UNDERWOOD MITIGATION SITE
Chatham County, NC
DENR Contract 003268
NCEEP Project Number 94641

Monitoring Year 1 Annual Report
FINAL
Data Collection Period: August-September 2013
Draft Submission Date: November 15, 2013
Final Submission Date: December 12, 2013

Prepared for:

NCDENR, NCEEP
1652 Mail Service Center
Raleigh, NC
27699-1652

Prepared by:

Wildlands Engineering, Inc.
1430 S. Mint Street, #104
Charlotte, NC 28203
P – 704-332-7754
F – 704-332-3306

UNDERWOOD MITIGATION SITE
Monitoring Year 1 Annual Report

1.0 Executive Summary 1
1.1 Project Goals and Objectives 1
1.2 Monitoring Year 1 Data Assessment 3
1.2.1 Vegetative Assessment 3
1.2.2 Stream Assessment 3
1.2.3 Hydrology Assessment 4
1.2.4 Maintenance Plan 4
1.2.5 Wetland Assessment 4
1.3 Monitoring Year 1 Summary 4
2.0 Methodology 5
3.0 References 6

APPENDICES

Appendix 1 **General Tables and Figures**
Figure 1 Project Vicinity Map
Figure 2a-c Project Component/Asset Map
Table 1 Project Components and Mitigation Credits
Table 2 Project Activity and Reporting History
Table 3 Project Contact Table
Table 4 Project Information and Attributes

Appendix 2 **Visual Assessment Data**
Figure 3.0-3.3 Integrated Current Condition Plan View
Table 5a-h Visual Stream Morphology Stability Assessment Table
Table 6 Vegetation Condition Assessment Table
Stream Photographs
Vegetation Photographs

Appendix 3 **Vegetation Plot Data**
Table 7 Vegetation Plot Criteria Attainment
Table 8 CVS Vegetation Plot Metadata
Table 9 Planted and Total Stem Counts (Species by Plot with Annual Means)

Appendix 4 **Morphological Summary Data and Plots**
Table 10a-c Baseline Stream Data Summary
Table 11 Monitoring Data – Dimensional Morphology Summary (Dimensional Parameters – Cross-Section)
Table 12a-f Monitoring Data – Stream Reach Data Summary
Longitudinal Profile Plots
Cross-Section Plots
Reachwide and Cross-Section Substrate Plots

Appendix 5 **Hydrology Summary Data and Plots**

Table 13 Verification of Bankfull Events

Table 14 Wetland Gage Attainment Summary

Groundwater Gage Plots

Monthly Rainfall Data

1.0 Executive Summary

The Underwood Mitigation Site, hereafter referred to as the Site, consists of two separate areas (Harris Site and Lindley Site) located in western Chatham County within the Cape Fear River Basin (USGS Hydrologic Unit 03030002) north of Siler City, North Carolina. The Harris site is located within the upstream area of the project watershed along Clyde Underwood Road, just west of Planfield Church Road. The Lindley Site is located downstream from the Harris Site, southwest of Moon Lindley Road between Johnny Lindley Road and Bob Clark Road. The Site is located within the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). Approximately 60% of the land in the project watershed is forest, 39% is classified as managed herbaceous cover or agricultural, and the remaining 1% is split between unmanaged herbaceous and open water (MRLC, 2001). The drainage areas for the Harris Site and Lindley Site are 1,051 acres (1.64 square miles) and 3,362 acres (5.25 square miles) respectively.

The project stream reaches consist of SF1, SF3, SF4, SF4A, UT1, and UT2 (stream restoration and/or enhancement level I approach) and SF2, SF3, UT1, UT1A, and UT1B (enhancement level II approach). Mitigation work within the Site included restoring and enhancing 9,133 linear feet (LF) of perennial and intermittent stream channel and restoring, enhancing, and creating 13.84 acres of riparian and non-riparian wetland. The stream and wetland areas were also planted with native vegetation to improve habitat and protect water quality. Construction activities were completed by Land Mechanics Designs, Inc. in November 2012. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in January 2013. Four separate conservation easements have been recorded and are in place along the riparian corridors and stream resources to protect them in perpetuity; 7.68 acres (Deed Book 1578, Page 495) within the tract owned by Mary Jean Harris, 18.44 acres (Deed Book 1578, Page 507) within the tract owned by William Darrel Harris, 5.34 acres property (Deed Book 1579, Page 1067) within the tract owned by James Randall Lindley, and 6.29 acres property (Deed Book 716, Page 707) within the tract owned by Jonathan Marshall Lindley. Directions and a map of the Site are provided in Figure 1 and project components are illustrated for the Site in Figures 2a and 2b.

1.1 Project Goals and Objectives

Prior to construction activities, the streams and wetlands on the Harris Site were impacted by cattle grazing, which led to stream bank erosion and instability. The Lindley site was used for row crop agriculture and the streams were straightened and deepened and much of the riparian vegetation was removed. Related degradation includes declining aquatic habitat, loss of forest, degraded riparian buffers, loss of wetlands, and water quality problems related to increased sediment and nutrient loadings. Table 4 in Appendix 1 and Tables 10a, 10b, and 10c in Appendix 4 present the pre-restoration conditions in detail.

The Underwood Mitigation Site was designed to meet the over-arching goals as described in the mitigation plan (2011). The project addresses multiple watershed stressors that have been documented for both the Cane Creek and Jordan Lake watersheds. While many of these benefits are limited to the Underwood Site project area, others, such as pollutant removal and improved aquatic and terrestrial habitat, have more far-reaching effects. The following project specific goals established in the mitigation plan include:

- Restore and stabilize stream dimensions, pattern, and profile;
- Establish proper substrate distribution throughout restored and enhanced streams;

- Improve aquatic and benthic habitat;
- Reduce nutrient loads within the watershed and to downstream waters;
- Further improve water quality within the watershed through reductions of sediment, bacteria, and other pollutants;
- Decrease water temperature and increase dissolved oxygen concentrations;
- Establish appropriate hydrology for wetland areas;
- Restore native vegetation to wetlands and riparian buffers/improve existing buffers; and
- Create appropriate terrestrial habitat.

The design features of this project were developed to achieve multiple project objectives. The stream restoration elements were designed to frequently flood the reconnected floodplain and adjacent riparian wetlands. This design approach provides more frequent dissipation of energy from higher flows (bankfull and above) to improve channel stability; provide water quality treatment through detention, settling, and biological removal of pollutants; and restore a more natural hydrologic regime. Existing, restored, and created wetlands were key components of the design incorporated to better meet goals described above. The project objectives defined in the mitigation plan (2011) are as follows:

- Construct stream channels that will remain relatively stable over time and adequately transport their sediment loads without significant erosion or aggradation;
- Construct stream channels that maintain riffles with coarse bed material and pools with finer bed material;
- Provide aquatic and benthic habitat diversity in the form of pools, riffles, woody debris, and in-stream structures;
- Add riffle features and structures and riparian vegetation to decrease water temperatures and increase dissolved oxygen to improve water quality;
- Construct stream reaches so that floodplains and wetlands are frequently flooded to provide energy dissipation, detain and treat flood flows, and create a more natural hydrologic regime;
- Construct fencing to keep livestock out of the streams;
- Raise local groundwater table through raising stream beds and removing agricultural drainage features;
- Grade wetland creation areas as necessary to promote wetland hydrology; and
- Plant native tree species to establish appropriate wetland and floodplain communities and retain existing, native trees were possible.

The design streams and wetlands were restored to the appropriate type based on the surrounding landscape, climate, and natural vegetation communities but also with strong consideration to existing watershed conditions and trajectory. The mitigation project corrected incision and lack of pattern caused by channelization, bank instability caused by erosion and livestock access, lack of vegetation in riparian zones, lack of riparian and aquatic habitat, and depletion of hydrology for adjacent wetlands. The final mitigation plan was submitted and accepted by the NCEEP in September of 2011. Construction activities were completed by Land Mechanics Designs, Inc. in November 2012. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in January 2013. Baseline monitoring (MY-0) was conducted between December 2012 and February of 2013. Annual monitoring will be conducted for five years with the close-out anticipated to commence in 2018 given the success criteria are met. Appendix 1 provides more detailed project activity, history, contact information, and watershed/site background information for this project.

1.2 Monitoring Year 1 Data Assessment

Annual monitoring and quarterly site visits were conducted during monitoring year 1 (MY-1) to assess the condition of the project. The stream and wetland mitigation success criteria for the Site follow the approved success criteria presented in the Underwood Mitigation Plan (5/7/2013).

1.2.1 Vegetative Assessment

Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-NCEEP Level 2 Protocol (Lee et al., 2006). A total of 42 vegetation plots were established during the baseline monitoring within the project easement areas (29 at the Harris Site; 13 at the Lindley Site) using a standard 10 meter by 10 meter plot. The final vegetative success criteria will be the survival of 260 planted stems per acre in the riparian corridor along restored and enhanced reaches at the end of year five of the monitoring period. The interim measure of vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of year three of the monitoring period.

The MY-1 vegetative survey was completed in September 2013. The 2013 annual vegetation monitoring resulted in an average stem density of 605 stems per acre, which is greater than the interim requirement of 320 stems/acre, but approximately 15% less than the baseline density recorded (712 stems/acre) in January 2013. There is an average of 9 stems per plot which has remained the same since MY-0. A total of 38 out of 40 plots are on track to meet the success criteria required for MY-5 (Table 9, Appendix 3). Although two plots are not meeting success criteria, supplemental plantings will not be installed prior to the MY-2 survey. Wildlands has observed on other mitigation sites that bare roots which appear to be dead during the MY-1 survey may re-sprout in subsequent monitoring years. The bare roots planted in MY-0 can also be difficult to re-locate during the MY-1 survey where there is dense herbaceous cover. Following MY-2, Wildlands will re-evaluate low stem densities within the Site and conducted supplemental planting as needed. Please refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

1.2.2 Stream Assessment

Morphological surveys for the MY-1 were conducted in August and September 2013. With the exception of SF4A, all streams within the Site are stable with little to no erosion and have met the success criteria for MY-1. Please refer to Appendix 2 for the visual assessment table, Current condition plan view (CCPV), and reference photographs. Refer to Appendix 4 for the morphological data and plots.

In general cross-sections show little to no change in the bankfull area, maximum depth ratio, or width-to-depth ratio. Surveyed riffle cross-sections fell within the parameters defined for channels of the appropriate Rosgen stream type. The surveyed longitudinal profile data for SF1, UT2, SF3, UT1, and SF4 illustrates that the bedform features are maintaining lateral and vertical stability. The riffles are remaining steeper and shallower than the pools, while the pools are remaining deeper than the riffles and maintaining flat water surface slopes. The longitudinal profiles show that the bank height ratios remain very near to 1.0 for the restoration reaches. Degradation was documented in the upper portion of SF4A (approximate STA 900+00-905+33). In this section the stream has downcut up to 0.5 ft in some locations. Although the adjustments in SF4A's profile were not intended in the design, the stream is maintaining a stable bedform at a lower elevation. SF4A will be closely monitored over the upcoming MY-2 degradation advancement. If during MY-2

degradation continues along SF4A, Wildlands will prepare a maintenance plan to address the problem areas. Details regarding the tentative maintenance plan are discussed below in section 1.2.3. Pattern data will be collected in MY-5 only if there are indicators from the profile or dimensions that significant geomorphic adjustments have occurred. No changes were observed during MY-1 that indicated a change in the radius of curvature or channel belt width.

1.2.3 Hydrology Assessment

At the end of the five year monitoring period, two or more bankfull events must have occured in separate years within the restoration reaches. Additional bankfull events were recorded on all the streams except for UT2 with crest gages during the MY-1 data collection. Bankfull events have also been observed on UT1, SF2, SF3, SF4, and SF4A shortly after completion of construction. These bankfull events occurred prior to the installation of crest gages, but were evidenced by wrack lines. Please refer to Appendix 5 for hydrologic data.

1.2.4 Maintenance Plan

No maintenance plan is necessary at this time. Wildlands will continue to monitor SF4A and will develop a maintenance plan if it becomes apparent that the stream continues to downcut or otherwise destabilize. A maintenance plan to correct this problem would likely consist of installation of sills at the downstream end of riffles to stabilize those features, add additional grade control, and backfill over time to raise the bed through the riffle sections.

1.2.5 Wetland Assessment

Fifteen groundwater monitoring gages were established during the baseline monitoring within the wetland restoration, creation, and enhancement zones. The gages were installed at appropriate locations so that the data collected will provide an indication of groundwater levels throughout the site. To provide data for the determination of the growing season for the wetland areas, two soil temperature loggers were installed in representative areas within RW3 and RW4. A barrotroll logger (to measure barometric pressure used in the calculations of groundwater levels with well transducer data) and a rain gage were also installed within the wetland areas on both the Harris and Lindley Site. All monitoring gages were downloaded on a quarterly basis and maintained on an as needed basis. The success criteria for wetland hydrology is to have a free groundwater surface within 12 inches of the ground surface for 7.5 percent of the growing season, which is measured on consecutive days under typical precipitation conditions. All groundwater gages met the annual wetland hydrology success criteria for MY-1. Please refer to Appendix 2 for the groundwater gage locations and Appendix 5 for groundwater hydrology data and plots.

1.3 Monitoring Year 1 Summary

With the exception of SF4A, all streams within the Site are stable and functioning as designed. Degradation observed on SF4A will be monitored for indications of long term instability. A maintenance plan will be prepared after MY-2 if conditions continue to degrade. The average stem density for the Site is on track to meeting the MY-5 success criteria; however, a few individual vegetation plots did not meet the MY-1 success criteria as noted in the CCPV. There has been one documented bankfull event with the crest gage recorded along UT1, SF2, SF3, SF4, and SF4A since construction commenced along with visual verifications such as wrack lines. The MY-5 stream hydrology attainment requirement has been partially met for the Site at this time. All groundwater gages met the MY-1 success criteria.

Summary information and data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Mitigation Plan documents available on NCEEP's website. All raw data supporting the tables and figures in the appendices are available from NCEEP upon request.

2.0 Methodology

Geomorphic data was collected followed the standards outlined in The Stream Channel Reference Site: An Illustrated Guide to Field Techniques (Harrelson et al., 1994) and in the Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). Longitudinal and cross-sectional data were collected using a total station and were georeferenced. All CCPV mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using was Pathfinder and ArcView. Crest gages were installed in surveyed riffle cross-sections and monitored quarterly. Hydrology attainment installation and monitoring methods are in accordance with the USACE (2003) standards. Vegetation monitoring protocols followed the Carolina Vegetation Survey-NCEEP Level 2 Protocol (Lee et al., 2008).

3.0 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, C.C., Rawlins, C.L., Potyondy, J.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.

Lee, M.T., Peet, R.K., S.D., Wentworth, T.R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-5.pdf.

Rosgen, D. L. 1994. A classification of natural rivers. *Catena* 22:169-199.

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

Rosgen, D.L. 1997. A Geomorphological Approach to Restoration of Incised Rivers. Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision. Center For Computational Hydroscience and Bioengineering, Oxford Campus, University of Mississippi, Pages 12-22.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina, 3rd approx. North Carolina Natural Heritage Program, Raleigh, North Carolina.

Simon, A. 1989. A model of channel response in disturbed alluvial channels. *Earth Surface Processes and Landforms* 14(1):11-26.

United States Army Corps of Engineers (USACE). 2010. Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (ERDC/EL TR-10-9). U.S. Army Engineer Research and Development Center, Vicksburg, MS

United States Department of Agriculture (USDA). 2002. Natural Resources Conservation Service, Climate Information for Catawba County, NC (1971-2000).
WETS Station: Catawba 3 NNW, NC1579.
http://www.wcc.nrcs.usda.gov/ftpref/support/climate/wetlands/nc/37035.txt

United States Department of Agriculture (USDA). 2009. Natural Resources Conservation Service, Soil Survey Geographic (SSURGO) database for Catawba County, North Carolina. http://SoilDataMart.nrcs.usda.gov

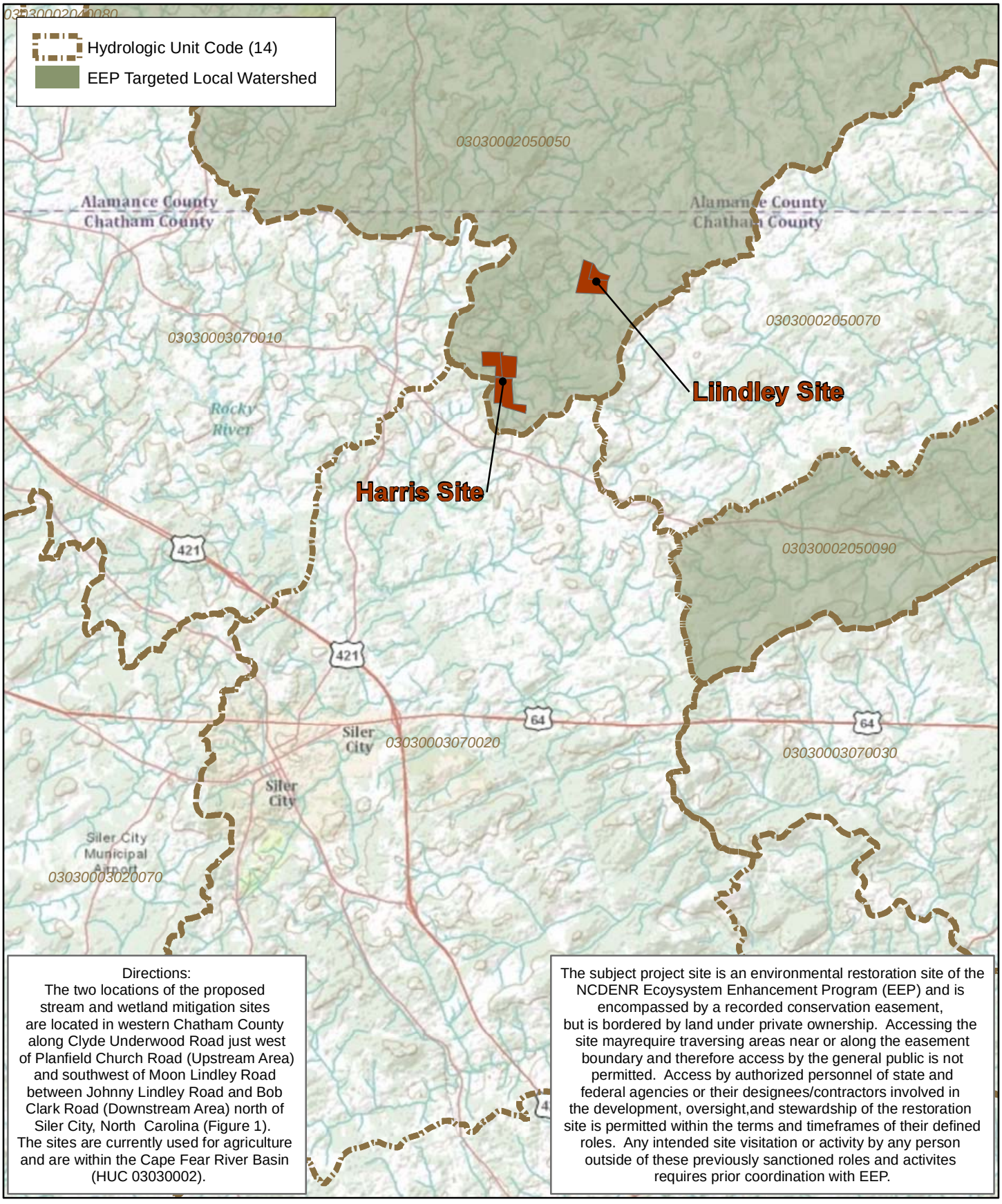
United States Geological Survey (USGS). 1998. North Carolina Geology. http:// http://www.geology.enr.state.nc.us/usgs/carolina.htm

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.

