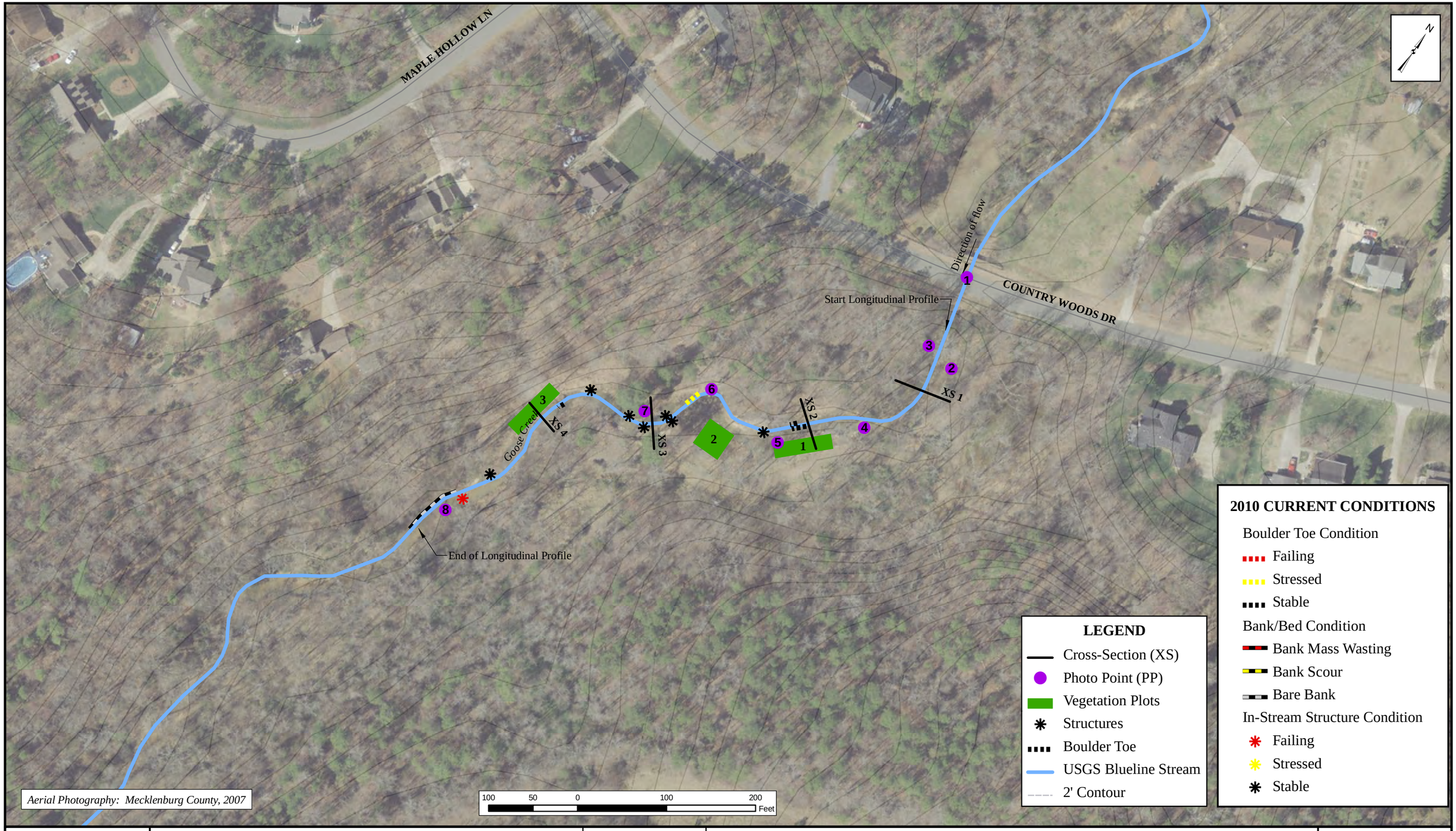
APPENDIX 1
GENERAL FIGURES AND PLAN VIEWS