Wildlands Engineering, Inc. 2012. Underwood Mitigation Plan. NCEEP, Raleigh, NC.

Wildlands Engineering, Inc. 2013. Underwood Mitigation Site Baseline Monitoring Document and As-Built Baseline Report. NCEEP, Raleigh, NC.

APPENDIX 1. General Tables and Figures



Directions:
The two locations of the proposed stream and wetland mitigation sites are located in western Chatham County along Clyde Underwood Road just west of Planfield Church Road (Upstream Area) and southwest of Moon Lindley Road between Johnny Lindley Road and Bob Clark Road (Downstream Area) north of Siler City, North Carolina (Figure 1). The sites are currently used for agriculture and are within the Cape Fear River Basin (HUC 03030002).

The subject project site is an environmental restoration site of the NCDENR Ecoysystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site mayrequire traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight,and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activites requires prior coordination with EEP.

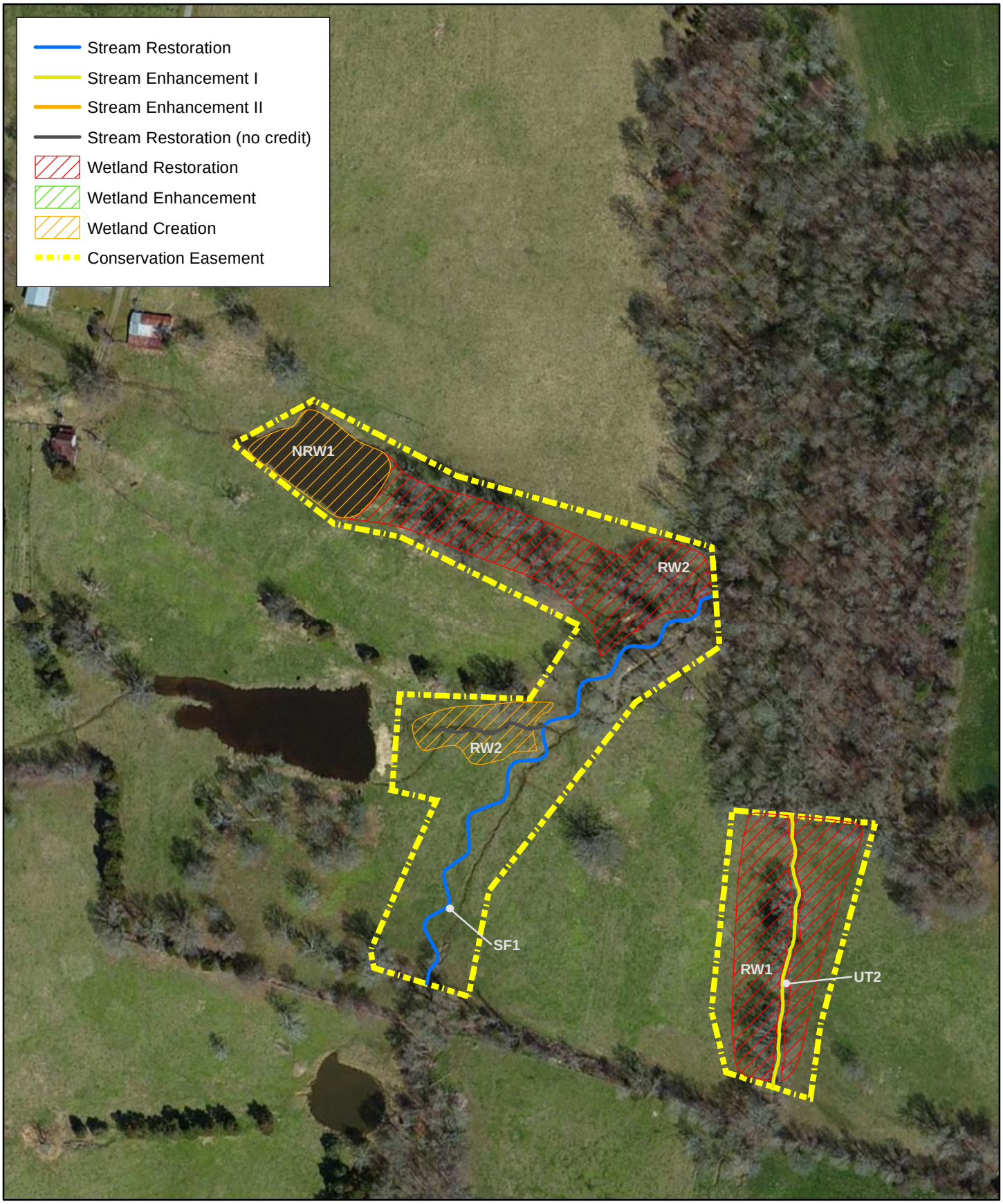
WILDLANDS ENGINEERING

0 0.625 1.25 Miles

N

Figure 1 Project Vicinity Map
Underwood Mitigation Site
NCEEP Project No. 94641
Monitoring Year 1

Chatham County, NC



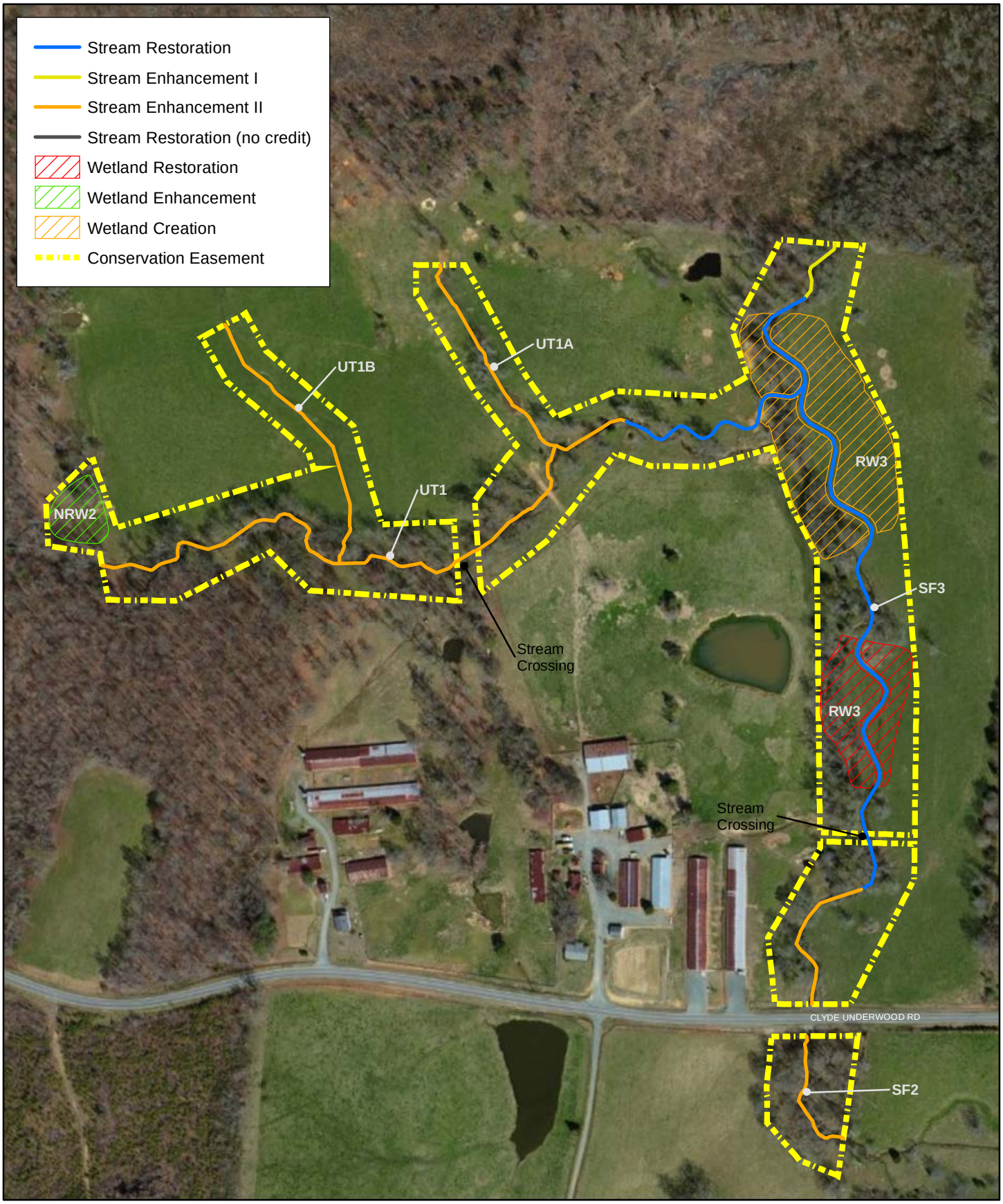
WILDLANDS ENGINEERING

0 110 220 Feet

N

Figure 2a Project Component/Asset Map
Underwood Mitigation Site - Harris Site
NCEEP Project No. 94641
Monitoring Year 1

Chatham County, NC

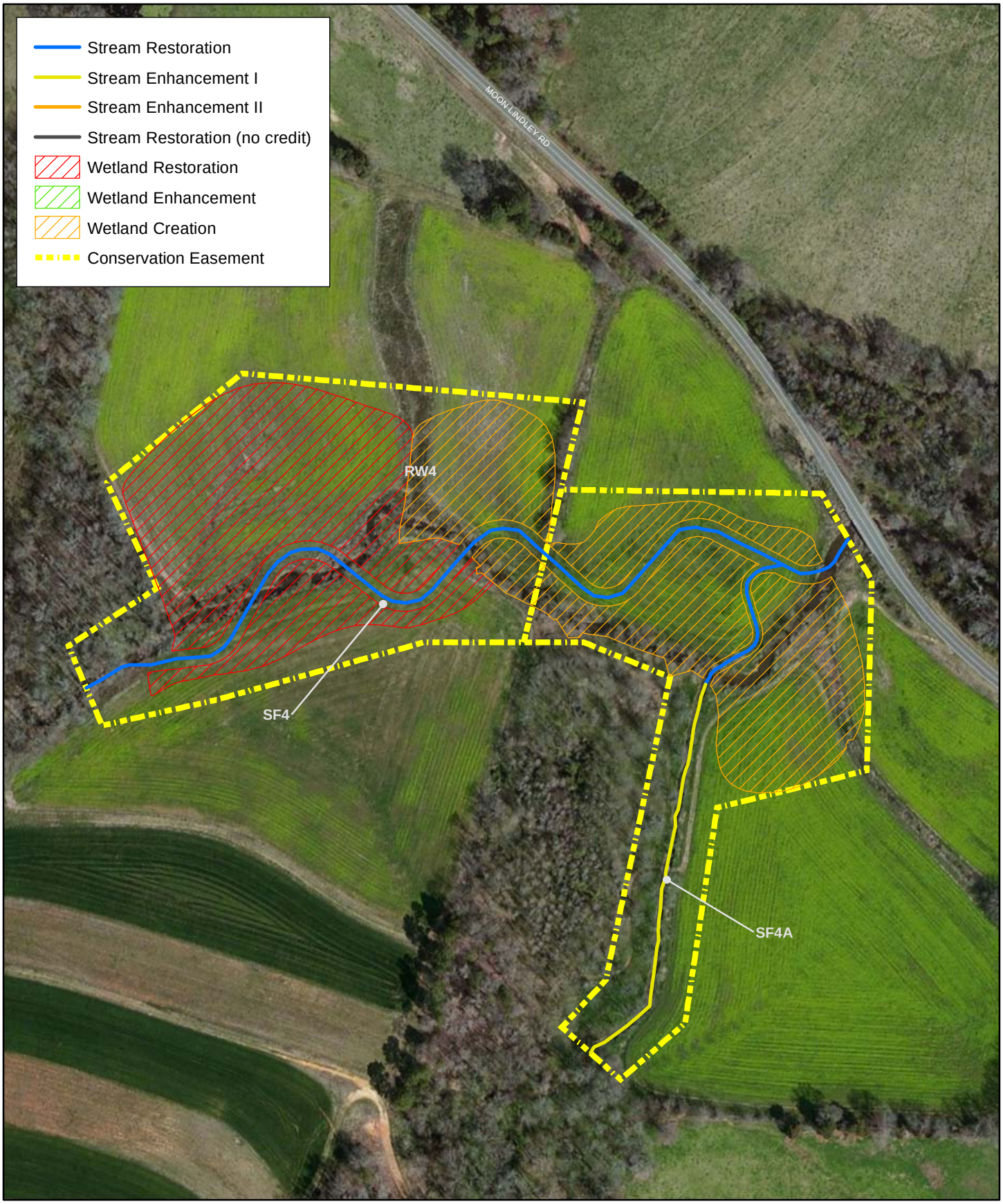


WILDLANDS ENGINEERING

0 150 300 Feet

Figure 2b Project Component/Asset Map
Underwood Mitigation Site - Harris Site
NCEEP Project No. 94641
Monitoring Year 1

Chatham County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

N

Figure 2c Project Component/Asset Map
Underwood Mitigation Site - Lindley Site
NCEEP Project No. 94641
Monitoring Year 1

Chatham County, NC

Table 1. Project Components and Mitigation Credits
Underwood Mitigation Site (NCEEP Project No.94641)
Monitoring Year 1

Mitigation Credits									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	6,764	0	8.0	N/A	0.9	0.2	N/A	N/A	N/A

Project Components						
Reach ID	As-Built Stationing/ Location (LF)	Existing Footage (LF)/ Acreage (Ac)	Approach	Restoration or Restoration Equivalent	Restoration Footage (LF) / Acreage (Ac)*	Mitigation Ratio
Streams						
SF1	100+00-108+74	773	Priority 1	Restoration	874	1:1
SF2	300+00-303+02	302	N/A	Enhancement Level II	302	2.5:1
SF3	400+00-421+20	532	N/A	Enhancement Level II	359	2.5:1
		1,499	Priority 1	Restoration	1,586	1:1
		152	N/A	Enhancement Level I	153	1.5:1
SF4	800+00-814+29	1,450	Priority 1	Restoration	1,429	1:1
SF4A	900+00-908+66	0	Priority 1	Restoration	257	1:1
		609	N/A	Enhancement Level I	609	1.5:1
UT1	500+00-520+38	1,463	N/A	Enhancement Level II	1,468	2.5:1
		452	Priority 1	Restoration	515	1:1
UT1A	700+00-705+11	524	N/A	Enhancement Level II	511	2.5:1
UT1B	600+00-606+52	660	N/A	Enhancement Level II	652	2.5:1
UT2	0+00-4+18	421	N/A	Enhancement Level I	418	1.5:1
Wetlands						
RW1	N/A	1.25	N/A	Restoration	1.12	1:1
RW2	N/A	0.45	N/A	Creation	0.30	3:1
		0.50		Restoration	0.40	1:1
RW3	N/A	2.63	N/A	Creation	2.53	3:1
		1.33		Restoration	1.02	1:1
RW4	N/A	3.95	N/A	Creation	3.63	3:1
		3.65		Restoration	3.30	1:1
NRW1	N/A	1.20	N/A	Restoration	0.75	1:1
				Creation	0.45	3:1
NRW2	N/A	0.34	N/A	Enhancement	0.34	2:1

Component Summation						
Restoration Level	Stream (LF)	Riparian Wetland (Ac)		Non-Riparian Wetland (acres)	Buffer (sq. ft)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	4,661	5.84	-	0.75	-	-
Enhancement			-	0.34	-	-
Enhancement I	1,180					
Enhancement II	3,292					
Creation		6.46	-	0.45		
Preservation	-	-	-	-		-
High Quality Preservation	-	-	-	-		-

* Note that lengths do not match stationing because channel sections that do not generate credit have been removed from length calculations.

Table 2. Project Activity and Reporting History
Underwood Mitigation Site (NCEEP Project No.94641)
Monitoring Year 1

Activity or Report	Date Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	September 2011	September 2011
Final Design - Construction Plans	July 2012	July 2012
Construction	November 2012	November 2012
Temporary S&E mix applied to entire project area[1]	November 2012	November 2012
Permanent seed mix applied to reach/segments	November 2012	November 2012
Bare root and live stake plantings for reach/segments	January 2013	January 2013
Baseline Monitoring Document (Year 0 Monitoring - baseline)	March 2013	March 2013
Year 1 Monitoring	September 2013	November 2013
Year 2 Monitoring	2014	December 2014
Year 3 Monitoring	2015	December 2015
Year 4 Monitoring	2016	December 2016
Year 5 Monitoring	2017	December 2017

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

Table 3. Project Contact Table
Underwood Mitigation Site (NCEEP Project No.94641)
Monitoring Year 1

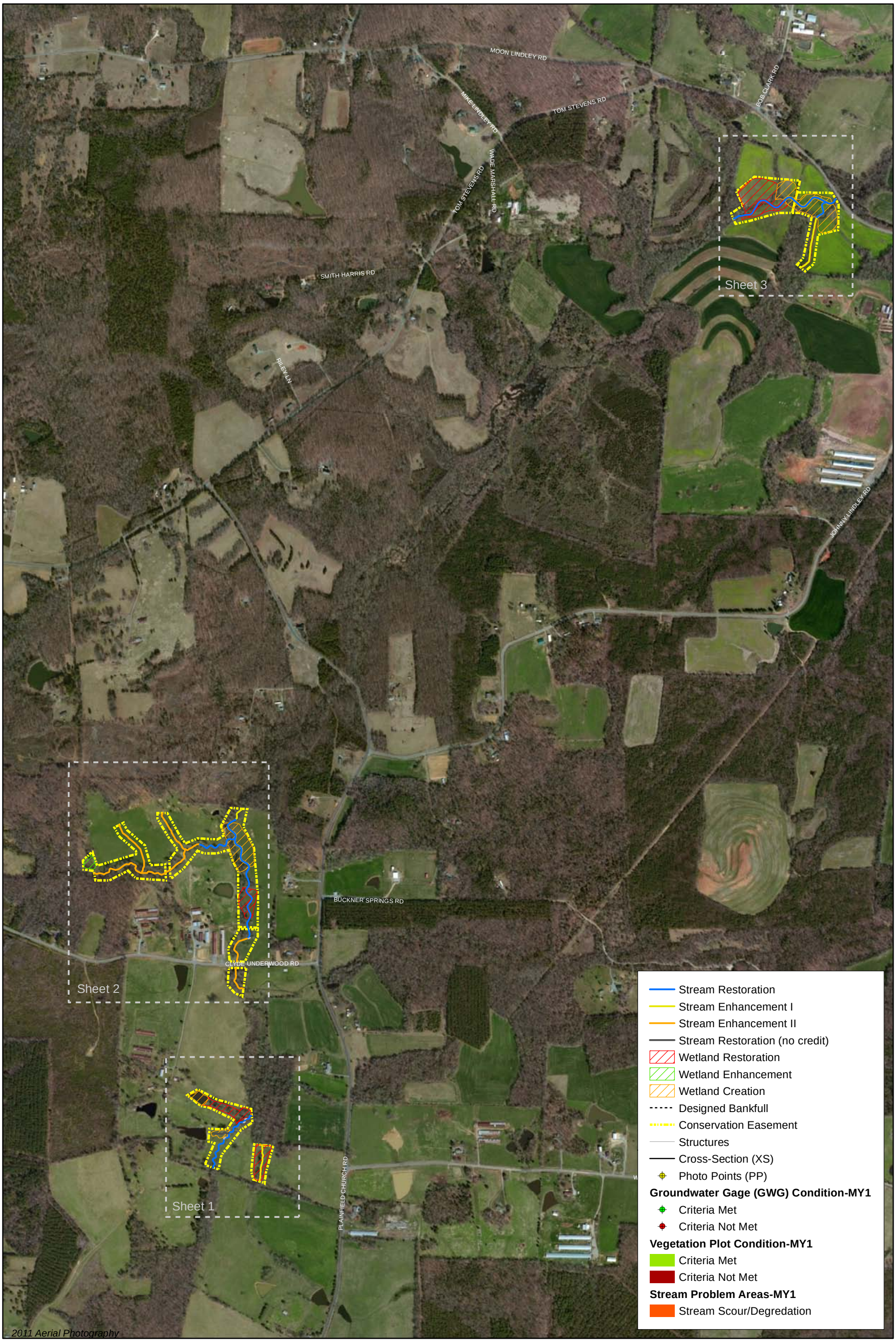
Designer	**Wildlands Engineering, Inc.**
Nicole Makaluso, PE	5605 Chapel Hill Road, Suite 122 Raleigh, NC 27604 919.851.9986
Construction Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Seed Mix Sources	**Green Resource, LLC**
Nursery Stock Suppliers	
Bare Roots	**ArborGlen, Inc**
Live Stakes	**Foggy Mountain Nursery**
Monitoring Performers	**Wildlands Engineering, Inc.**
Stream, Vegetation, and Wetland Monitoring, POC	Kirsten Gimbert 704.332.7754, ext. 110

Table 4. Project Baseline Information and Attributes
Underwood Mitigation Site (NCEEP Project No.94641)
Monitoring Year 1

Project Information									
Project Name	Underwood Mitigation Site								
County	Chatham County								
Project Area (acres)	38 ac								
Project Coordinates (latitude and longitude)	35° 48' 05"N, 79° 24' 10"W (Harris Site), 35° 49' 51"N, 79° 22' 60"W (Lindley Site)								
Project Watershed Summary Information									
Physiographic Province	Carolina Slate Belt of the Piedmont Physiographic Province								
River Basin	Cape Fear								
USGS Hydrologic Unit 8-digit	03030002								
USGS Hydrologic Unit 14-digit	03030002050050								
DWQ Sub-basin	03-06-04								
Project Drainiage Area (acres)	1,504 ac (Harris Site) and 3,362 ac (Lindley Site)								
Project Drainage Area Percentage of Impervious Area	<1%								
CGIA Land Use Classification	60% Forest Land, 39% managed herbaceous cover/agricultural, 1% unmanaged herbaceous/open water								
Reach Summary Information									
Parameters	**SF1**	**SF2**	**SF3**	**UT1**	**UT1A**	**UT1B**	**UT2**	**SF4**	**SF4A**
Length of reach (linear feet) - Post-Restoration	874	302	2,098	1,983	511	652	418	1,429	866
Drainage area (acres)	134	781	1,056	230	11	11	78	3362	637
NCDWQ stream identification score	36/50.5/43.25			40	22.75	24.25	38	U	34.5
NCDWQ Water Quality Classification	WS-V, NSW	WS-V, NSW	WS-V, NSW	C	C	C	C	WS-V, NSW	C
Morphological Desription (stream type)	P	P	P	P	I	I	P	P	P
Evolutionary trend (Simon's Model) - Pre-Restoration	IV	IV	IV	IV	IV	IV	IV	IV	IV
Underlying mapped soils	Nanford-Baden Complex						Georgeville Silt Loam	Chewacla and Wehadkee	
Drainage class	---	---	---	---	---	---	---	---	---
Soil Hydric status	---	---	---	---	---	---	---	---	---
Slope	---	---	---	---	---	---	---	---	---
FEMA classification	---	---	---	---	---	---	---	AE	---
Native vegetation community	Piedmont bottomland forest								
Percent composition of exotic invasive vegetation - Post-Restoration	0%								
Regulatory Considerations									
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**						
Waters of the United States - Section 404	X	X	USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 3689						
Waters of the United States - Section 401		X							
Division of Land Quality (Dam Safety)	N/A	N/A	N/A						
Endangered Species Act	X	X	Underwood Mitigation Plan; no critical habitat for listed species exists within the project area (USFWS correspondence letter)						
Historic Preservation Act	X	X	No historic resources were found to be impacted (letter from SHPO)						
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A						
FEMA Floodplain Compliance	X	X	Approved CLOMR						
Essential Fisheries Habitat	N/A	N/A	N/A						

U: Unknown

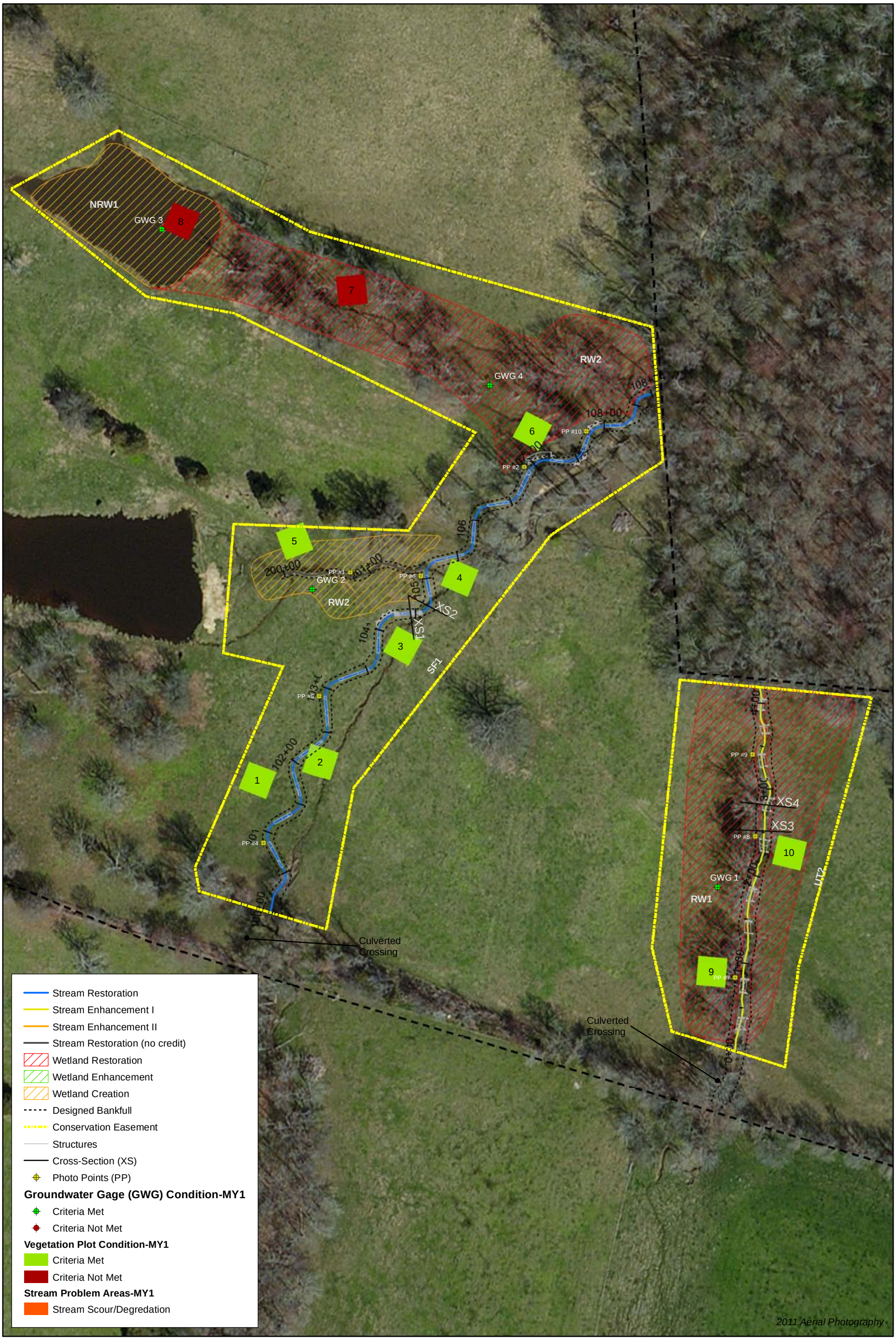
APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

0 500 1,000 2,000 Feet

Figure 3.0 Integrated Current Condition Plan View (Key)
Underwood Mitigation Site
NCEEP Project No. 94641
Monitoring Year 1
Chatham County, NC



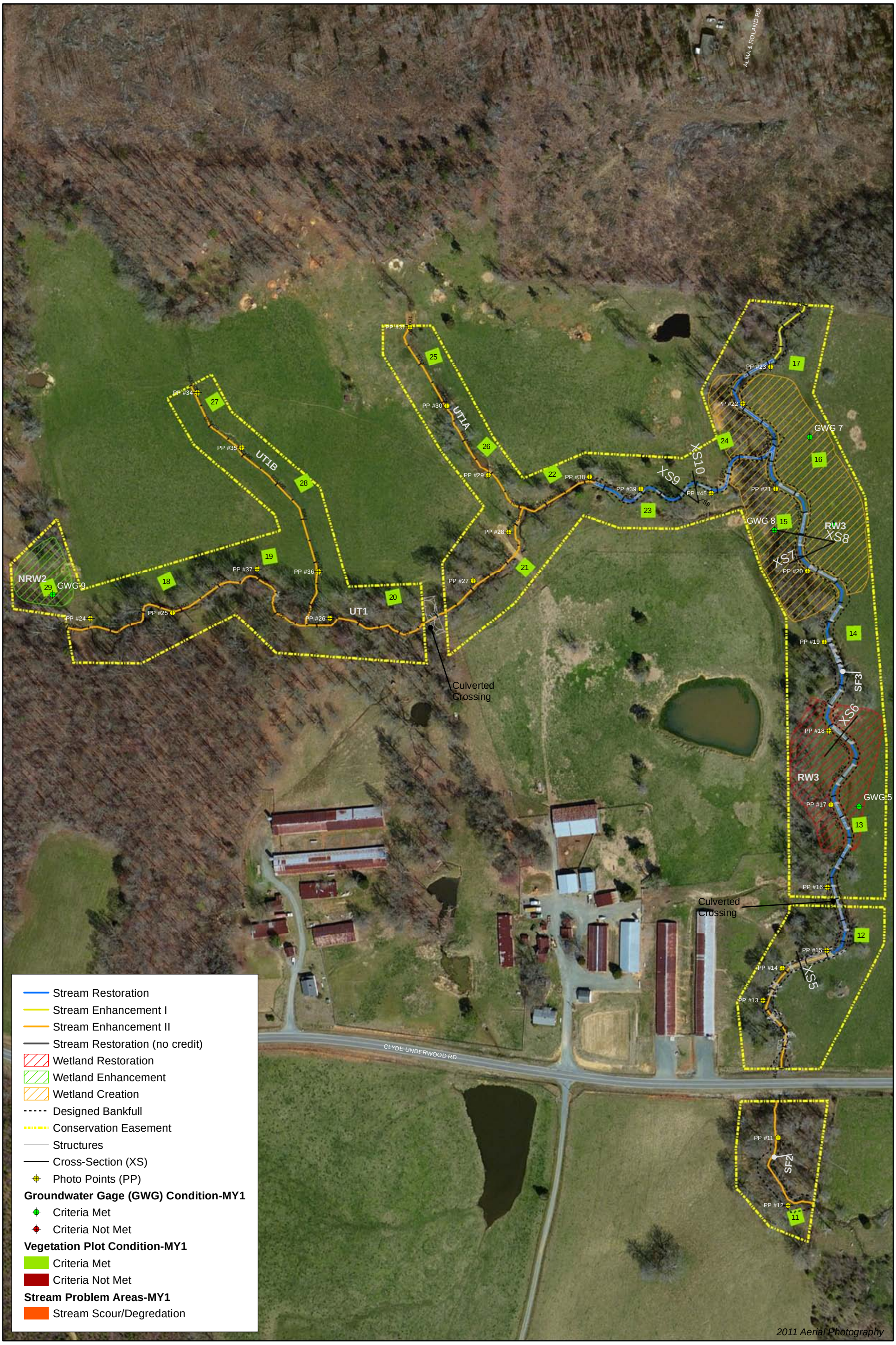
WILDLANDS ENGINEERING

0 50 100 200 Feet

N

Figure 3.1 Integrated Current Condition Plan View
(Sheet 1 of 3)
Underwood Mitigation Site - Harris Site
NCEEP Project No. 94641
Monitoring Year 1

Chatham County, NC



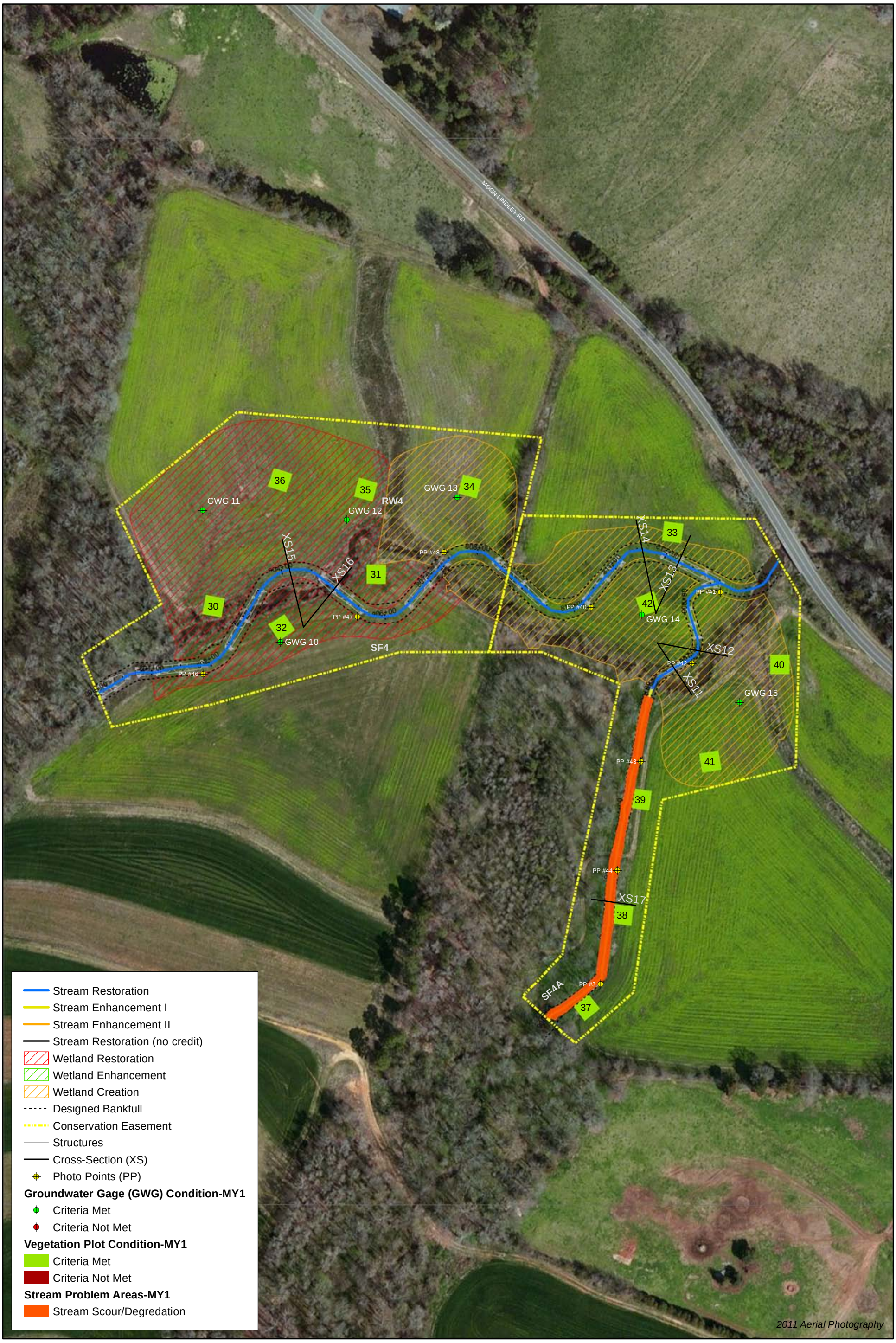
WILDLANDS ENGINEERING

0 100 200 400 Feet

N

Figure 3.2 Integrated Current Condition Plan View
(Sheet 2 of 3)
Underwood Mitigation Site - Harris Site
NCEEP Project No. 94641
Monitoring Year 1

Chatham County, NC



WILDLANDS ENGINEERING

0 75 150 300 Feet

N

Figure 3.3 Integrated Current Condition Plan View
(Sheet 3 of 3)
Underwood Mitigation Site - Lindley Site
NCEEP Project No. 94641
Monitoring Year 1
Chatham County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; SF1 (874 LF)
Monitoring Year 1

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	15	15			100%			
	3. Meander Pool Condition	Depth Sufficient	15	15			100%			
		Lenth Appropriate	15	15			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	15	15			100%			
		Thalweg centering at downstream of meander bend (Glide)	15	15			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	10	10			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	10	10			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	10	10			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	10	10			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	10	10			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 5b. Visual Stream Morphology Stability Assessment Table
Undewood Mitigation Site (EEP Project No. 94641)
Harris Site; UT2 (418 LF)
Monitoring Year 1

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	10	10			100%			
	3. Meander Pool Condition	Depth Sufficient	10	10			100%			
		Lenth Appropriate	10	10			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	10	10			100%			
		Thalweg centering at downstream of meander bend (Glide)	10	10			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	n/a	n/a			n/a			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 5c. Visual Stream Morphology Stability Assessment Table
Undewood Mitigation Site (EEP Project No. 94641)
Harris Site; SF2 (302 LF)
Monitoring Year 1

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	n/a	n/a			n/a			
	3. Meander Pool Condition	Depth Sufficient	n/a	n/a			n/a			
		Lenth Appropriate	n/a	n/a			n/a			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	n/a	n/a			n/a			
		Thalweg centering at downstream of meander bend (Glide)	n/a	n/a			n/a			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	n/a	n/a			n/a			

Table 5d. Visual Stream Morphology Stability Assessment Table
Undewood Mitigation Site (EEP Project No. 94641)
Harris Site; SF3 (2,120 LF)
Monitoring Year 1

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]	**1. Vertical Stability (Riffle and Run units)**	Aggradation			0	0	100%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	19	19			100%			
	3. Meander Pool Condition	Depth Sufficient	19	19			100%			
		Lenth Appropriate	19	19			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	19	19			100%			
		Thalweg centering at downstream of meander bend (Glide)	19	19			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[2]	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	7	7			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	7	7			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	7	7			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	7	7			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	7	7			100%			

[1]Number of riffles and pools are determined based on the as-built survey along Restoration and Enhancement Level I reaches.

[2]Excludes constructed riffles since they are evaluated in section 1.

Table 5e. Visual Stream Morphology Stability Assessment Table
Undewood Mitigation Site (EEP Project No. 94641)
Harris Site; UT1 (2,038 LF)
Monitoring Year 1

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]	**1. Vertical Stability (Riffle and Run units)**	Aggradation			0	0	100%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	7	7			100%			
	3. Meander Pool Condition	Depth Sufficient	7	7			100%			
		Lenth Appropriate	7	7			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	7	7			100%			
		Thalweg centering at downstream of meander bend (Glide)	7	7			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[2]	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	15	15			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	15	15			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	15	15			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	15	15			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	15	15			100%			

[1]Number of riffles and pools are determined based on the as-built survey along Restoration and Enhancement Level I reaches.

[2]Excludes constructed riffles since they are evaluated in section 1.

Table 5f. Visual Stream Morphology Stability Assessment Table
Undewood Mitigation Site (EEP Project No. 94641)
Harris Site; UT1A & UT1B (1,163 LF)
Monitoring Year 1

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	n/a	n/a			n/a			
	3. Meander Pool Condition	Depth Sufficient	n/a	n/a			n/a			
		Lenth Appropriate	n/a	n/a			n/a			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	n/a	n/a			n/a			
		Thalweg centering at downstream of meander bend (Glide)	n/a	n/a			n/a			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	n/a	n/a			n/a			

Table 5g. Visual Stream Morphology Stability Assessment Table
Undewood Mitigation Site (EEP Project No. 94641)
Lindley Site; SF4 (1,429 LF)
Monitoring Year 1

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]	**1. Vertical Stability (Riffle and Run units)**	Aggradation			0	0	100%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	8	8			100%			
	3. Meander Pool Condition	Depth Sufficient	8	8			100%			
		Lenth Appropriate	8	8			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		Thalweg centering at downstream of meander bend (Glide)	8	8			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[2]	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	2	2			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	2	2			100%			

[1]Number of riffles and pools are determined based on the as-built survey along Restoration and Enhancement Level I reaches.