1.1 Project Vicinity Map

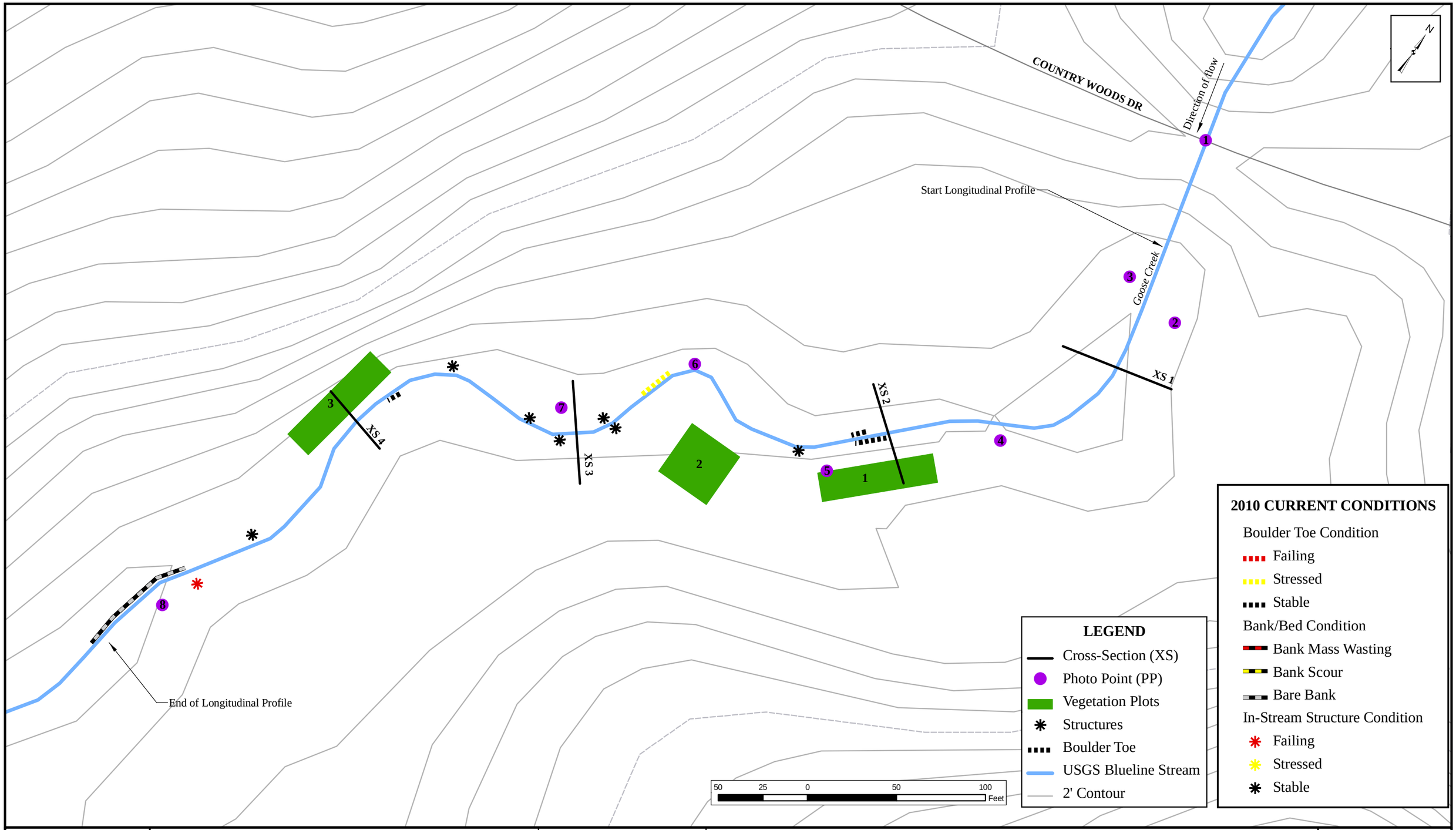
1.2 Current Condition Plan View



Appendix 1.1 Project Vicinity Map
Goose Creek (Greene Mitigation Site)/EEP Project No. 92709
Mecklenburg County, North Carolina
Monitoring Year 2 of 5
Submittal Date: March 2010



Ecosystem Enhancement Program	EEP PROJECT NO. 92709 MECKLENBURG COUNTY, NORTH CAROLINA MONITORING YEAR 2 OF 5	JJG	**NC ECOSYSTEM ENHANCEMENT PROGRAM** **GOOSE CREEK (GREENE MITIGATION SITE)** APPENDIX 1.2 CURRENT CONDITION PLAN VIEW	March 2010 1"=100' Figure KEY



Ecosystem Enhancement Program

EEP PROJECT NO. 92709
MECKLENBURG COUNTY, NORTH CAROLINA
MONITORING YEAR 2 OF 5

JJG

NC ECOSYSTEM ENHANCEMENT PROGRAM
GOOSE CREEK (GREENE MITIGATION SITE)

APPENDIX 1.2
CURRENT CONDITION PLAN VIEW

March 2010
1"=50'

Figure 1 OF 1

APPENDIX 2
GENERAL PROJECT TABLES

2.1 Project Mitigation Structure and Objectives

2.2 Project Activity and Reporting History

2.3 Project Contacts

2.4 Project Attribute Table

Appendix 2.1 Project Mitigation Structure and Objectives
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

Segment/Reach	Mitigation Type	Approach	Linear Footage or Acres	Stationing (ft)*	Comments
Goose Creek	Enhancement	Level 1	783 lf	0+00-7+83	Channel enhancement with use of grade control and bank protection structures.

Component Summations						
		Wetland (ac)				
Restoration Level	Stream (lf)	Riparian	Non-Riparian	Upland (ac)	Buffer (ac)	BMP
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
Enhancement 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**

Appendix 2.2 Project Activity and Reporting History
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

Elapsed Time Since Grading Complete: 5 Years 10 Months
Elapsed Time Since Planting Complete: 5 Years 10 Months
Number of Reporting Years: 2

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	TBD	TBD
Year 4 Monitoring	TBD	TBD
Year 5 Monitoring	TBD	TBD

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

Appendix 2.3 Project Contacts
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

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 309 E. Morehead Street, Suite 110 Charlotte, NC 28202
Stream Monitoring, POC	Alison Nichols, 704-527-4106 ext.227
Vegetation Monitoring, POC	

Table 2.4 Project Attribute Table
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

Project County	Mecklenburg County, North Carolina
Physiographic Region	Piedmont
Ecoregion	Southern Outer Piedmont
Project River Basin	Yadkin
USGS HUC for Project (14 digit)	03040105030020
NCDWQ Sub-basin for Project and Reference	03-07-12
Within extent of EEP Watershed Plan?	Yes
WRC Class (Warm, Cool, Cold)	Warm
% of project easement fenced or demarcated?	0%
Beaver activity observed during design phase?	No
Restoration Component Attribute Table	
	Main Channel
Drainage Area (sq.mi.)	3.15
Stream Order	3rd
Restored Length (ft)	783
Perennial or Intermittent	Perennial
Watershed type (Rural, Urban, Developing)	Urban
Watershed LULC Distribution	
Agriculture	-
Commercial	-
Public/Institutional	-
Residential	-
Transportation	-
Watershed Impervious Cover (%)	5%
NCDWQ AU/Index number	
NCDWQ classification	C
303d listed?	No
Upstream of a 303d listed sedment?	No
Reasons for 303d listing or stressor	N/A
Total acreage of easement	4.4 acres
Total vegetated acreage within the easement	7.8*
Total planted acreage as part of the restoration	U
Rosgen classification of the pre-existing	U
Rosgen classification of the As-Built	B4c/C4
Valley Type	-
Valley slope	-
Valley side slope range	-
Valley toe slope range	-
Cowardin classification	N/A
Trout waters designation	No
Species of concern, endangered, etc? (Y/N)	N/A
Dominant soil series and characteristics	Monacan, Lignum gravelly silt loam, Georgeville silt loam
Series	-
Depth	-
Clay %	-
K	-
T	-

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

*Estimated from information provided in the as-built report by NCWRC, 2005

APPENDIX 3
VEGETATION ASSESSMENT DATA

3.1 Vegetation Plot Mitigation Success

3.2 Vegetation Monitoring Plot Photos

3.3 Vegetation Plot Summary Data Table

3.4 Vegetation Condition Assessment

Appendix 3.1 Vegetation Plot Mitigation Success
Goose Creek (Greene Mitigation)/EEP Project No. 92709
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Vegetation Plot ID	Vegetation Survival Threshold Met (Y/N)
Plot 1	Y
Plot 2	Y
Plot 3	Y

Vegetation Plot 1
(10/2010)

Vegetation Plot 2
(10/2010)

Vegetation Plot 3
(10/2010)

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Appendix 3.2 Vegetation Monitoring Plot Photos
Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
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Submittal Date: March 2011