[2]Excludes constructed riffles since they are evaluated in section 1.

Table 5h. Visual Stream Morphology Stability Assessment Table
Undewood Mitigation Site (EEP Project No. 94641)
Lindley Site; SF4A (866 LF)
Monitoring Year 1

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]	**1. Vertical Stability (Riffle and Run units)**	Aggradation			0	0	100%			
		Degredation			1	533	63%			
	2. Riffle Condition	Texture/Substrate	8	10			80%			
	3. Meander Pool Condition	Depth Sufficient	7	9			78%			
		Lenth Appropriate	7	9			78%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	9	9			100%			
		Thalweg centering at downstream of meander bend (Glide)	9	9			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	533	38%	1	533	57%
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	1	533	100%	1	533	57%
3. Engineered Structures[2]	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	2	2			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	2	2			100%			

[1]Number of riffles and pools are determined based on the as-built survey along Restoration and Enhancement Level I reaches. Approximately 533 LF of the stream bed has downcut along SF4A and riffles and pools shifted have shifted downstream. Although these conditions were not intended in the design, the stream has maintained a stable bedform with riffles and pools at a lower elevation.

[2]Excludes constructed riffles since they are evaluated in section 1.

Table 6. Vegetation Condition Assessment Table
Undewood Mitigation Site (EEP Project No. 94641)
Monitoring Year 1

Planted Acreage **38**

Vegetation Category	Definitions	Mapping Threshold (Ac)	Number of Polygons	Combined Acreage	% of Planted Acreage*
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	0	0	0.00%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	0	0.0	0.0%
		Total	**0**	**0.0**	**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.	0.25 Ac	0	0	0%
		Cumulative Total	**0**	**0.0**	**1%**

Easement Acreage **38**

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	0.0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

Stream Photographs
(Harris Site)

	
Photo Point 1 – looking upstream (08/08/2013)	Photo Point 1 – looking downstream (08/08/2013)
	
Photo Point 2 – looking upstream (08/08/2013)	Photo Point 2 – looking downstream (08/08/2013)
	
Photo Point 3 – looking upstream (08/08/2013	Photo Point 3 – looking downstream (08/08/2013)

	
Photo Point 4 – looking upstream (08/08/2013)	Photo Point 4 – looking downstream (08/08/2013)
	
Photo Point 5 – looking upstream (08/08/2013)	Photo Point 5 – looking downstream (08/08/2013)
	
Photo Point 6 – looking upstream (08/08/2013)	Photo Point 6 – looking downstream (08/08/2013)

	
Photo Point 7 – looking upstream (08/08/2013)	Photo Point 7 – looking downstream (08/08/2013)
	
Photo Point 8 – looking upstream (08/08/2013)	Photo Point 8 – looking downstream (08/08/2013)
	
Photo Point 9 – looking upstream (08/08/2013)	Photo Point 9 – looking downstream (08/08/2013)

	
Photo Point 10 – looking upstream (08/01/2013)	Photo Point 10 – looking downstream (08/01/2013)
	
Photo Point 11 – looking upstream (08/01/2013)	Photo Point 11 – looking downstream (08/01/2013)
	
Photo Point 12 – looking upstream (08/01/2013)	Photo Point 12 – looking downstream (08/01/2013)

	
Photo Point 13 – looking upstream (08/01/2013)	Photo Point 13 – looking downstream (08/01/2013)
	
Photo Point 14 – looking upstream (08/01/2013)	Photo Point 14 – looking downstream (08/01/2013)
	
Photo Point 15 – looking upstream (08/01/2013)	Photo Point 15 – looking downstream (08/01/2013)

	
Photo Point 16 – looking upstream (08/01/2013)	Photo Point 16 – looking downstream (08/01/2013)
	
Photo Point 17 – looking upstream (08/01/2013)	Photo Point 17 – looking downstream (08/01/2013)
	
Photo Point 18 – looking upstream (08/01/2013)	Photo Point 18 – looking downstream (08/01/2013)

	
Photo Point 19 – looking upstream (08/01/2013)	Photo Point 19 – looking upstream (08/01/2013)
	
Photo Point 20 – looking upstream (08/01/2013)	Photo Point 20 – looking upstream (08/01/2013)
	
Photo Point 21 – looking upstream (08/01/2013)	Photo Point 21 – looking downstream (08/01/2013)

	
Photo Point 22 – looking upstream (08/01/2013)	Photo Point 22 – looking downstream (08/01/2013)
	
Photo Point 23 – looking upstream (08/08/2013)	Photo Point 23 – looking downstream (08/08/2013)
	
Photo Point 24 – looking upstream (08/08/2013)	Photo Point 24 – looking downstream (08/08/2013)

	
Photo Point 25 – looking upstream (01/22/2013)	Photo Point 25 – looking downstream (01/22/2013)
	
Photo Point 26 – looking upstream (08/08/2013)	Photo Point 26 – looking downstream (08/08/2013)
	
Photo Point 27 – looking upstream (08/08/2013)	Photo Point 27 – looking downstream (08/08/2013)

	
Photo Point 28 – looking upstream (08/08/2013)	Photo Point 28 – looking downstream (08/08/2013)
	
Photo Point 29 – looking upstream (08/01/2013)	Photo Point 29 – looking downstream (08/01/2013)
	
Photo Point 30 – looking upstream (08/01/2013)	Photo Point 30 – looking downstream (08/01/2013)

	
Photo Point 31 – looking upstream (08/01/2013)	Photo Point 31 – looking downstream (08/01/2013)
	
Photo Point 34 – looking upstream (08/08/2013)	Photo Point 34 – looking downstream (08/08/2013)
	
Photo Point 35 – looking upstream (08/08/2013)	Photo Point 35 – looking downstream (08/08/2013)

	
Photo Point 36 – looking upstream (08/08/2013)	Photo Point 36 – looking downstream (08/08/2013)
	
Photo Point 37 – looking upstream (02/12/2013)	Photo Point 37 – looking downstream (02/12/2013)
	
Photo Point 38 – looking upstream (08/08/2013)	Photo Point 38 – looking downstream (08/08/2013)

	
Photo Point 39 – looking upstream (08/08/2013)	Photo Point 39 – looking downstream (08/08/2013)

Stream Photographs
(Lindley Site)

	
Photo Point 40 – looking upstream (01/22/2013)	Photo Point 40 – looking downstream (01/22/2013)
	
Photo Point 41 – looking upstream (01/22/2013)	Photo Point 41 – looking downstream (01/22/2013)
	
Photo Point 42 – looking upstream (01/22/2013)	Photo Point 42 – looking downstream (01/22/2013)

	
Photo Point 43 – looking upstream (01/22/2013)	Photo Point 43 – looking downstream (01/22/2013)
	
Photo Point 44 – looking upstream (01/22/2013)	Photo Point 44 – looking downstream (01/22/2013)
	
Photo Point 45 – looking upstream (01/22/2013)	Photo Point 45 – looking downstream (01/22/2013)

	
Photo Point 46 – looking upstream (01/22/2013)	Photo Point 46 – looking downstream (01/22/2013)
	
Photo Point 47 – looking upstream (01/22/2013)	Photo Point 47 – looking downstream (01/22/2013)
	
Photo Point 48 – looking upstream (01/22/2013)	Photo Point 48 – looking downstream (01/22/2013)

Vegetation Photographs
(Harris Site)

	
Vegetation Plot 1 (01/22/2013)	Vegetation Plot 2 (01/22/2013)
	
Vegetation Plot 3 (01/22/2013)	Vegetation Plot 4 (01/22/2013)
	
Vegetation Plot 5 (01/22/2013)	Vegetation Plot 6 (01/22/2013)

	
Vegetation Plot 7 (01/22/2013)	Vegetation Plot 8 (01/22/2013)
	
Vegetation Plot 9 (01/22/2013)	Vegetation Plot 10 (01/22/2013)
	
Vegetation Plot 11 (01/22/2013)	Vegetation Plot 12 (01/22/2013)

	
Vegetation Plot 13 (01/22/2013)	Vegetation Plot 14 (01/22/2013)
	
Vegetation Plot 15 (01/22/2013)	Vegetation Plot 16 (01/22/2013)
	
Vegetation Plot 17 (01/22/2013)	Vegetation Plot 18 (01/22/2013)

	
Vegetation Plot 19 (01/22/2013)	Vegetation Plot 20 (01/22/2013)
	
Vegetation Plot 21 (01/22/2013)	Vegetation Plot 22 (01/22/2013)
	
Vegetation Plot 23 (01/22/2013)	Vegetation Plot 24 (01/22/2013)

Vegetation Plot 25 (01/22/2013)

Vegetation Plot 26 (01/22/2013)

Vegetation Plot 27 (01/22/2013)

Vegetation Plot 28 (01/22/2013)

Vegetation Plot 29 (01/22/2013)

Vegetation Photographs
(Lindley Site)

	
Vegetation Plot 30 (09/25/2013)	Vegetation Plot 31 (09/25/2013)
	
Vegetation Plot 32 (09/25/2013)	Vegetation Plot 33 (09/25/2013)
	
Vegetation Plot 34 (09/25/2013)	Vegetation Plot 35 (09/25/2013)

	
Vegetation Plot 36 (09/25/2013)	Vegetation Plot 37 (09/25/2013)
	
Vegetation Plot 38 (09/25/2013)	Vegetation Plot 39 (09/25/2013)
	
Vegetation Plot 40 (09/25/2013)	Vegetation Plot 41 (09/25/2013)

Vegetation Plot 42 (09/25/2013)

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment
Underwood Mitigation Site (NCEEP Project No. 94641)
Monitoring Year 1

Harris Site		
Plot	MY1 Success Criteria Met (Y/N)	Tract Mean
1	Y	
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	
7	N	
8	N	
9	Y	
10	Y	
11	Y	
12	Y	
13	Y	
14	Y	
15	Y	93%
16	Y	
17	Y	
18	Y	
19	Y	
20	Y	
21	Y	
22	Y	
23	Y	
24	Y	
25	Y	
26	Y	
27	Y	
28	Y	
29	Y	

Lindley Site		
Plot	MY1 Success Criteria Met (Y/N)	Tract Mean
30	Y	
31	Y	
32	Y	
33	Y	
34	Y	
35	Y	
36	Y	100%
37	Y	
38	Y	
39	Y	
40	Y	
41	Y	
42	Y	

Table 8. CVS Vegetation Tables - Metadata
Underwood Mitigation Site (NCEEP Project No. 94641)
Monitoring Year 1

database name	Underwood MY1-cvs-eep-entrytool-v2.3.0.mdb
database location	Q:\ActiveProjects\005-02125 Underwood Mitigation FDP\Monitoring\Monitoring Year 1\Vegetation Assessment
computer name	KIRSTEN
file size	51187712
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	94641
project Name	Underwood Mitigation Site
Description	Stream and Wetland
River Basin	
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	42

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)														
			94641-WEI-0001			94641-WEI-0002			94641-WEI-0003			94641-WEI-0004			94641-WEI-0005		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	2	2	2	3	3	3	2	2	2	1	1	1	2	2	2
Cornus amomum	silky dogwood	Shrub															
Fraxinus pennsylvanica	green ash	Tree	1	1	1	2	2	2	1	1	1	4	4	4	3	3	3
Liriodendron tulipifera	tuliptree	Tree	1	1	1	2	2	2	2	2	2						
Platanus occidentalis	American sycamore	Tree	4	4	4	5	5	5	3	3	3	4	4	4	8	8	8
Quercus michauxii	swamp chestnut oak	Tree	4	4	4				7	7	7	4	4	4			
Quercus pagoda	cherrybark oak	Tree	3	3	3	2	2	2	1	1	1	1	1	1			
Quercus phellos	willow oak	Tree	2	2	2	6	6	6							4	4	4
Salix sericea	silky willow	Shrub															
Stem count			17	17	17	20	20	20	16	16	16	14	14	14	17	17	17
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			7	7	7	6	6	6	6	6	6	5	5	5	4	4	4
Stems per ACRE			688	688	688	809	809	809	647	647	647	567	567	567	688	688	688

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)														
			94641-WEI-0006			94641-WEI-0007			94641-WEI-0008			94641-WEI-0009			94641-WEI-0010		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	1	1	1	2	2	2	1	1	1	3	3	3	1	1	1
Cornus amomum	silky dogwood	Shrub													1	1	1
Fraxinus pennsylvanica	green ash	Tree				3	3	3	1	1	1				3	3	3
Liriodendron tulipifera	tuliptree	Tree															
Platanus occidentalis	American sycamore	Tree	5	5	5	2	2	2	2	2	2	1	1	1			
Quercus michauxii	swamp chestnut oak	Tree													1	1	1
Quercus pagoda	cherrybark oak	Tree	3	3	3							1	1	1			
Quercus phellos	willow oak	Tree	2	2	2							7	7	7			
Salix sericea	silky willow	Shrub										2	2	2	5	5	5
Stem count			11	11	11	7	7	7	4	4	4	14	14	14	11	11	11
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			4	4	4	3	3	3	3	3	3	5	5	5	5	5	5
Stems per ACRE			445	445	445	283	283	283	162	162	162	567	567	567	445	445	445

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)														
			94641-WEI-0011			94641-WEI-0012			94641-WEI-0013			94641-WEI-0014			94641-WEI-0015		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	2	2	2	3	3	3				1	1	1	5	5	5
Cornus amomum	silky dogwood	Shrub															
Fraxinus pennsylvanica	green ash	Tree	4	4	4	1	1	1				1	1	1	3	3	3
Liriodendron tulipifera	tuliptree	Tree				3	3	3									
Platanus occidentalis	American sycamore	Tree	4	4	4	2	2	2	16	16	16	5	5	5	4	4	4
Quercus michauxii	swamp chestnut oak	Tree	5	5	5	1	1	1				2	2	2			
Quercus pagoda	cherrybark oak	Tree	1	1	1	2	2	2				3	3	3	1	1	1
Quercus phellos	willow oak	Tree	2	2	2	1	1	1				4	4	4	1	1	1
Salix sericea	silky willow	Shrub													1	1	1
Stem count			18	18	18	13	13	13	16	16	16	16	16	16	15	15	15
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			6	6	6	7	7	7	1	1	1	6	6	6	6	6	6
Stems per ACRE			728	728	728	526	526	526	647	647	647	647	647	647	607	607	607

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)														
			94641-WEI-0016			94641-WEI-0017			94641-WEI-0018			94641-WEI-0019			94641-WEI-0020		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	3	3	3	2	2	2									
Cornus amomum	silky dogwood	Shrub	5	5	5												
Fraxinus pennsylvanica	green ash	Tree							3	3	3	1	1	1			
Liriodendron tulipifera	tuliptree	Tree				4	4	4	2	2	2	2	2	2	1	1	1
Platanus occidentalis	American sycamore	Tree	2	2	2	1	1	1	2	2	2	7	7	7	3	3	3
Quercus michauxii	swamp chestnut oak	Tree	1	1	1				5	5	5	3	3	3	5	5	5
Quercus pagoda	cherrybark oak	Tree				3	3	3				1	1	1	3	3	3
Quercus phellos	willow oak	Tree	2	2	2	6	6	6	1	1	1	2	2	2	1	1	1
Salix sericea	silky willow	Shrub	5	5	5												
		Stem count	18	18	18	16	16	16	13	13	13	16	16	16	13	13	13
		size (ares)		1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	6	6	6	5	5	5	5	5	5	6	6	6	5	5	5
		Stems per ACRE	728	728	728	647	647	647	526	526	526	647	647	647	526	526	526

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)														
			94641-WEI-0021			94641-WEI-0022			94641-WEI-0023			94641-WEI-0024			94641-WEI-0025		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	2	2	2				1	1	1	1	1	1	2	2	2
Cornus amomum	silky dogwood	Shrub										1	1	1			
Fraxinus pennsylvanica	green ash	Tree	2	2	2	1	1	1	1	1	1	1	1	1			
Liriodendron tulipifera	tuliptree	Tree				1	1	1									
Platanus occidentalis	American sycamore	Tree	2	2	2	2	2	2	1	1	1	6	6	6	6	6	6
Quercus michauxii	swamp chestnut oak	Tree	2	2	2	7	7	7	3	3	3				2	2	2
Quercus pagoda	cherrybark oak	Tree	2	2	2	2	2	2	4	4	4				2	2	2
Quercus phellos	willow oak	Tree	1	1	1	3	3	3				3	3	3	4	4	4
Salix sericea	silky willow	Shrub										2	2	2			
Stem count			11	11	11	16	16	16	10	10	10	14	14	14	16	16	16
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			6	6	6	6	6	6	5	5	5	6	6	6	5	5	5
Stems per ACRE			445	445	445	647	647	647	405	405	405	567	567	567	647	647	647

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)														
			94641-WEI-0026			94641-WEI-0027			94641-WEI-0028			94641-WEI-0029			94641-WEI-0030		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	1	1	1							9	9	9	1	1	1
Cornus amomum	silky dogwood	Shrub													1	1	1
Fraxinus pennsylvanica	green ash	Tree	4	4	4	2	2	2	3	3	3	1	1	1	10	10	10
Liriodendron tulipifera	tuliptree	Tree	1	1	1	1	1	1									
Platanus occidentalis	American sycamore	Tree	3	3	3							6	6	6			
Quercus michauxii	swamp chestnut oak	Tree	5	5	5	3	3	3	1	1	1						
Quercus pagoda	cherrybark oak	Tree	2	2	2	5	5	5	3	3	3	4	4	4	3	3	3
Quercus phellos	willow oak	Tree							3	3	3	1	1	1	1	1	1
Salix sericea	silky willow	Shrub										2	2	2	1	1	1
		Stem count	16	16	16	11	11	11	10	10	10	23	23	23	17	17	17
		size (ares)	1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02		
		Species count	6	6	6	4	4	4	4	4	4	6	6	6	6	6	6
		Stems per ACRE	647	647	647	445	445	445	405	405	405	931	931	931	688	688	688

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)														
			94641-WEI-0031			94641-WEI-0032			94641-WEI-0033			94641-WEI-0034			94641-WEI-0035		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	4	4	4	1	1	1	3	3	3				3	3	3
Cornus amomum	silky dogwood	Shrub	2	2	2	1	1	1	1	1	1	4	4	4	1	1	1
Fraxinus pennsylvanica	green ash	Tree	3	3	3	3	3	3	4	4	24	4	4	4	1	1	1
Liriodendron tulipifera	tuliptree	Tree															
Platanus occidentalis	American sycamore	Tree	1	1	1	4	4	4	9	9	29	4	4	4	8	8	8
Quercus michauxii	swamp chestnut oak	Tree															
Quercus pagoda	cherrybark oak	Tree	6	6	6	4	4	4				2	2	2	2	2	2
Quercus phellos	willow oak	Tree				1	1	1	3	3	3	2	2	2			
Salix sericea	silky willow	Shrub	5	5	5	2	2	2				6	6	6			
		Stem count	21	21	21	16	16	16	20	20	60	22	22	22	15	15	15
		size (ares)	1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02		
		Species count	6	6	6	7	7	7	5	5	5	6	6	6	5	5	5
		Stems per ACRE	850	850	850	647	647	647	809	809	2428	890	890	890	607	607	607

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)														
			94641-WEI-0036			94641-WEI-0037			94641-WEI-0038			94641-WEI-0039			94641-WEI-0040		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	3	3	3	2	2	2	1	1	1	5	5	5	1	1	1
Cornus amomum	silky dogwood	Shrub	2	2	2										1	1	1
Fraxinus pennsylvanica	green ash	Tree	3	3	3				6	6	6	1	1	1			
Liriodendron tulipifera	tuliptree	Tree															
Platanus occidentalis	American sycamore	Tree				1	1	1	1	1	1	3	3	3	3	3	3
Quercus michauxii	swamp chestnut oak	Tree				6	6	6	2	2	2	2	2	2			
Quercus pagoda	cherrybark oak	Tree	2	2	2	5	5	5	5	5	5	3	3	3	5	5	5
Quercus phellos	willow oak	Tree	5	5	5							2	2	2	1	1	1
Salix sericea	silky willow	Shrub	4	4	4												
Stem count			19	19	19	14	14	14	15	15	15	16	16	16	11	11	11
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			6	6	6	4	4	4	5	5	5	6	6	6	5	5	5
Stems per ACRE			769	769	769	567	567	567	607	607	607	647	647	647	445	445	445

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts
Underwood Mitigation Site (NCEEP Project Code 94641)
Monitoring Year 1

			Current Plot Data (MY1 - 9/2013)						Annual Means					
			94641-WEI-0041			94641-WEI-0042			MY1 (9/2013)			MY0 (1/2013)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	4	4	4	4	4	4	82	82	82	124	124	124
Cornus amomum	silky dogwood	Shrub	4	4	4	1	1	1	25	25	25	30	30	30
Fraxinus pennsylvanica	green ash	Tree			20	1	1	21	82	82	142	86	86	86
Liriodendron tulipifera	tuliptree	Tree							20	20	20	35	35	35
Platanus occidentalis	American sycamore	Tree	2	2	22	2	2	22	144	144	204	145	145	145
Quercus michauxii	swamp chestnut oak	Tree							71	71	71	87	87	87
Quercus pagoda	cherrybark oak	Tree	6	6	6	1	1	1	93	93	93	131	131	131
Quercus phellos	willow oak	Tree				1	1	1	72	72	72	64	64	64
Salix sericea	silky willow	Shrub	3	3	3	1	1	1	39	39	39	38	38	38
Stem count			19	19	59	11	11	51	628	628	748	740	740	740
size (ares)			1			1			42			42		
size (ACRES)			0.02			0.02			1.04			1.04		
Species count			5	5	6	7	7	7	9	9	9	9	9	9
Stems per ACRE			769	769	2388	445	445	2064	605	605	721	712	712	712

Color Coding for Table

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF1 and UT2
Monitoring Year 1

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data				Design				As-Built/Baseline			
		SF1		UT2		Long Branch		UT to Cane Creek		SF1		UT2		SF1		UT2	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	n/a	7.6		7.0		14.8	18.6	8.2	11.8	8.8		7.1		9.0		16.6	
Floodprone Width (ft)		51.9		133.2		50+		40+		50+		200+		50+		200+	
Bankfull Mean Depth		1.2		1.4		1.3	2.1	0.9	1.0	0.7		0.6		0.7		0.8	
Bankfull Max Depth		2.2		1.8		1.9	2.9	1.5	1.7	1.0		0.7		1.1		1.1	
Bankfull Cross-sectional Area (ft^2)		9.5		9.6		25.0	34.6	8.5	10.7	6.5		4.2		6.3		13.6	
Width/Depth Ratio		6.2		5.2		7.9	13.8	7.9	13.1	12.0		12.0		12.9		20.4	
Entrenchment Ratio		6.8		18.9		3.4+		4.59+		2.2+		2.2+		2.2+		2.2+	
Bank Height Ratio		1.6		1.5		1.2	1.5	1.0	1.0	1.0		1.0		1.0		1.0	
D50 (mm)		4.7		6.1										119.3		145.5	
Profile																	
Riffle Length (ft)	n/a					---		---		---		---		11	36	7	25
Riffle Slope (ft/ft)*		0.011	0.0100	---		0.0130	0.0120	0.0120		0.0143	0.0255	0.0197	0.0353	0.0053	0.0283	0.0040	0.1512
Pool Length (ft)						---		---		---		---		16	34	16	51
Pool Max Depth (ft)		---		---		---		---		---		---		1.67		2.70	
Pool Spacing (ft)^		---		---		---		---		35	62	29	50	37	61	23	59
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	n/a	N/A		N/A		60		50	77	26	44	N/A		26	44	N/A	
Radius of Curvature (ft)		N/A		N/A		16	87	11.3	27.1	15	25	N/A		15	25	N/A	
Rc:Bankfull Width (ft/ft)		---		---		1.1	4.7	1	2.5	2	3	N/A		2	3	N/A	
Meander Length (ft)		N/A		N/A		66	191	29	96	62	106	N/A		62	106	N/A	
Meander Width Ratio		---		---		3.2	4.1	50	77	3	5	N/A		3	5	N/A	
Substrate, Bed and Transport Parameters																	
Ri%/Ru%/P%/G%/S%	n/a																
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100		N/A/0.9/4.7/20.9/87/362		N/A/N/A/6.1/62/128/256		---		---						SC/SC/SC/46.6/100/256		SC/SC/SC/58.6/111.2/180	
Reach Shear Stress (Competency) lb/ft^2 [1]		---		---						0.42		---		0.39		N/A	
Max part size (mm) mobilized at bankfull																	
Stream Power (Capacity) W/m^2																	
Additional Reach Parameters																	
Drainage Area (SM)	n/a	0.21		0.12		1.49		0.28		0.21		0.12		0.21		0.12	
Watershed Impervious Cover Estimate (%)		<1%		<1%		---		---		<1%		<1%		<1%		<1%	
Rosgen Classification		E4		E4		C/E4		C/E4		C4		C4		C5		C5	
Bankfull Velocity (fps)		3.1		2.04						3.1		3.1		3.2		1.0	
Bankfull Discharge (cfs)		20		13.1		101	124	20.6	53.2	20		13.1		20		13.1	
Q-NFF regression		45.2		30.96													
Q-USGS extrapolation		---		---													
Q-Mannings		---		---													
Valley Length (ft)		---		---		---		---		---		---					
Channel Thalweg Length (ft)		773		421		---		---		878		421		874		418	
Sinuosity (ft)		1.1		1.0		1.30		1.20		1.2		1.0		1.2		1.0	
Water Surface Slope ($ft/ft)^2$		0.011		0.015		0.004		0.005		0.0102		0.0141		0.0104		0.0143	
Bankfull Slope (ft/ft)		---		---		0.006		---		---		---		0.0104		0.0145	

(---): Data was not provided
N/A: Not Applicable

[1]Design Parameters based on revised Shields Diagram.

[2]Channel was dry at time of baseline survey. Slopes were calculated using the channel thalweg.

[3]As-Built pattern measuremeants fell within the design ranges, therefore the design parameters set are still applicable.

[4]Slopes outside of design range are from the tie in points at the channel confluence.

Table 10b. Baseline Stream Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3 and UT1
Monitoring Year 1

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data				Design						As-Built/Baseline			
		SF3		UT1		Long Branch		UT to Cane Creek		SF3-u/s of UT1		SF3-d/s of UT1		UT1		SF3		UT1	
		Min	Max	Min	Max	Min	Max	Min	Max			Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																			
Bankfull Width (ft)	n/a	15.9		9.0		14.8	18.6	8.2	11.8	18.2		18.0		10.7		22.6	29.3	4.1	
Floodprone Width (ft)		48.6		14.2		50+		40+		50+		200+		>100		50+	200+	100+	
Bankfull Mean Depth		1.8		0.8		1.3	2.1	0.9	1.0	1.5		1.5		0.9		1.0	1.5	0.3	
Bankfull Max Depth		2.4		1.5		1.9	2.9	1.5	1.7	2.1		2.1		1.3		2.3	2.6	0.5	
Bankfull Cross-sectional Area (ft^2)		28.9		7.2		25.0	34.6	8.5	10.7	27.5		27.1		9.6		27.0	34.5	1.2	
Width/Depth Ratio		8.8		11.1		7.9	13.8	7.9	13.1	12.0		12.0		12.0		14.8	28.8	14.2	
Entrenchment Ratio		3.1		1.6		3.4+		4.59+		2.2+		2.2+		>2.2		2.2+	2.2+	2.2+	
Bank Height Ratio		1.6		1.9		1.2	1.5	1.0	1.0	1.0		1.0		1.0		1.0	1.0	1.0	
D50 (mm)		4.7		1.0												50.6	63.3	73.8	
Profile																			
Riffle Length (ft)	n/a					---		---		---		---		---		12	103	11	26
Riffle Slope (ft/ft)		0.030	0.0500			0.0130	0.0120	0.0120		0.005	0.009	0.0078	0.0140	0.0118	0.0210	0.0003	0.0169	0.0023	0.0185
Pool Length (ft)						---		---		---		---		---		23	100	20	80
Pool Max Depth (ft)		---		---		---		---		---		---		---		2.3	2.6	3.1	
Pool Spacing (ft)^		---		---		---		---		---		---		---		53	166	58	76
Pool Volume (ft^3)																			
Pattern																			
Channel Beltwidth (ft)	n/a	51	106	31	59	60		50	77	54	91	54	90	32	54	54	91	32	54
Radius of Curvature (ft)		27	105	10	83	16	87	11.3	27.1	31	51	31	50	21	30	31	51	21	30
Rc:Bankfull Width (ft/ft)		7	16	1	9	1	5	1	3	2	3	2	3	2	3	2	3	2	3
Meander Length (ft)		46	272	80	161	66	191	29	96	127	218	126	216	75	129	126	218	75	129
Meander Width Ratio		26	70	3	7	3	4	50	77	3	5	3	5	3	5	3	5	3	5
Substrate, Bed and Transport Parameters																			
Ri%/Ru%/P%/G%/S%	n/a																		
SC%/Sa%/G%/C%/B%/Be%																			
d16/d35/d50/d84/d95/d100		7.53/16.66/40.82/74.02/97.42/180		N/A/N/A/1/16/107.3/256		---		---								0.08/0.21/11/67.2/256/>2048		0.07/0.16/0.3/26.9/71.7/256	
Reach Shear Stress (Competency) lb/ft^2 [1]		---		---						0.35		0.52		0.37		0.28		0.12	
Max part size (mm) mobilized at bankfull																			
Stream Power (Capacity) W/m^2																			
Additional Reach Parameters																			
Drainage Area (SM)	n/a	1.27		0.36		1.49		0.28		1.27				0.36		1.27		0.36	
Watershed Impervious Cover Estimate (%)		<1%		<1%		---		---		<1%		<1%		<1%		<1%		<1%	
Rosgen Classification		E4		E/G5		C/E4		C/E4		C4		C4		C5		C4		C5	
Bankfull Velocity (fps)		3.7		5.87						3.0		3.4		3.2		3.0	2.9	25.3	
Bankfull Discharge (cfs)		81.5		30.3		101	124	20.6	53.2	81.5		99.8		30.3		81.5	99.8	30.3	
Q-NFF regression		159.7		65.7															
Q-USGS extrapolation		---		---															
Q-Mannings		---		---															
Valley Length (ft)		---		---		---		---		---		---		---					
Channel Thalweg Length (ft)		2183		1915		---		---		2116				1997		2120		2038	
Sinuosity (ft)		1.2		1.2		1.3		1.2		1.2		1.2		1.2		1.2		1.2	
Water Surface Slope $(ft/ft)^2$		0.004		0.01		0.004		0.005		0.0036		0.0056		0.0084		0.0041		0.0075	
Bankfull Slope (ft/ft)		---		---		0.006		---		---		---		---		0.0047		0.0083	

(---): Data was not provided
N/A: Not Applicable

[1]Design Parameters based on revised Shields Diagram.

[2]Channel was dry at time of baseline survey. Slopes were calculated using the channel thalweg.

[3]As-Built pattern measuremeants fell within the design ranges, therefore the design parameters set are still applicable.

[4]Slopes outside of design range are from the tie in points at the channel confluence.

Table 10c. Baseline Stream Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4 and SF4A
Monitoring Year 1

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data				Design				As-Built/Baseline			
		SF4		SFA		Long Branch		UT to Cane Creek		SF4		SFA		SF4		SFA	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	n/a	18.6		10.3		14.8	18.6	8.2	11.8	14.0		12.0		26.7	27.3	13.6	17.3
Floodprone Width (ft)		157.3		29.4		50+		40+		50+		200+		200+	200+	200+	200+
Bankfull Mean Depth		2.7		1.6		1.3	2.1	0.9	1.0	1.9		1.2		2.0	2.9	1.2	1.6
Bankfull Max Depth		4.0		2.2		1.9	2.9	1.5	1.7	2.3		1.7		2.9	3.0	2.1	2.8
Bankfull Cross-sectional Area (ft^2)		49.7		16.9		25.0	34.6	8.5	10.7	53.0		18.0		49.0	53.8	16.1	27.1
Width/Depth Ratio		6.9		6.3		7.9	13.8	7.9	13.1	14.0		12.0		13.8	14.6	11.1	11.5
Entrenchment Ratio		3.5		2.9		3.4+		4.59+		2.2+		2.2+		2.2+	2.2+	2.2+	2.2+
Bank Height Ratio		1.4		1.8		1.2	1.5	1.0	1.0	1.0		1.0		1.0	1.0	1.0	1.0
D50 (mm)		0.3		0.8										117.2	134.4	22.6	82.0
Profile																	
Riffle Length (ft)	n/a					---		---		---		---		51	112	41	79
Riffle Slope (ft/ft)		---		---		0.0130	0.0120	0.0120		0.0048	0.0085	0.0108	0.0193	0.0010	0.0098	0.0001	0.0210
Pool Length (ft)						---		---		---		---		54	123	28	79
Pool Max Depth (ft)		---		---		---		---		---		---		2.9	3.0	2.1	2.8
Pool Spacing (ft)^		---		---		---		---		---		---		146	210	71	110
Pool Volume (ft^3)																	
Pattern[3]																	
Channel Beltwidth (ft)	n/a	N/A		N/A		60		50	77	82	136	44	74	82	136	44	74
Radius of Curvature (ft)		N/A		N/A		16	87	11	27	46	76	25	41	46	76	25	41
Rc:Bankfull Width (ft/ft)		---		---		1	5	1	3	1.7	2.8	1.7	2.8	2	3	2	3
Meander Length (ft)		N/A		N/A		66	191	29	96	191	327	103	177	191	327	103	177
Meander Width Ratio		---		---		3	4	6	7	3	5	3	5	3	5	3	5
Substrate, Bed and Transport Parameters																	
Ri%/Ru%/P%/G%/S%	n/a																
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100		N/A/N/A/0.3/17.9/45.8/90		N/A/0.1/0.8/204./62.9/362		---		---						0.13/0.36/5.3/102.5/320.7/>2048		SC/0.12/1.4/44/71.3/362	
Reach Shear Stress (Competency) $lb/ft^{2,1}$		---		---						0.32	0.63	---		0.33	0.33	0.44	0.58
Max part size (mm) mobilized at bankfull																	
Stream Power (Capacity) W/m^2																	
Additional Reach Parameters																	
Drainage Area (SM)	n/a	5.26		1.00		1.49		0.28		5.26		1.00		5.26		1.00	
Watershed Impervious Cover Estimate (%)		<1%		<1%		---		---		<1%		<1%		<1%		<1%	
Rosgen Classification		E5		E5		C/E4		C/E4		C5		C5		C4		C5	
Bankfull Velocity (fps)		5.9		5.26						3.9		3.7		4.2	3.8	4.2	2.5
Bankfull Discharge (cfs)		247.4		67.3		101	124	20.6	53.2	204		67.3		204		67.3	
Q-NFF regression		432.92		134.59													
Q-USGS extrapolation		---		---													
Q-Mannings		---		---													
Valley Length (ft)		---		---		---		---		---		---					
Channel Thalweg Length (ft)		1450.0		609.0		---		---		1,424		868		1429		866	
Sinuosity (ft)		1.3		1.1		1.3		1.2		1.2		1.0		1.2		1.1	
Water Surface Slope (ft/ft)[2]		0.003		0.008		0.004		0.005		0.0034		0.0077		0.0033		0.0070	
Bankfull Slope (ft/ft)		---		---		0.006		---		0.0034		0.0077		0.0034		0.0067	

(---): Data was not provided
N/A: Not Applicable

[1]Design Parameters based on revised Shields Diagram.

[2]Channel was dry at time of baseline survey. Slopes were calculated using the channel thalweg.

[3]As-Built pattern measuremeants fell within the design ranges, therefore the design parameters set are still applicable.

[4]Slopes outside of design range are from the tie in points at the channel confluence.

Table 11. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris and Lindley Site
Monitoring Year 1

	SF1												UT2											
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Pool)						Cross-Section 4 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation																								
Bankfull Width (ft)	8.4	9.0					11.7	13.9					15.0	19.4					16.6	18.6				
Floodprone Width (ft)	50+	50+					N/A	N/A					N/A	N/A					200+	200+				
Bankfull Mean Depth (ft)	0.7	0.7					0.9	0.9					1.6	1.4					0.8	0.9				
Bankfull Max Depth (ft)	1.0	1.1					1.7	2.1					2.7	2.7					1.1	1.4				
Bankfull Cross-Sectional Area (ft^2)	5.6	6.3					12.8	12.2					24.2	26.2					13.6	18.6				
Bankfull Width/Depth Ratio	12.8	12.9					N/A	N/A					N/A	N/A					20.4	25.4				
Bankfull Entrenchment Ratio	2.2+	2.2+					N/A	N/A					N/A	N/A					2.2+	2.2+				
Bankfull Bank Height Ratio	1.0	1.0					1.2	1.2					1.0	1.0					1.0	1.0				

	SF3																							
	Cross-Section 5 (Riffle)						Cross-Section 6 (Pool)						Cross-Section 7 (Riffle)						Cross-Section 8 (Pool)					
based on fixed bankfull elevation	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
Bankfull Width (ft)	19.67	22.6					19.67	24.8					16.7	29.3					19.68	22.3				
Floodprone Width (ft)	200+	200+					N/A	N/A					200+	200+					N/A	N/A				
Bankfull Mean Depth (ft)	1.6	1.5					1.6	2.0					1.2	1.0					1.4	1.7				
Bankfull Max Depth (ft)	2.34	2.5					2.34	4.1					2.18	2.6					3	3.5				
Bankfull Cross-Sectional Area (ft^2)	30.54	34.5					30.54	50.2					20.64	29.8					27.96	36.9				
Bankfull Width/Depth Ratio	12.67	14.8					12.67	12.1					13.51	28.8					13.85	13.5				
Bankfull Entrenchment Ratio	2.2+	2.2+					N/A	N/A					2.2+	2.2+					N/A	N/A				
Bankfull Bank Height Ratio	1.0	1.0					1.0	1.0					1.0	1.0					1.0	1.0				

	SF3						UT1												SF4					
	Cross-Section 9 (Riffle)						Cross-Section 10 (Riffle)						Cross-Section 11 (Pool)						Cross-Section 12 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation																								
Bankfull Width (ft)	15.9	24.2					12.57	4.1					14.18	9.4					33.27	34.1				
Floodprone Width (ft)	200+	200+					100+	100+					N/A	N/A					N/A	N/A				
Bankfull Mean Depth (ft)	1.2	1.1					0.83	0.3					1.25	2.0					2.24	2.1				
Bankfull Max Depth (ft)	1.8	2.3					1.5	0.5					2.6	3.1					4.9	4.7				
Bankfull Cross-Sectional Area (ft^2)	19.0	27.0					10.45	1.2					17.73	18.3					74.39	72.2				
Bankfull Width/Depth Ratio	13.29	21.6					15.12	14.2					11.34	4.8					14.88	16.2				
Bankfull Entrenchment Ratio	2.2+	2.2+					2.2+	2.2+					N/A	N/A					N/A	N/A				
Bankfull Bank Height Ratio	1.0	1.0					1	1.0					1.0	1.0					1.0	1.0				