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Appendix 3.3 Vegetation Plot Summary Data Table
Goose Creek (Greene Mitigation)/EEP Project No. 92709
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			Current Data (MY2-2010)						Annual Means					
			Plot 1		Plot 2		Plot 3		Current Mean		MY0-2005*		MY1-2009	
Species	**Common Name**	**Type**	P	T	P	T	P	T	**P**	**T**	**P**	**T**	**P**	**T**
Acer negundo	boxelder	T			1	2		1	**1**	**2**			**1**	**3**
Acer rubrum	red maple	T	1	7	2	2		2	**2**	**4**	**3**	**3**	**2**	**3**
Alnus serrulata	tag alder	T	9	14	14	14	6	6	**10**	**11**	**27**	**27**	**10**	**12**
Baccharis halimifolia	groundsel tree	T		1					**N/A**	**1**				
Betula nigra	river birch	T	1	1		1			**1**	**1**				
Carpinus caroliniana	american hornbeam	T	4	36	6	34	9	34	**6**	**35**	**2**	**2**	**6**	**28**
Carya ovata	shagbark hickory	T		1					**N/A**	**1**				
Cephalanthus occidentalis	buttonbush	S							**N/A**	**N/A**	**6**	**6**		
Cornus amomum	silky dogwood	S			1	1	2	2	**2**	**2**	**43**	**43**	**2**	**2**
Fagus grandifolia	american beech	T							**N/A**	**N/A**	**9**	**9**		
Fraxinus pennsylvanica	green ash	T	2	7			1	2	**2**	**5**			**2**	**3**
Juglans nigra	black walnut	T							**N/A**	**N/A**	**25**	**25**		
Juniperus virginiana	eastern red cedar	T	1	5		5	1	1	**1**	**4**	**3**	**3**	**1**	**3**
Lindera benzoin	spicebush	S		9		2		5	**N/A**	**5**				
Lirodendron tulipifera	tulip poplar	T		3		3	6	10	**6**	**5**	**3**	**3**		
Liquidambar styraciflua	sweet gum	T		23		29		20	**N/A**	**24**				**20**
Morus rubra	red mulberry	T						4	**N/A**	**4**				
Platanus occidentalis	sycamore	T	3	3	15	19	1	1	**6**	**8**			**6**	**8**
Pinus taeda	loblolly pine	T		10				5	**N/A**	**8**				**10**
Pinus sp.	pine species	T							**N/A**	**N/A**	**7**	**7**		
Prunus serotina	black cherry	T					2	2	**2**	**2**	**1**	**1**		
Quercus alba	white oak	T					1	7	**1**	**7**			**1**	**7**
Quercus lyrata	overcup oak	T					2	2	**2**	**2**			**2**	**2**
Quercus palustris	pin oak	T							**N/A**	**N/A**	**1**	**1**		
Quercus phellos	willow oak	T		4	2	2	1	3	**2**	**3**				
Quercus sp.	oak species	T							**N/A**	**N/A**	**2**	**2**		
Rhus glabra	smooth sumac	S		1					**N/A**	**1**				
Salix nigra	black willow	S	10	12					**10**	**12**	**1**	**1**	**15**	**15**
Salix sericea	silky willow	S	2	3	5	6	4	4	**4**	**4**	**54**	**54**		
Sambucus canadensis	elderberry	S					2	2	**2**	**2**	**3**	**3**	**2**	**2**
Ulmus alata	winged elm	T		6		1		9	**N/A**	**5**				
Unknown sp.							1	1	**1**	**1**	**4**	**4**		
Plot Area (acres)			**0.0247**								******			
Species Count			**9**	**18**	**8**	**14**	**14**	**21**	**10**	**18**	**17**		**10**	**18**
Stem Count			**33**	**146**	**46**	**121**	**39**	**123**	**39**	**130**	**195**		**41**	**125**
Stems per Acre			**1336**	**5911**	**1862**	**4899**	**1579**	**4980**	**1592**	**5263**	**2324**		**1673**	**5074**

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 3.4 Vegetation Condition Assessment
Goose Creek (Greene Mitigation)/EEP Project No. 92709
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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.				

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%

APPENDIX 4
STREAM ASSESSMENT DATA

4.1 Stream Station Photos

4.2 Qualitative Visual Stability Assessment

4.3 Verification of Bankfull Events

4.4 Cross-Section Plots and Raw Data Tables*

4.5 Longitudinal Plots and Raw Data Tables*

4.6 Pebble Count Plots and Raw Data Tables*

*Raw data tables have been provided electronically.

Photo Point 1: View Downstream Left Bank
(4/2010)

Photo Point 1: View Downstream Right Bank
(4/2010)

Photo Point 2: View Upstream
(4/2010)

Photo Point 2: View Downstream
(4/2010)

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Appendix 4.1 Stream Station Photos
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Photo Point 3: View Upstream
(4/2010)

Photo Point 3: View Downstream
(4/2010)

Photo Point 4: View Upstream
(4/2010)

Photo Point 4: View Downstream
(4/2010)

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Appendix 4.1 Stream Station Photos
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Photo Point 5: View Upstream
(4/2010)

Photo Point 5: View Downstream
(4/2010)

Photo Point 6: View Upstream
(4/2010)

Photo Point 6: View Downstream
(4/2010)

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Appendix 4.1 Stream Station Photos
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Photo Point 7: View Upstream
(4/2010)

Photo Point 7: View Downstream
(4/2010)

Photo Point 8: View Upstream
(4/2010)

Photo Point 8: View Downstream
(4/2010)

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Appendix 4.1 Stream Station Photos
Goose Creek (Greene Mitigation) Stream Enhancement/EEP Project No. 92709
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Appendix 4.2 Qualitative Visual Stability Assessment
Main Channel (783lf)
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

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	97%	1	25	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	97%	1	25	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 4.3 Verification of Bankfull Events
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

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

Appendix 4.4 Cross-Section Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

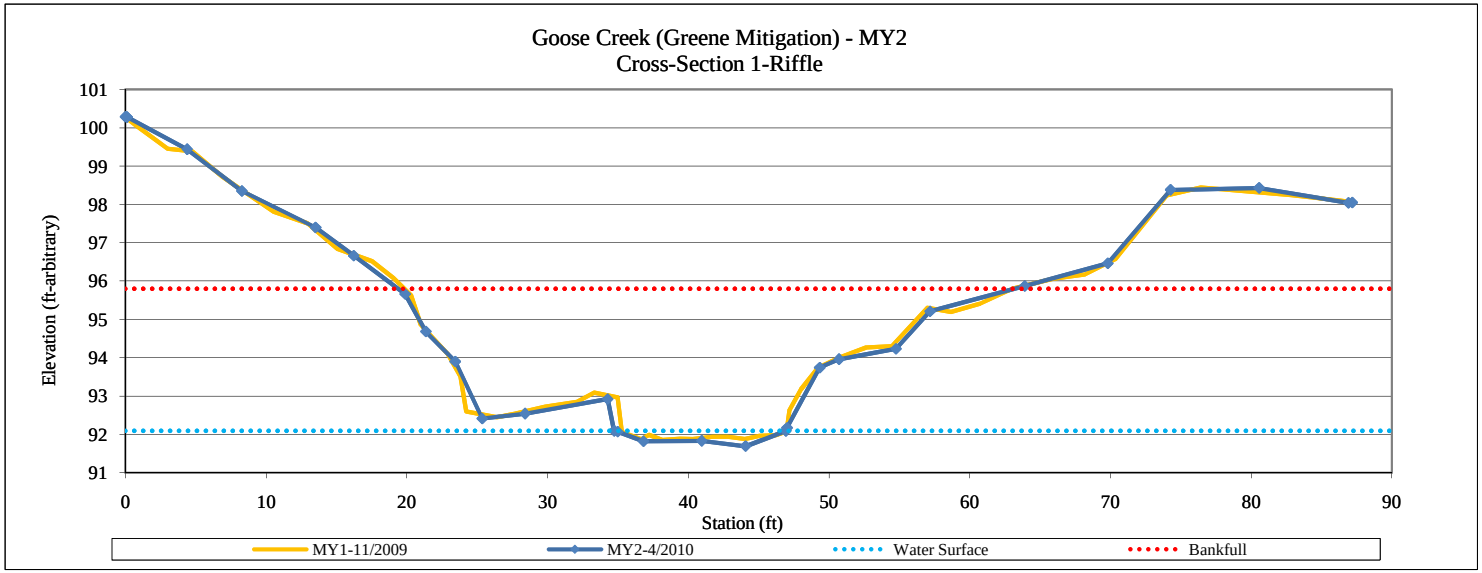
Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-1, Riffle, 0+51**
Survey Date	**4/2010**

SUMMARY DATA	
Bankfull Elevation (ft)	95.80
Bankfull Cross-Sectional Area (ft^2)	107.95
Bankfull Width (ft)	43.82
Flood Prone Area Elevation (ft)	99.91
Flood Prone Width (ft)	>100
Bankfull Mean Depth (ft)	2.46
Bankfull Max Depth (ft)	4.11
W/D Ratio	17.81
Entrenchment Ratio	>2.2
Bank Height Ratio	2.00

XS-1: View Upstream

XS-1: View Downstream

Station	Elevation	Notes
-0.13	100.27	x1
0	100.29	x1
0.11	100.28	x1-lpt
0.12	100.28	x1
4.39	99.44	x1
8.28	98.35	x1
13.52	97.40	x1
16.23	96.66	x1
19.89	95.66	x1
21.36	94.68	x1
23.44	93.90	x1-b
25.36	92.41	x1
28.41	92.54	x1
34.28	92.92	x1
34.74	92.09	x1-w
34.99	92.07	x1
36.82	91.82	x1
40.96	91.83	x1
44.07	91.69	x1
46.93	92.09	x1-w
47.02	92.17	x1
49.34	93.74	x1-b
50.72	93.96	x1
54.76	94.23	x1
57.18	95.21	x1
63.91	95.87	x1
69.81	96.46	x1
74.27	98.38	x1
80.56	98.43	x1
86.91	98.04	x1
87.19	98.05	x1-rpt



Appendix 4.4 Cross-Section Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

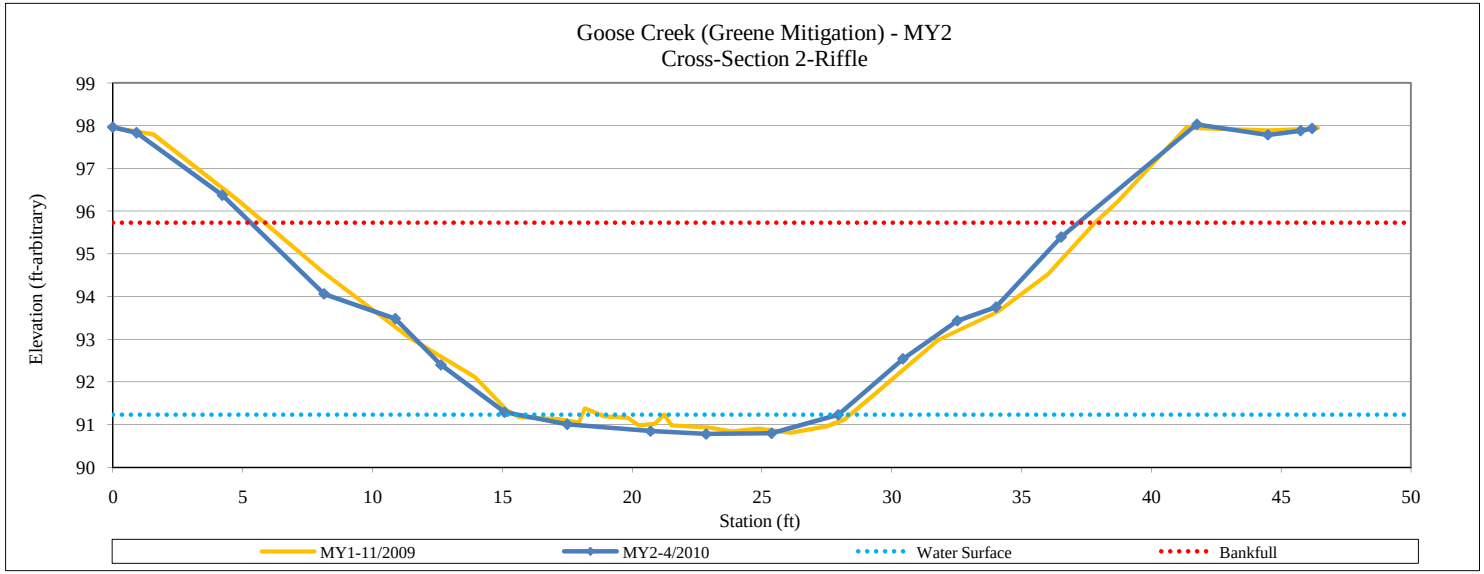
Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-2, Riffle, 1+95**
Survey Date	**4/2010**

SUMMARY DATA	
Bankfull Elevation (ft)	95.73
Bankfull Cross-Sectional Area (ft^2)	105.22
Bankfull Width (ft)	31.89
Flood Prone Area Elevation (ft)	100.68
Flood Prone Width (ft)	>100
Bankfull Mean Depth (ft)	3.30
Bankfull Max Depth (ft)	4.95
W/D Ratio	9.66
Entrenchment Ratio	~3.14
Bank Height Ratio	2.00