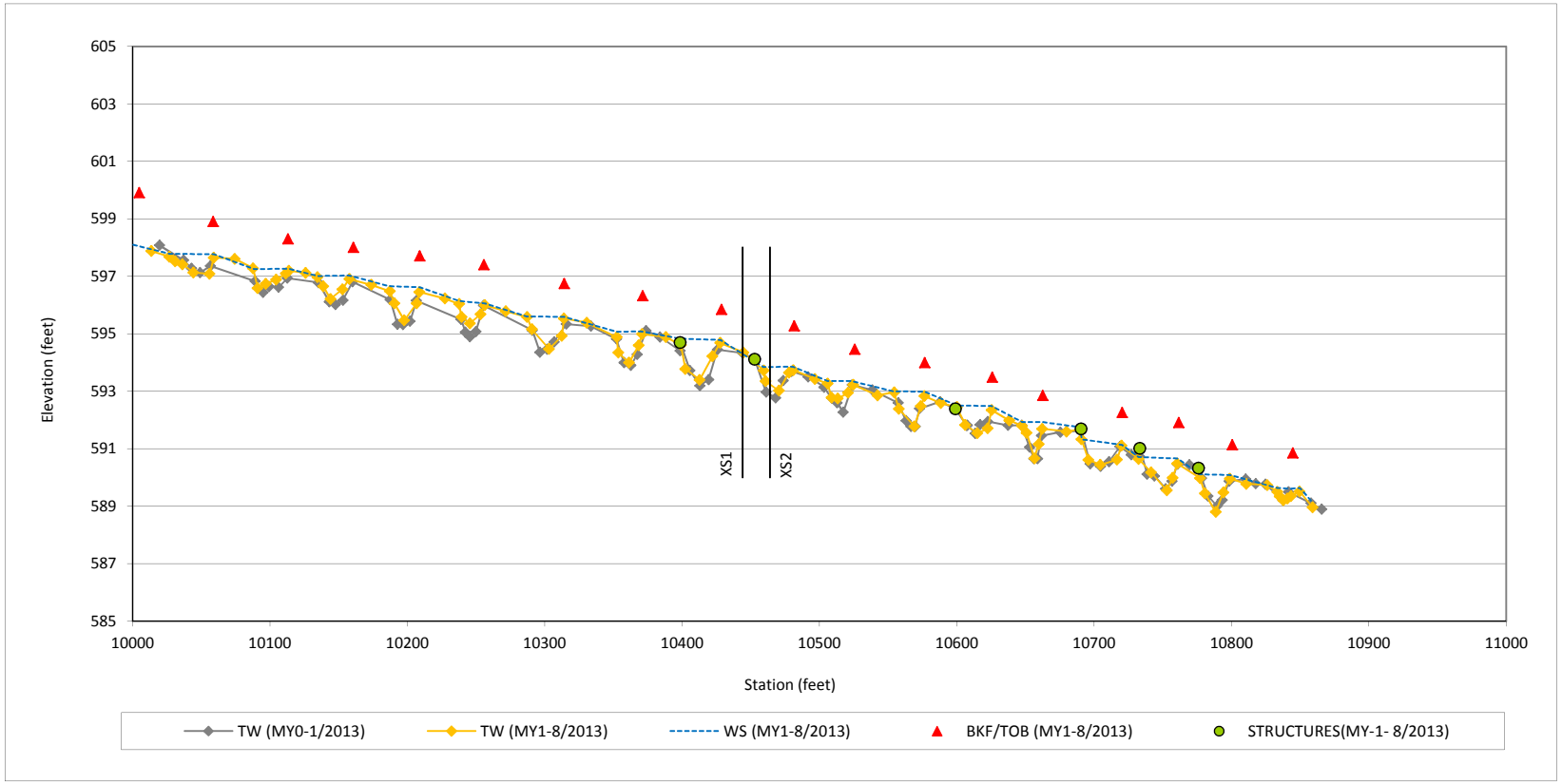
	SF4																		SF4A					
	Cross-Section 13 (Riffle)						Cross-Section 14 (Pool)						Cross-Section 15 (Riffle)						Cross-Section 16 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation																								
Bankfull Width (ft)	27.34	26.7					38.71	44.4					27.61	27.3					23.71	17.3				
Floodprone Width (ft)	200+	200+					N/A	N/A					200+	200+					200+	200+				
Bankfull Mean Depth (ft)	1.81	2.9					1.82	1.8					1.85	2.0					0.86	1.6				
Bankfull Max Depth (ft)	3.0	2.9					4.3	4.6					3.2	3.0					2.3	2.8				
Bankfull Cross-Sectional Area (ft^2)	49.49	49.0					70.58	78.1					51.19	53.8					20.43	27.1				
Bankfull Width/Depth Ratio	15.11	14.6					21.23	25.3					14.89	13.8					27.51	11.1				
Bankfull Entrenchment Ratio	2.2+	2.2+					N/A	N/A					2.2+	2.2+					2.2+	2.2+				
Bankfull Bank Height Ratio	1.0	1.0					1.0	1.0					1.0	1.0					1.0	1.0				

	SF4A											
	Cross-Section 17 (Riffle)						Cross-Section 18 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation												
Bankfull Width (ft)	13.87	13.6					15.97	13.5				
Floodprone Width (ft)	200+	200+					N/A	N/A				
Bankfull Mean Depth (ft)	1.26	1.2					1.43	1.6				
Bankfull Max Depth (ft)	2.12	2.1					2.82	3.4				
Bankfull Cross-Sectional Area (ft^2)	17.46	16.1					22.9	21.0				
Bankfull Width/Depth Ratio	11.02	11.5					11.14	8.6				
Bankfull Entrenchment Ratio	2.2+	2.2+					N/A	N/A				
Bankfull Bank Height Ratio	1	1.0					1	1.0				

Table 12a. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF1
Monitoring Year 1

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	8.4		9.0									
Floodprone Width (ft)	50+		50+									
Bankfull Mean Depth	0.7		0.7									
Bankfull Max Depth	1.0		1.1									
Bankfull Cross-sectional Area (ft^2)	5.6		6.3									
Width/Depth Ratio	12.8		12.9									
Entrenchment Ratio	2.2+		2.2+									
Bank Height Ratio	1.0		1.0									
D50 (mm)												
Profile												
Riffle Length (ft)	11	36	13	38								
Riffle Slope (ft/ft)	0.0053	0.0283	0.0008	0.0376								
Pool Length (ft)	16	34	15	30								
Pool Max Depth (ft)	1.7		1.6									
Pool Spacing (ft)	37	61	36	59								
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	26	44										
Radius of Curvature (ft)	15	25										
Rc:Bankfull Width (ft/ft)	1.7	2.8										
Meander Wave Length (ft)	62	106										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C5		C5									
Channel Thalweg Length (ft)	874.1		874.1									
Sinuosity (ft)	1.2		1.2									
Water Surface Slope (ft/ft)	0.0104		0.0104									
Bankfull Slope (ft/ft)	0.0104		0.0108									
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/SC/SC/46.6/100/256		SC/SC/SC/91.6/202.4/362									
% of Reach with Eroding Banks			0%									

Longitudinal Profile Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF1
Monitoring Year 1



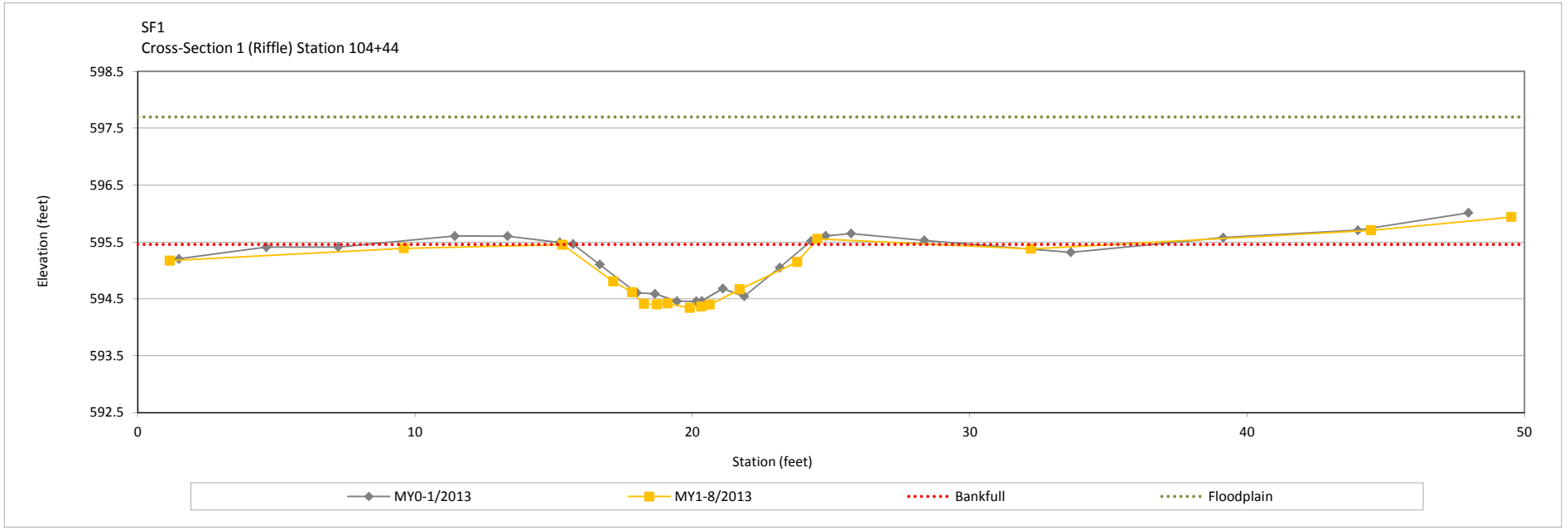
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF1, Cross-Section 1 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	1
Drainage Area	132 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	596.6
Bankfull Cross-Sectional Area (ft2)	6.3
Bankfull Width (ft)	9.0
Flood Prone Area Elevation (ft)	597.7
Flood Prone Width (ft)	50+
Max Depth at Bankfull (ft)	1.1
Mean Depth at Bankfull (ft)	0.7
W/D Ratio	12.9
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C

Cross-Section 1: View Upstream

Cross-Section 1: View Downstream



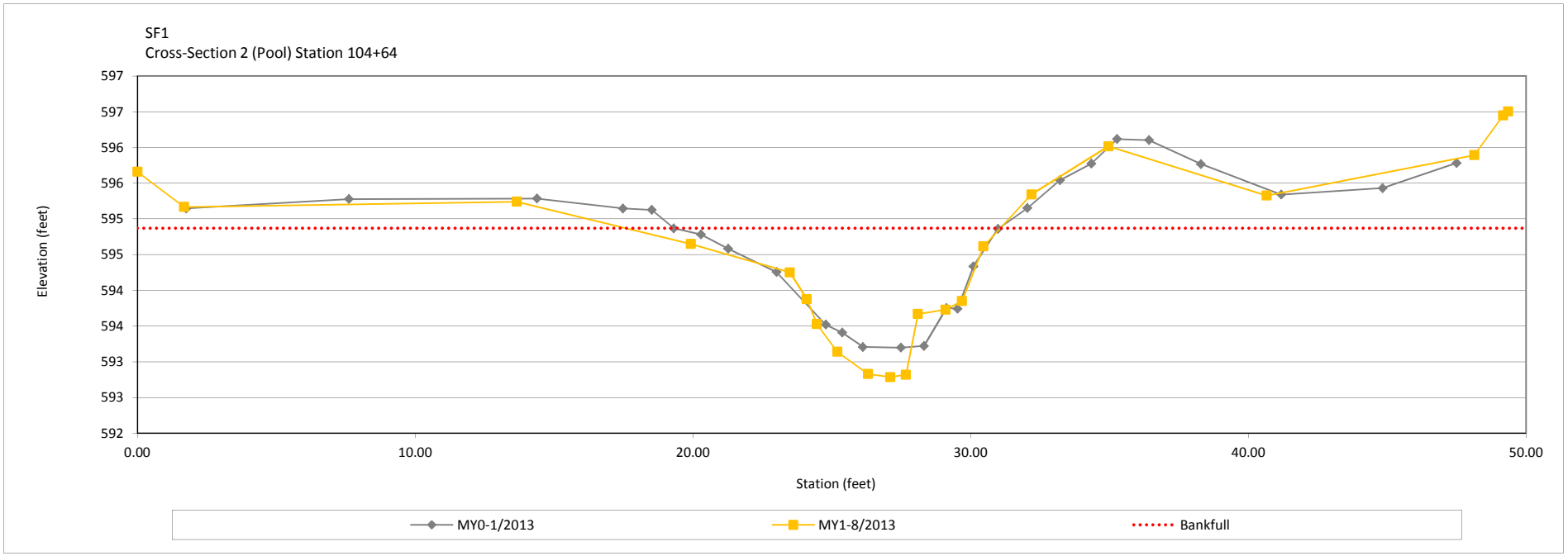
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF1, Cross-Section 2 (Pool)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	2
Drainage Area	132 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	594.9
Bankfull Cross-Sectional Area (ft2)	12.2
Bankfull Width (ft)	13.9
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	2.1
Mean Depth at Bankfull (ft)	0.9
W/D Ratio	15.8
Entrenchment Ratio	N/A
Bank Height Ratio	1.2
Stream Type	N/A

Cross-Section 2: View Upstream

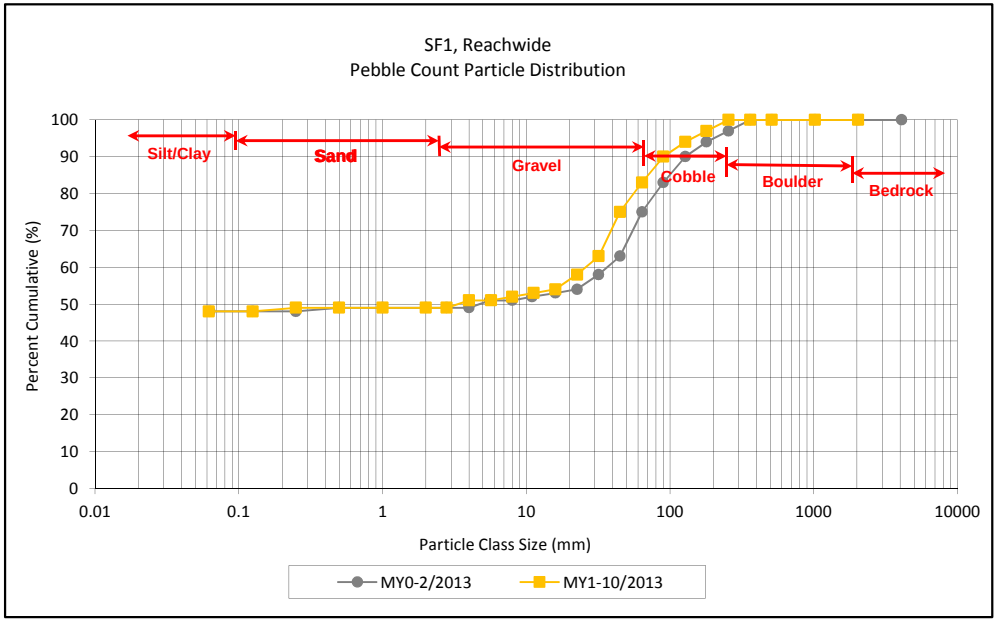
Cross-Section 2: View Downstream

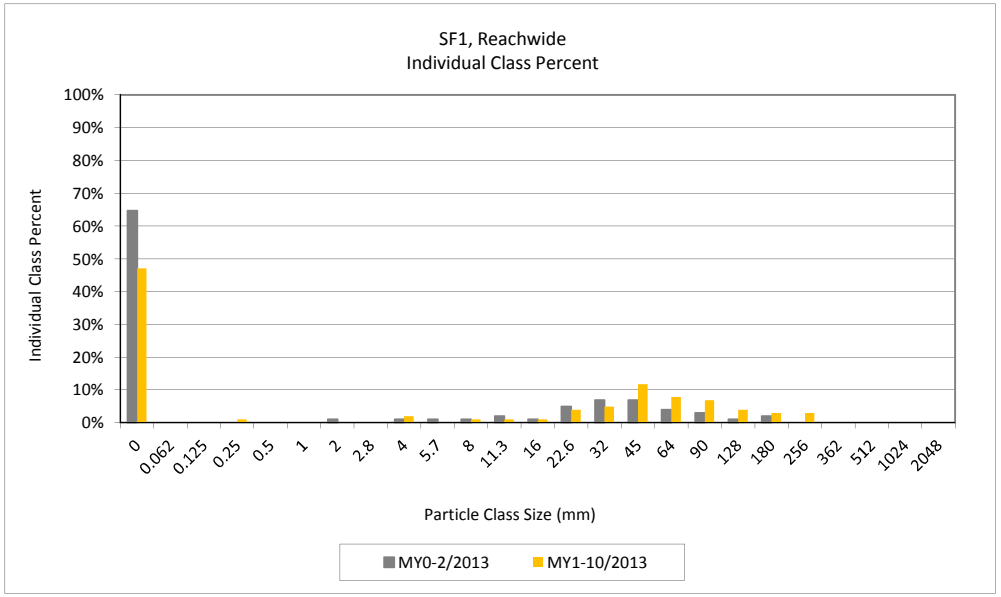


Reachwide and Cross-Section Pebble Count Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF1, Reachwide
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count			SF1 Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	3	45	48	48	48
SAND	Very fine	0.062	0.125					48
	Fine	0.125	0.250					48
	Medium	0.250	0.500	1		1	1	49
	Coarse	0.5	1.0					49
	Very Coarse	1.0	2.0					49
GRAVEL	Very Fine	2.0	2.8					49
	Very Fine	2.8	4.0					49
	Fine	4.0	5.7	2		2	2	51
	Fine	5.7	8.0					51
	Medium	8.0	11.3	1		1	1	52
	Medium	11.3	16.0	1		1	1	53
	Coarse	16.0	22.6	1		1	1	54
	Coarse	22.6	32	4		4	4	58
	Very Coarse	32	45	5		5	5	63
	Very Coarse	45	64	10	2	12	12	75
COBBLE	Small	64	90	5	3	8	8	83
	Small	90	128	7		7	7	90
	Large	128	180	4		4	4	94
	Large	180	256	3		3	3	97
BOULDER	Small	256	362	3		3	3	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	silt/clay
D_{35} =	silt/clay
D_{50} =	silt/clay
D_{84} =	94.6
D_{95} =	202.4
D_{100} =	362.0