XS-2: View Upstream

XS-2: View Downstream

Station	Elevation	Notes
-0.47	97.88	x2
0	97.96	x2-lpt
0.92	97.83	x2
4.22	96.37	x2
8.14	94.06	x2
10.88	93.48	x2
12.64	92.40	x2
15.09	91.23	x2-w
17.5	91.01	x2
20.71	90.85	x2
22.85	90.78	x2
25.37	90.80	x2
27.94	91.23	x2-w
30.43	92.54	x2-b
32.52	93.43	x2
34.01	93.75	x2
36.52	95.39	x2
41.75	98.03	x2
44.48	97.78	x2
45.74	97.88	x2
46.19	97.93	x2-rpt



Appendix 4.4 Cross-Section Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

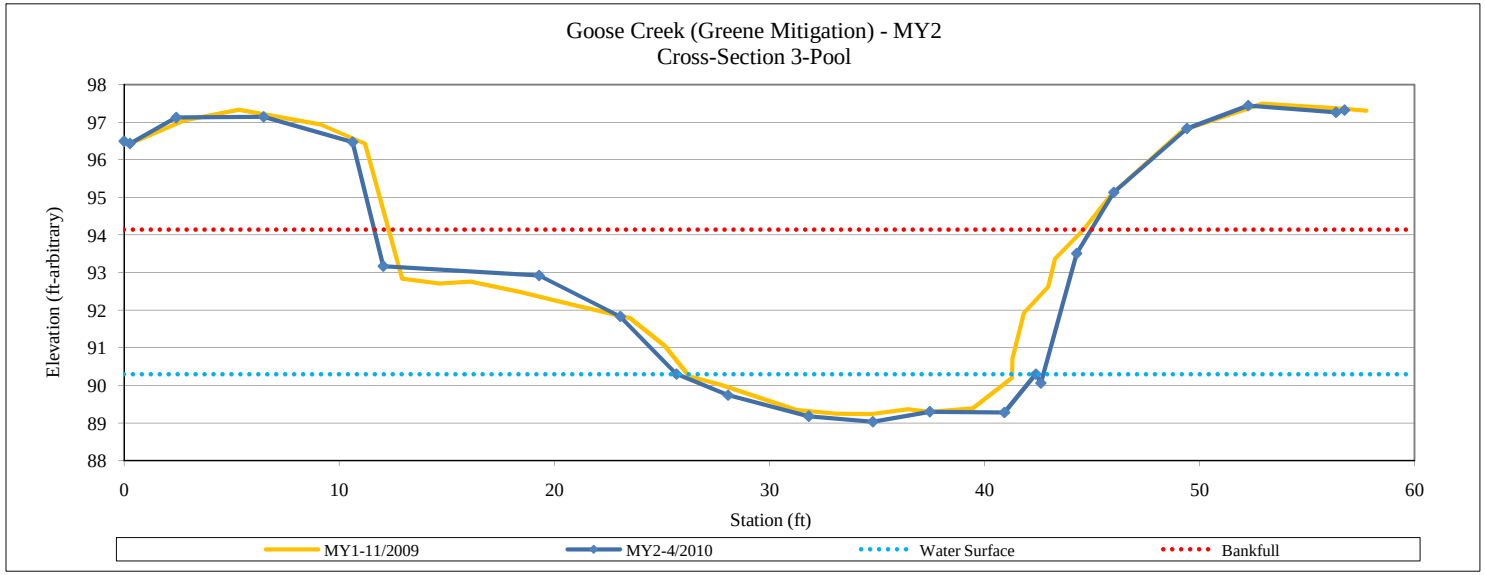
Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-3, Pool, 3+95**
Survey Date	**4/2010**

SUMMARY DATA	
Bankfull Elevation (ft)	94.14
Bankfull Cross-Sectional Area (ft^2)	106.68
Bankfull Width (ft)	33.33
Flood Prone Area Elevation (ft)	99.25
Flood Prone Width (ft)	N/A
Bankfull Mean Depth (ft)	3.20
Bankfull Max Depth (ft)	5.11
W/D Ratio	10.42
Entrenchment Ratio	N/A
Bank Height Ratio	2.00

XS-3: View Upstream

XS-3: View Downstream

Station	Elevation	Notes
0.00	96.49	x3-lpt
0.28	96.43	x3
2.43	97.12	x3
6.49	97.14	x3
10.63	96.47	x3
12.05	93.17	x3
19.30	92.92	x3
23.07	91.83	x3
25.68	90.30	x3-w
28.08	89.74	x3
31.83	89.18	x3
34.81	89.03	x3
37.46	89.30	x3
40.93	89.28	x3
42.39	90.30	x3-w
42.62	90.06	x3
44.29	93.51	x3
46.01	95.13	x3
49.41	96.83	x3
52.26	97.44	x3
56.34	97.26	x3
56.74	97.32	x3-rpt



Appendix 4.4 Cross-Section Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

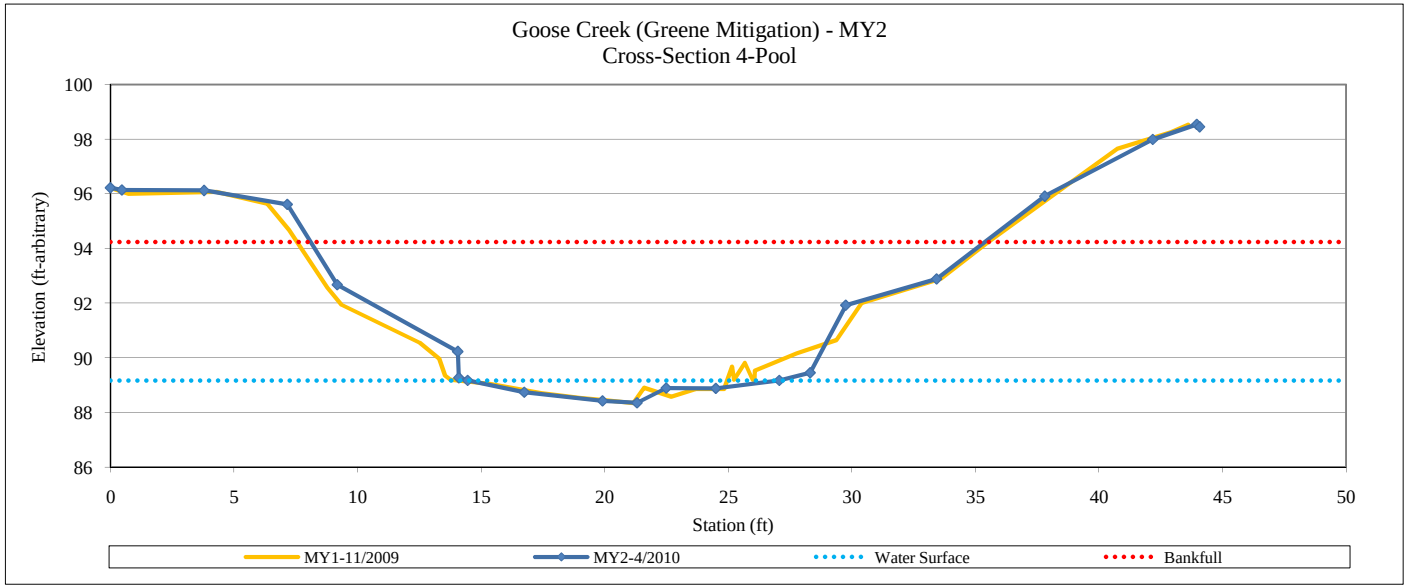
Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-4, Pool, 5+39**
Survey Date	**4/2010**