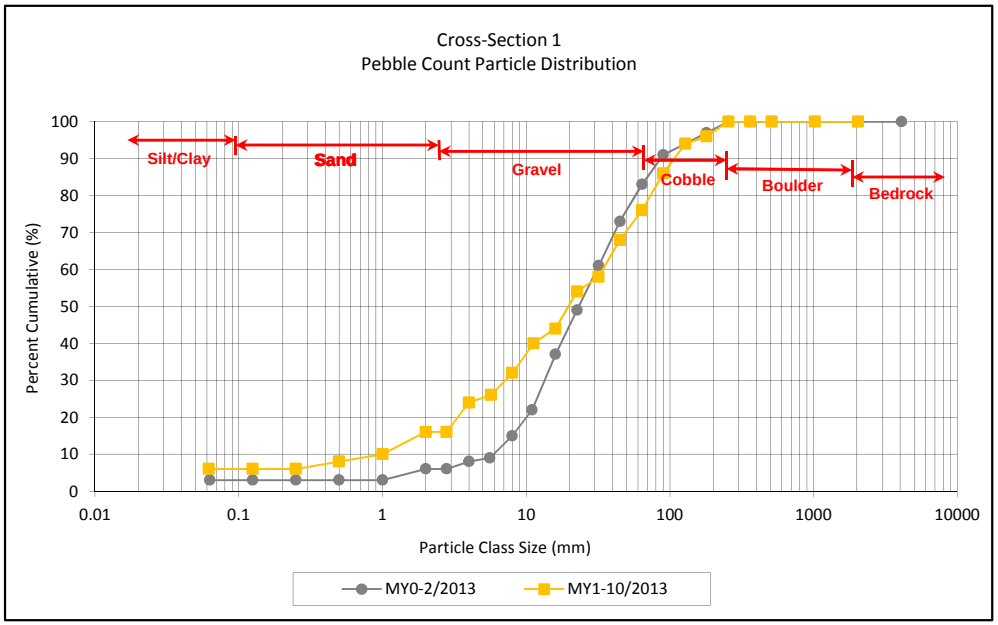




Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF1, Cross-Section 1
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 1 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	6	6
SAND	Very fine	0.062	0.125			6
	Fine	0.125	0.250			6
	Medium	0.250	0.500			6
	Coarse	0.5	1.0	2	2	8
	Very Coarse	1.0	2.0	2	2	10
GRAVEL	Very Fine	2.0	2.8	6	6	16
	Very Fine	2.8	4.0			16
	Fine	4.0	5.7	8	8	24
	Fine	5.7	8.0	2	2	26
	Medium	8.0	11.3	6	6	32
	Medium	11.3	16.0	8	8	40
	Coarse	16.0	22.6	4	4	44
	Coarse	22.6	32	10	10	54
	Very Coarse	32	45	4	4	58
	Very Coarse	45	64	10	10	68
COBBLE	Small	64	90	8	8	76
	Small	90	128	10	10	86
	Large	128	180	8	8	94
	Large	180	256	2	2	96
BOULDER	Small	256	362	4	4	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross-Section 1	
Channel materials (mm)	
D_{16} =	4.0
D_{35} =	12.7
D_{50} =	27.8
D_{84} =	119.3
D_{95} =	214.7
D_{100} =	362.0



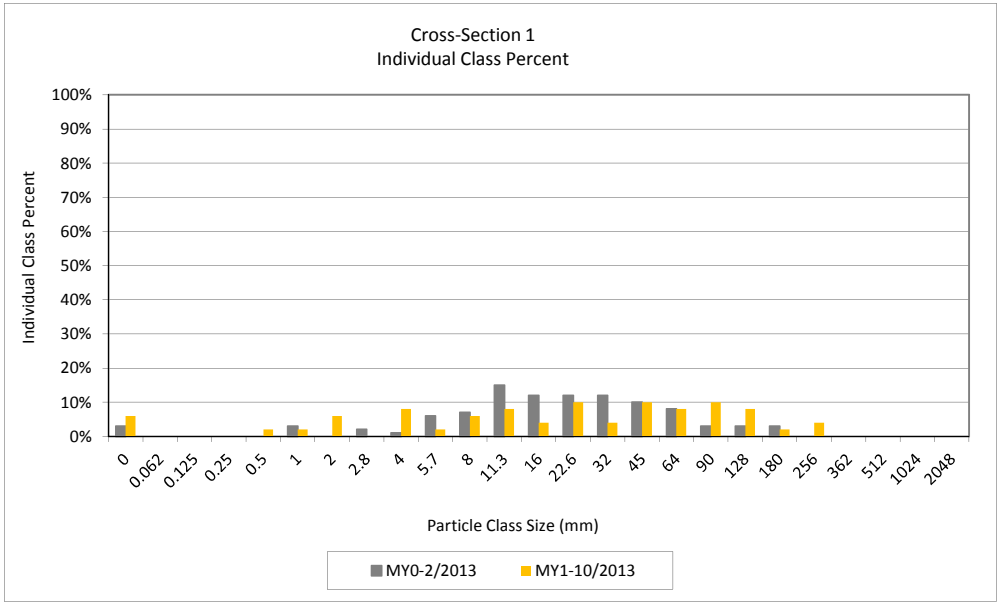
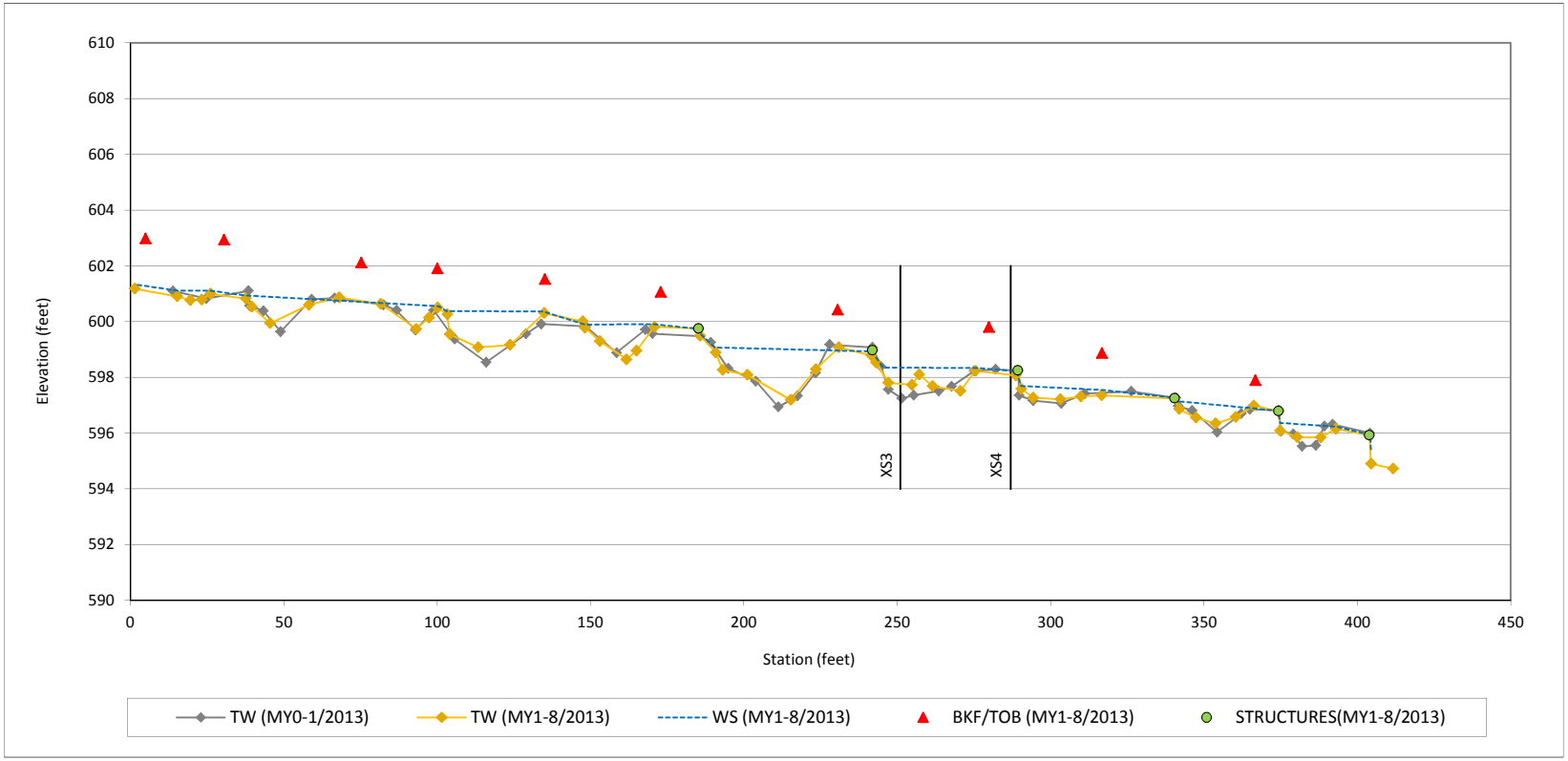


Table 12b. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT2
Monitoring Year 1

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	16.6		18.6									
Floodprone Width (ft)	200+		200+									
Bankfull Mean Depth	0.8		0.9									
Bankfull Max Depth	1.1		1.4									
Bankfull Cross-sectional Area (ft^2)	13.6		18.6									
Width/Depth Ratio	20.4		25.4									
Entrenchment Ratio	2.2+		2.2+									
Bank Height Ratio	1.0		1.0									
D50 (mm)												
Profile												
Riffle Length (ft)	7	25	3	24								
Riffle Slope (ft/ft)	0.0040	0.1512	0.0045	0.0775								
Pool Length (ft)	16	51	11	46								
Pool Max Depth (ft)	2.7		0.6									
Pool Spacing (ft)	23	59	21	60								
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	N/A											
Radius of Curvature (ft)	N/A											
Rc:Bankfull Width (ft/ft)	N/A											
Meander Wave Length (ft)	N/A											
Meander Width Ratio	N/A											
Additional Reach Parameters												
Rosgen Classification	C5		C5									
Channel Thalweg Length (ft)	417.87		417.87									
Sinuosity (ft)	1.0		1.0									
Water Surface Slope (ft/ft)	0.0143		0.0149									
Bankfull Slope (ft/ft)	0.0145		0.0141									
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/SC/SC/110.1/163.3/256		SC/SC/SC/58.6/111.2/181									
% of Reach with Eroding Banks			0%									

Longitudinal Profile Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT2
Monitoring Year 1



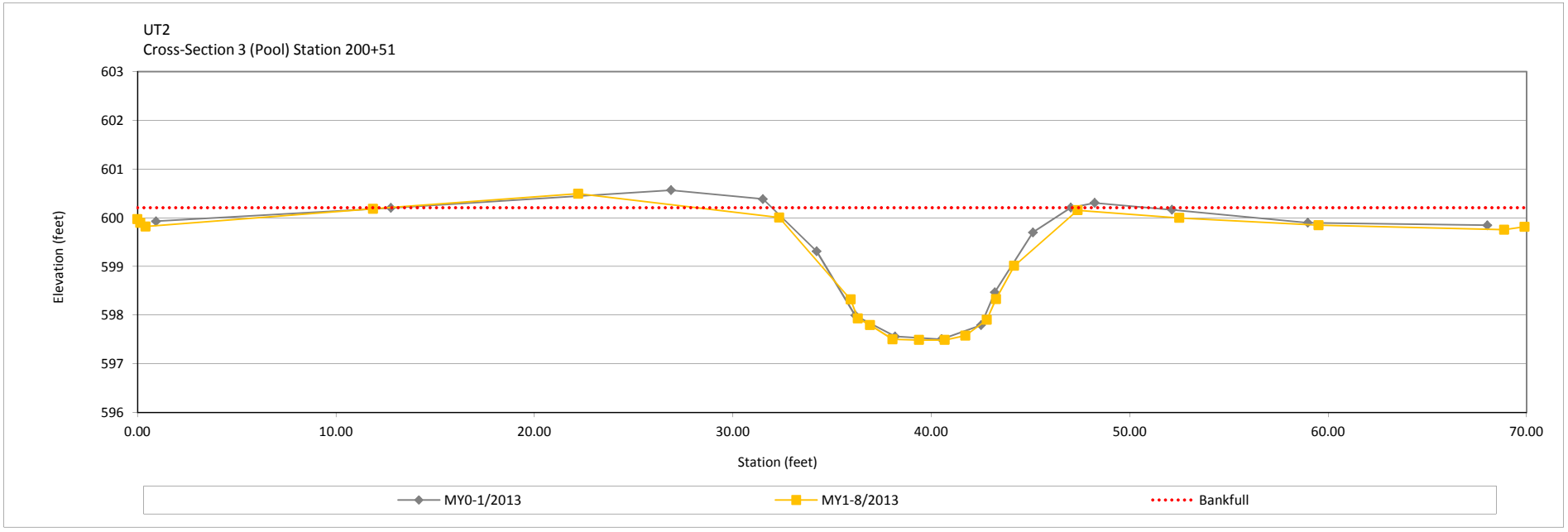
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT2, Cross-Section 3 (Pool)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	3
Drainage Area	78 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	600.2
Bankfull Cross-Sectional Area (ft2)	26.2
Bankfull Width (ft)	19.4
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	2.7
Mean Depth at Bankfull (ft)	1.4
W/D Ratio	14.3
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A

Cross-Section 3: View Upstream

Cross-Section 3: View Downstream



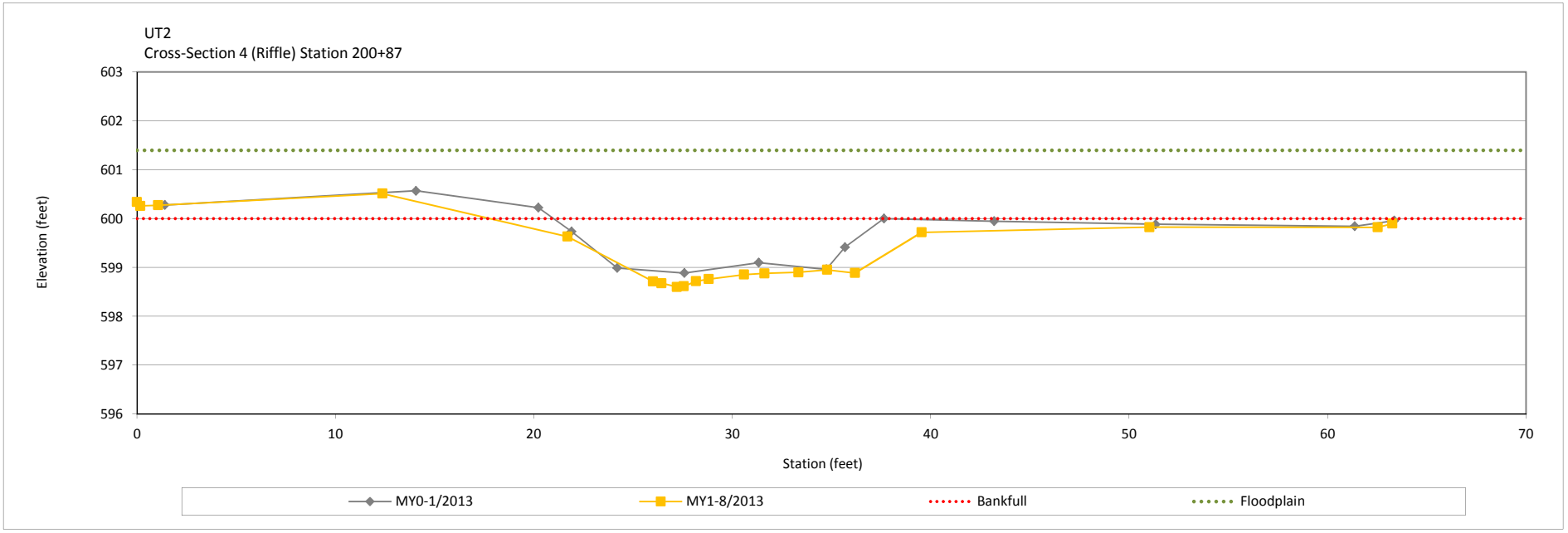
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT2, Cross-Section 4 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	4
Drainage Area	78 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	599.5
Bankfull Cross-Sectional Area (ft2)	18.6
Bankfull Width (ft)	21.8
Flood Prone Area Elevation (ft)	600.9
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	1.4
Mean Depth at Bankfull (ft)	0.9
W/D Ratio	25.4
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C

Cross-Section 4: View Upstream

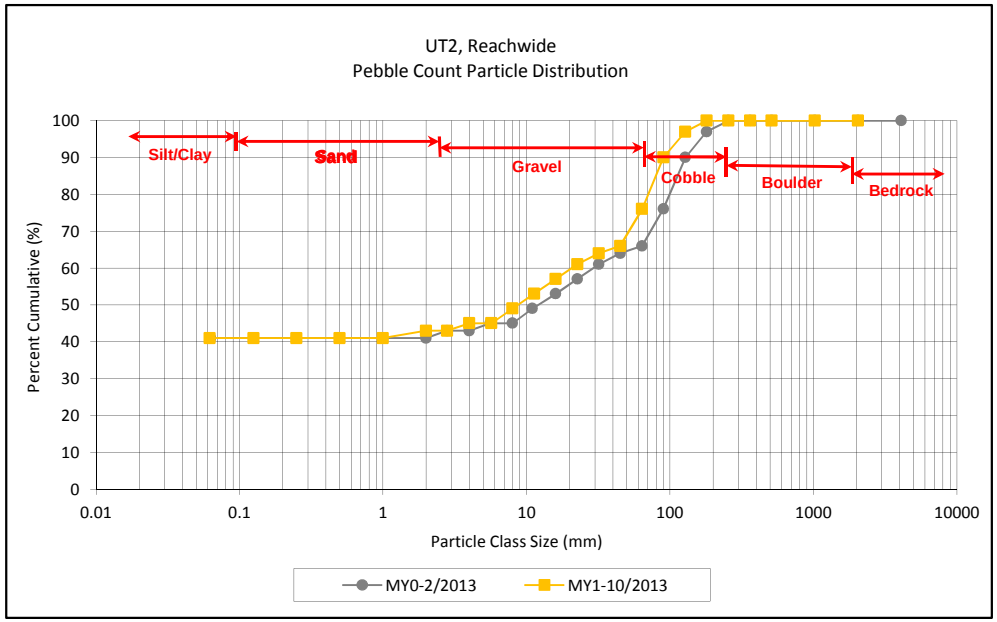
Cross-Section 4: View Downstream

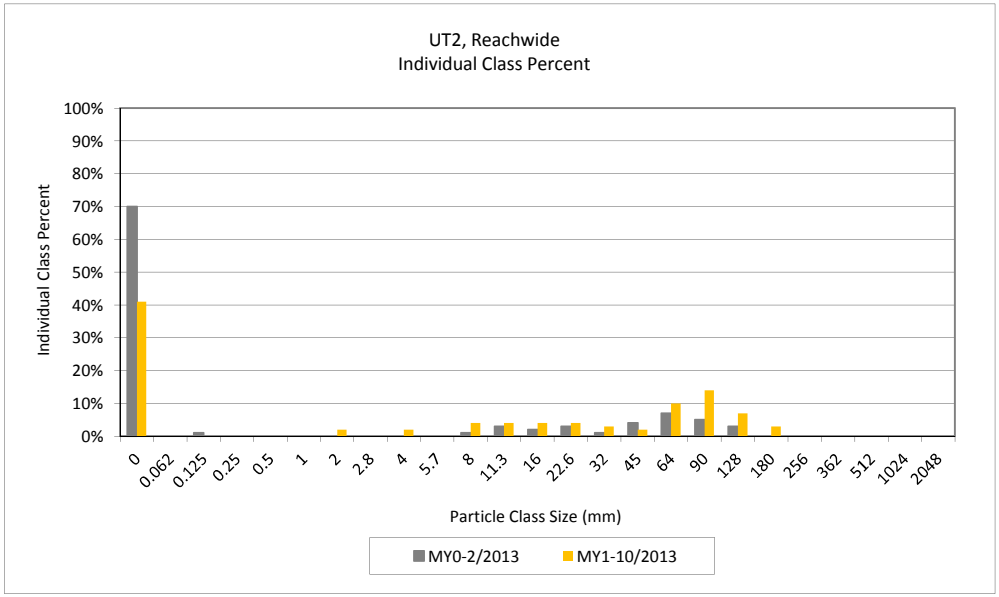


Reachwide and Cross-Section Pebble Count Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT2, Reachwide
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count			UT2 Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		41	41	41	41
SAND	Very fine	0.062	0.125					41
	Fine	0.125	0.250					41
	Medium	0.250	0.500					41
	Coarse	0.5	1.0					41
	Very Coarse	1.0	2.0					41
GRAVEL	Very Fine	2.0	2.8	2		2	2	43
	Very Fine	2.8	4.0					43
	Fine	4.0	5.7	2		2	2	45
	Fine	5.7	8.0					45
	Medium	8.0	11.3	3	1	4	4	49
	Medium	11.3	16.0	3	1	4	4	53
	Coarse	16.0	22.6	2	2	4	4	57
	Coarse	22.6	32	4		4	4	61
	Very Coarse	32	45	3		3	3	64
	Very Coarse	45	64	2		2	2	66
COBBLE	Small	64	90	8	2	10	10	76
	Small	90	128	13	1	14	14	90
	Large	128	180	5	2	7	7	97
	Large	180	256	3		3	3	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	silt/clay
D_{35} =	silt/clay
D_{50} =	silt/clay
D_{84} =	110.1
D_{95} =	163.3
D_{100} =	256.0