SUMMARY DATA	
Bankfull Elevation (ft)	94.23
Bankfull Cross-Sectional Area (ft^2)	104.53
Bankfull Width (ft)	27.27
Flood Prone Area Elevation (ft)	100.11
Flood Prone Width (ft)	N/A
Bankfull Mean Depth (ft)	3.83
Bankfull Max Depth (ft)	5.88
W/D Ratio	7.12
Entrenchment Ratio	N/A
Bank Height Ratio	2.00

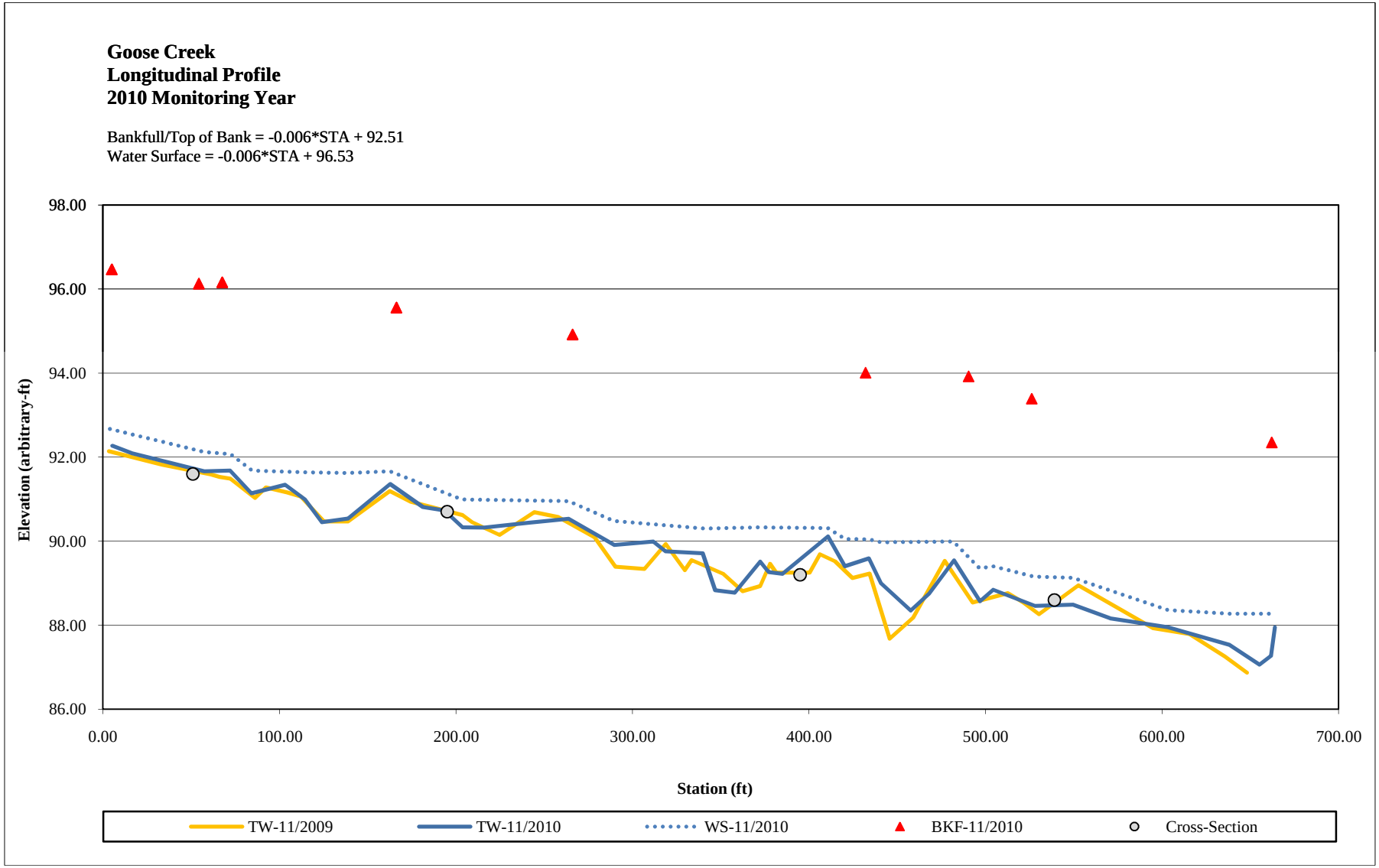
XS-4: View Upstream

XS-4: View Downstream

Station	Elevation	Notes
0.00	96.22	x4-lpt
0.47	96.14	x4
3.80	96.12	x4
7.16	95.61	x4
9.18	92.67	x4
14.06	90.23	x4
14.10	89.27	x4
14.46	89.17	x4-w
16.75	88.74	x4
19.92	88.42	x4
21.31	88.35	x4
22.49	88.89	x4
24.50	88.88	x4
27.07	89.17	x4-w
28.32	89.45	x4
29.76	91.92	x4
33.43	92.88	x4
37.81	95.91	x4
42.18	97.99	x4
43.96	98.54	x4-rpt
44.08	98.45	x4



Appendix 4.5 Longitudinal Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

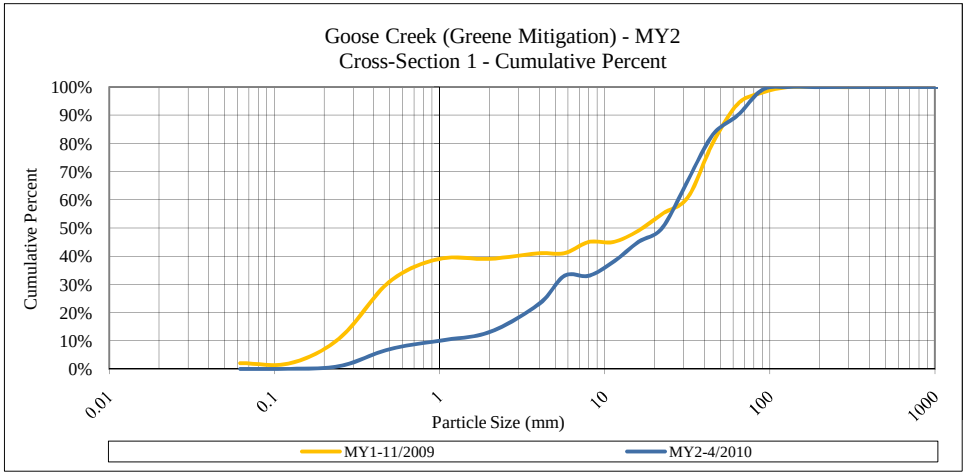


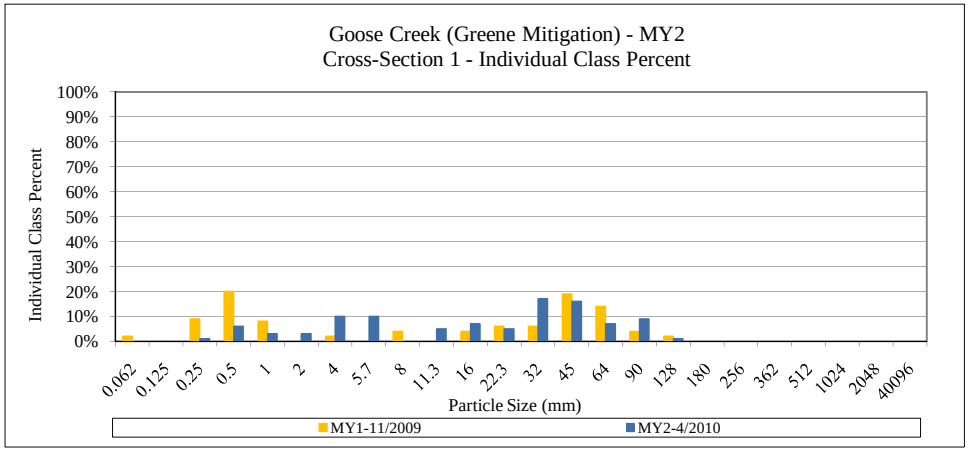
Appendix 4.6 Pebble Count Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-1, Riffle, 0+51**
Survey Date	**4/2010**

Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	1	1%	1%
	medium sand	0.50	6	6%	6%
	coarse sand	1.00	3	3%	3%
	very coarse sand	2.0	3	3%	3%
Gravel	very fine gravel	4.0	10	10%	10%
	fine gravel	5.7	10	10%	10%
	fine gravel	8.0	0	0%	0%
	medium gravel	11.3	5	5%	5%
	medium gravel	16.0	7	7%	7%
	course gravel	22.3	5	5%	5%
	course gravel	32.0	17	17%	17%
	very coarse gravel	45	16	16%	16%
	very coarse gravel	64	7	7%	7%
Cobble	small cobble	90	9	9%	9%
	medium cobble	128	1	1%	1%
	large cobble	180	0	0%	0%
	very large cobble	256	0	0%	0%
Boulder	small boulder	362	0	0%	0%
	small boulder	512	0	0%	0%
	medium boulder	1024	0	0%	0%
	large boulder	2048	0	0%	0%
Bedrock	bedrock	40096	0	0%	0%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	22.6
D84	47.71
D95	78.44



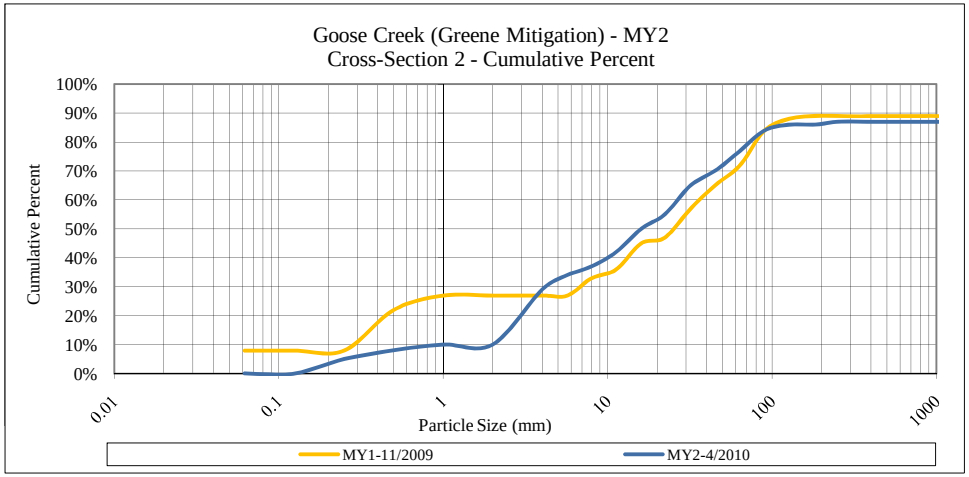


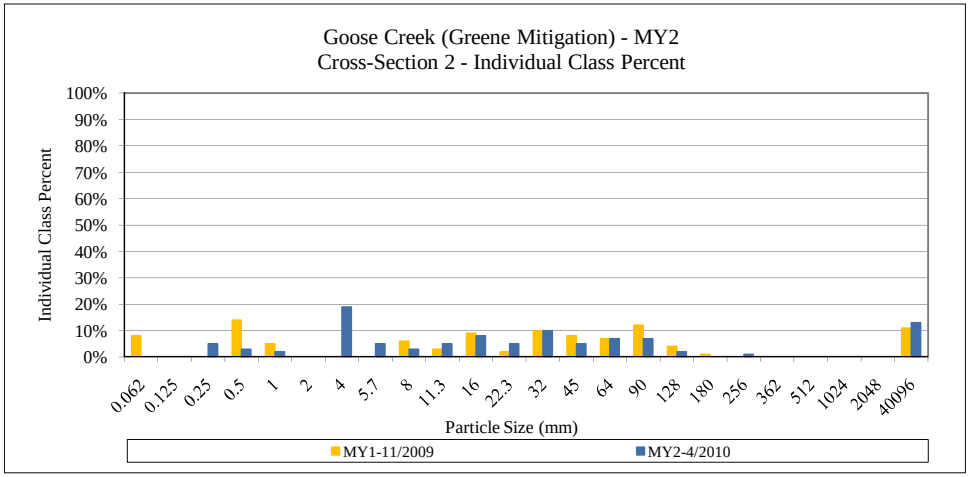
Appendix 4.6 Pebble Count Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-2, Riffle, 1+95**
Survey Date	**4/2010**

Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	5	5%	5%
	medium sand	0.50	3	3%	3%
	coarse sand	1.00	2	2%	2%
	very coarse sand	2.0	0	0%	0%
Gravel	very fine gravel	4.0	19	19%	19%
	fine gravel	5.7	5	5%	5%
	fine gravel	8.0	3	3%	3%
	medium gravel	11.3	5	5%	5%
	medium gravel	16.0	8	8%	8%
	course gravel	22.3	5	5%	5%
	course gravel	32.0	10	10%	10%
	very coarse gravel	45	5	5%	5%
	very coarse gravel	64	7	7%	7%
Cobble	small cobble	90	7	7%	7%
	medium cobble	128	2	2%	2%
	large cobble	180	0	0%	0%
	very large cobble	256	1	1%	1%
Boulder	small boulder	362	0	0%	0%
	small boulder	512	0	0%	0%
	medium boulder	1024	0	0%	0%
	large boulder	2048	0	0%	0%
Bedrock	bedrock	40096	13	13%	13%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	16
D84	90
D95	Bedrock



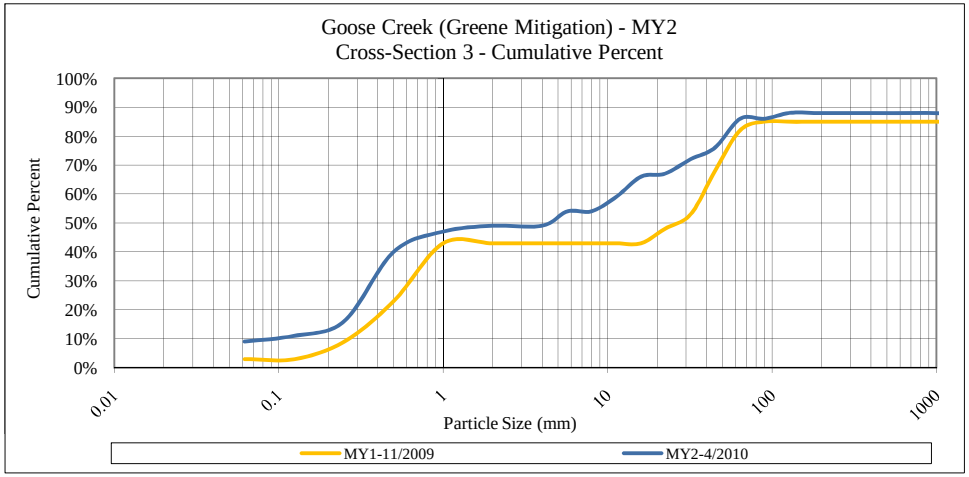


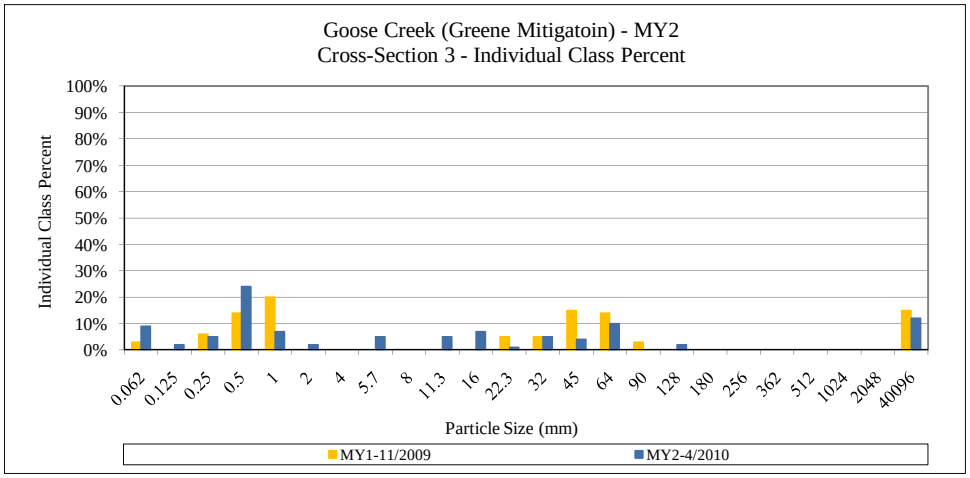
Appendix 4.6 Pebble Count Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-3, Pool, 3+95**
Survey Date	**4/2010**

Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	9	9%	9%
Sand	very fine sand	0.125	2	2%	2%
	fine sand	0.250	5	5%	5%
	medium sand	0.50	24	24%	24%
	coarse sand	1.00	7	7%	7%
	very coarse sand	2.0	2	2%	2%
Gravel	very fine gravel	4.0	0	0%	0%
	fine gravel	5.7	5	5%	5%
	fine gravel	8.0	0	0%	0%
	medium gravel	11.3	5	5%	5%
	medium gravel	16.0	7	7%	7%
	course gravel	22.3	1	1%	1%
	course gravel	32.0	5	5%	5%
	very coarse gravel	45	4	4%	4%
	very coarse gravel	64	10	10%	10%
Cobble	small cobble	90	0	0%	0%
	medium cobble	128	2	2%	2%
	large cobble	180	0	0%	0%
	very large cobble	256	0	0%	0%
Boulder	small boulder	362	0	0%	0%
	small boulder	512	0	0%	0%
	medium boulder	1024	0	0%	0%
	large boulder	2048	0	0%	0%
Bedrock	bedrock	40096	12	12%	12%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	4.34
D84	60.2
D95	Bedrock





Appendix 4.6 Pebble Count Plots and Raw Data Tables
Goose Creek (Greene Mitigation)/EEP Project No.92709
Monitoring Year 2 of 5

Project Name	**Goose Creek**
EEP Project Number	**92709**
Cross-Section ID	**XS-4, Pool, 5+39**
Survey Date	**4/2010**

Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	4	4%	4%
	medium sand	0.50	20	20%	20%
	coarse sand	1.00	4	4%	4%
	very coarse sand	2.0	1	1%	1%
Gravel	very fine gravel	4.0	7	7%	7%
	fine gravel	5.7	8	8%	8%
	fine gravel	8.0	1	1%	1%
	medium gravel	11.3	9	9%	9%
	medium gravel	16.0	5	5%	5%
	course gravel	22.3	8	8%	8%
	course gravel	32.0	5	5%	5%
	very coarse gravel	45	5	5%	5%
	very coarse gravel	64	1	1%	1%
Cobble	small cobble	90	3	3%	3%
	medium cobble	128	7	7%	7%
	large cobble	180	4	4%	4%
	very large cobble	256	0	0%	0%
Boulder	small boulder	362	0	0%	0%
	small boulder	512	0	0%	0%
	medium boulder	1024	0	0%	0%
	large boulder	2048	0	0%	0%
Bedrock	bedrock	40096	8	8%	8%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	9.83
D84	106.29
D95	Bedrock