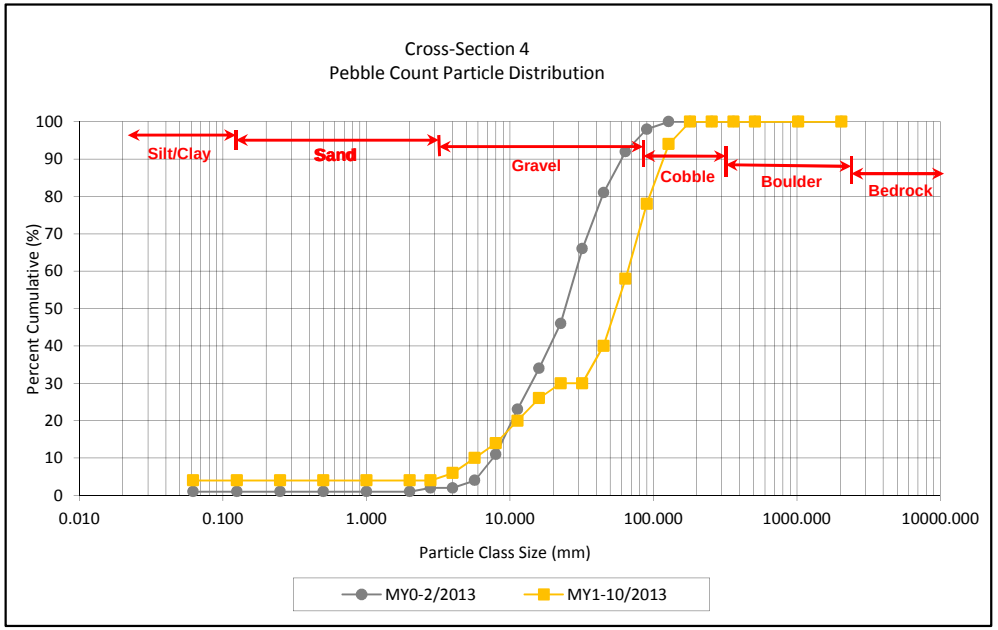




Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT2, Cross-Section 4
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 4 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	4	4
SAND	Very fine	0.062	0.125			4
	Fine	0.125	0.250			4
	Medium	0.250	0.500			4
	Coarse	0.5	1.0			4
	Very Coarse	1.0	2.0			4
GRAVEL	Very Fine	2.0	2.8			4
	Very Fine	2.8	4.0			4
	Fine	4.0	5.7	2	2	6
	Fine	5.7	8.0	4	4	10
	Medium	8.0	11.3	4	4	14
	Medium	11.3	16.0	6	6	20
	Coarse	16.0	22.6	6	6	26
	Coarse	22.6	32	4	4	30
	Very Coarse	32	45			30
	Very Coarse	45	64	10	10	40
COBBLE	Small	64	90	18	18	58
	Small	90	128	20	20	78
	Large	128	180	16	16	94
	Large	180	256	6	6	100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 4	
Channel materials (mm)	
D_{16} =	12.5
D_{35} =	53.7
D_{50} =	77.3
D_{84} =	145.5
D_{95} =	190.9
D_{100} =	256.0



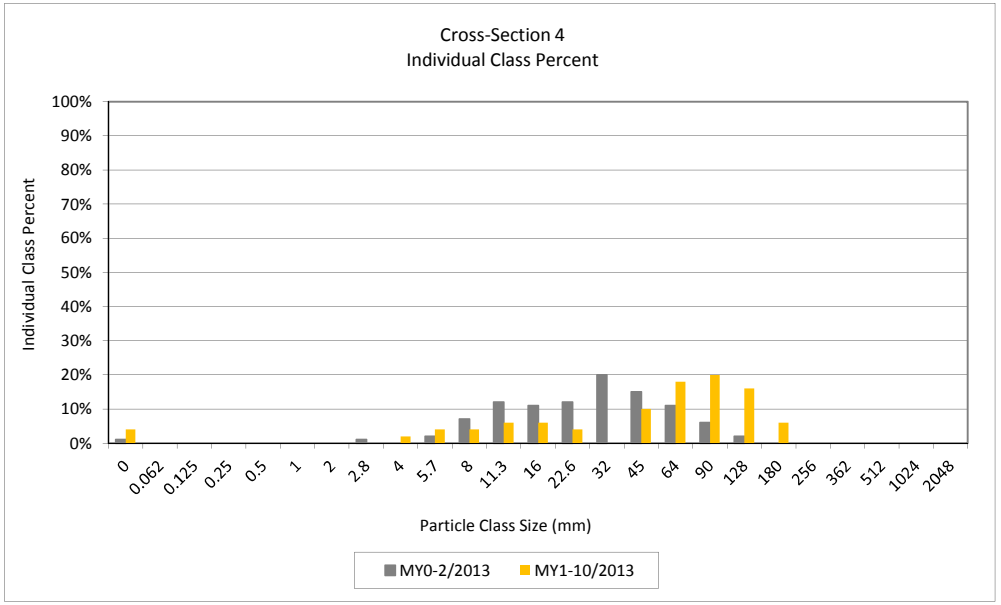
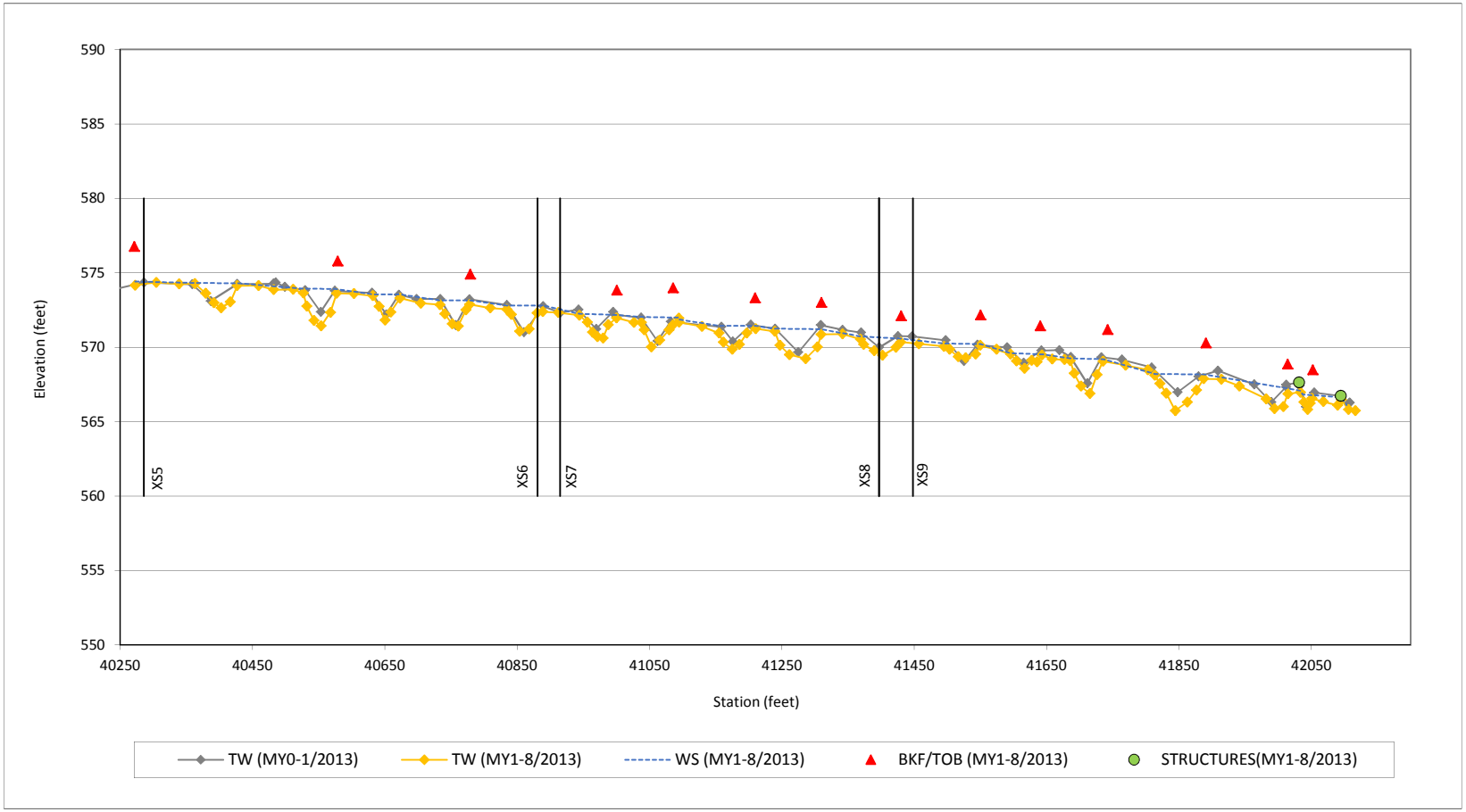


Table 12c. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3
Monitoring Year 1

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	15.9	19.7	22.6	35.6								
Floodprone Width (ft)	200+	200+	50+	200+								
Bankfull Mean Depth	1.2	1.6	0.8	1.5								
Bankfull Max Depth	1.8	2.3	2.3	2.5								
Bankfull Cross-sectional Area (ft^2)	19.0	30.5	27.0	34.5								
Width/Depth Ratio	12.7	13.5	14.8	44.2								
Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+								
Bank Height Ratio	1.0	1.0	1.0	1.0								
D50 (mm)												
Profile												
Riffle Length (ft)	12	103	29	100								
Riffle Slope (ft/ft)	0.0003	0.0169	0.0019	0.0129								
Pool Length (ft)	23	100	45	74								
Pool Max Depth (ft)	2.3	2.5	2.8	5.0								
Pool Spacing (ft)	53	166	50	151								
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	54	91										
Radius of Curvature (ft)	31	51										
Rc:Bankfull Width (ft/ft)	1.7	3.0										
Meander Wave Length (ft)	126	218										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C4		C4									
Channel Thalweg Length (ft)	2119.99		2119.99									
Sinuosity (ft)	1.2		1.2									
Water Surface Slope (ft/ft)	0.0041		0.0045									
Bankfull Slope (ft/ft)	0.0047		0.0047									
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.08/0.21/11/67.2/256/>2048		0.50/16.47/26/66.8/119.3/180									
% of Reach with Eroding Banks			0%									

Longitudinal Profile Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3
Monitoring Year 1



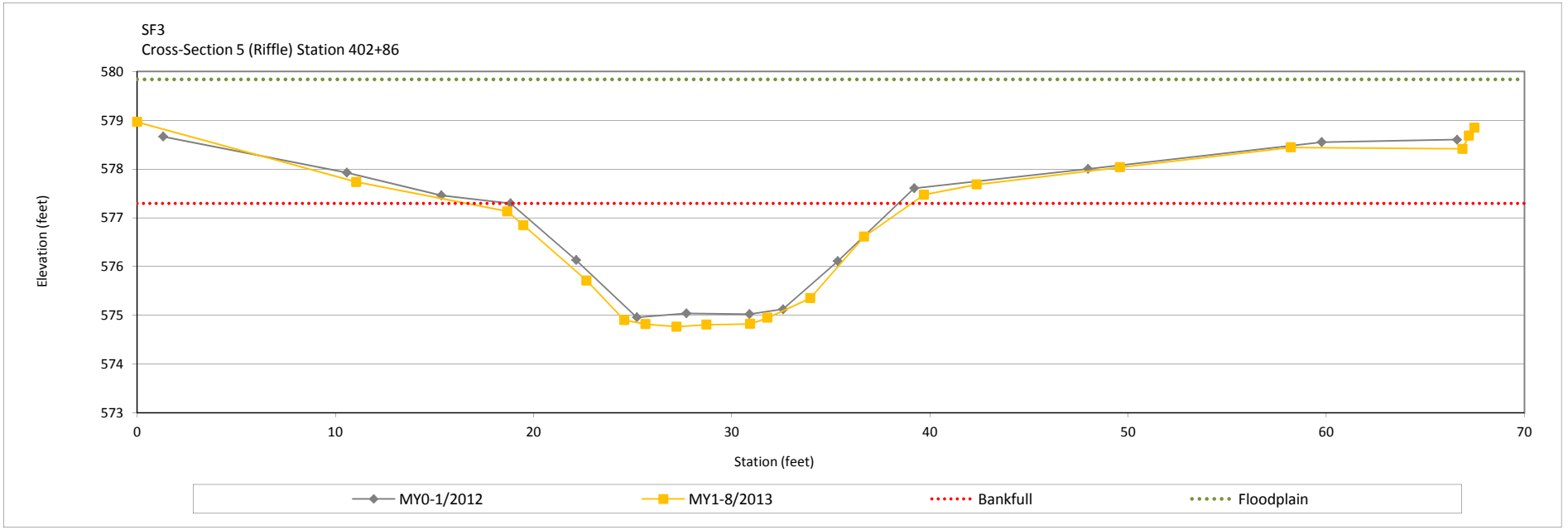
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3, Cross-Section 5 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	5
Drainage Area	1,056 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	576.8
Bankfull Cross-Sectional Area (ft2)	34.5
Bankfull Width (ft)	22.6
Flood Prone Area Elevation (ft)	579.3
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	2.5
Mean Depth at Bankfull (ft)	1.5
W/D Ratio	14.8
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C

Cross-Section 5: View Upstream

Cross-Section 5: View Downstream



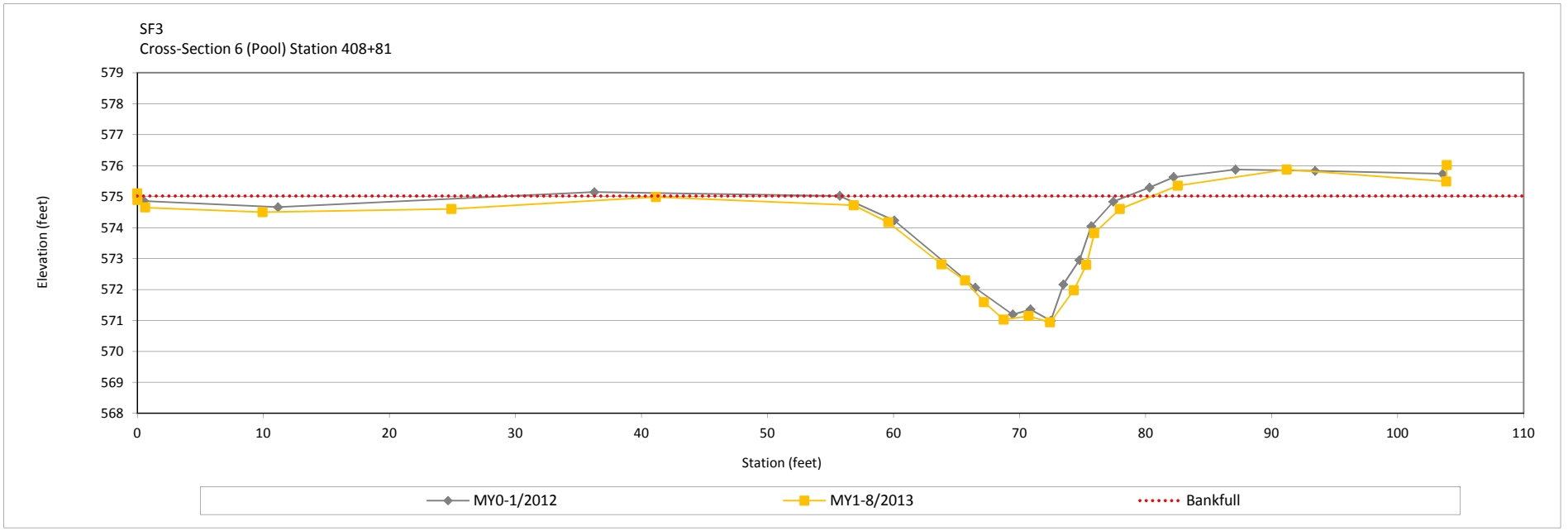
Harris Site; SF3, Cross-Section 6 (Pool)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	6
Drainage Area	1,056 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	575.0
Bankfull Cross-Sectional Area (ft2)	50.2
Bankfull Width (ft)	24.8
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	4.1
Mean Depth at Bankfull (ft)	2.0
W/D Ratio	12.1
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A

Cross-Section 6: View Upstream

Cross-Section 6: View Downstream



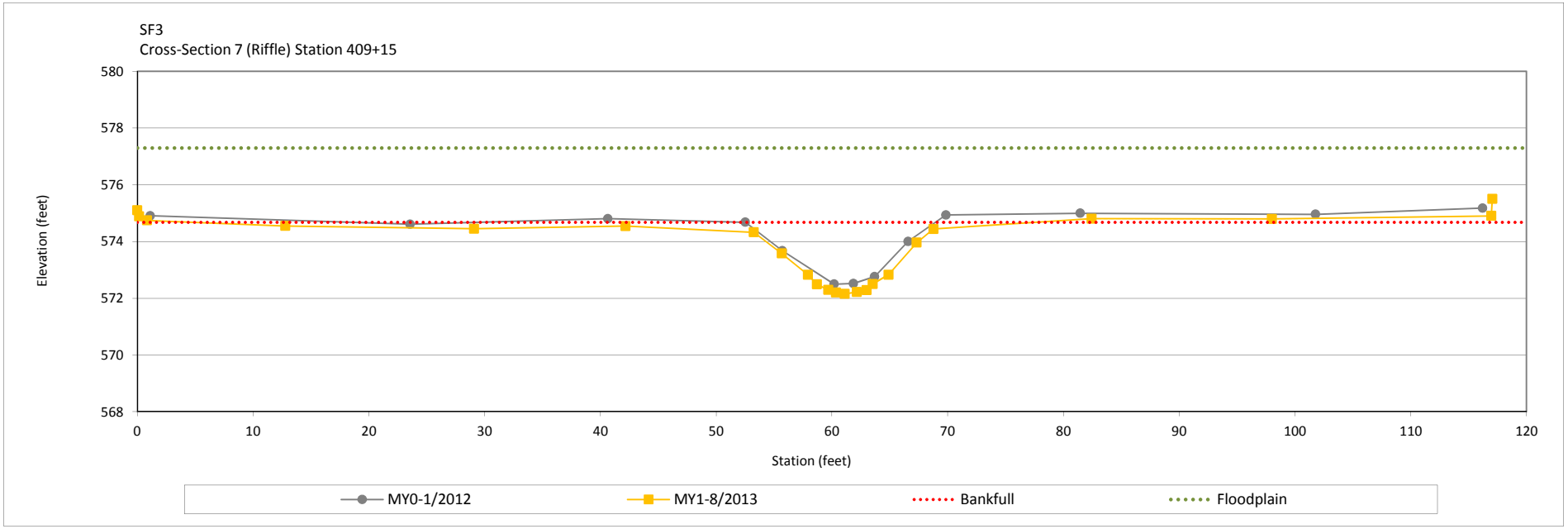
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3, Cross-Section 7 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	7
Drainage Area	1,056 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	574.7
Bankfull Cross-Sectional Area (ft2)	29.8
Bankfull Width (ft)	29.3
Flood Prone Area Elevation (ft)	577.3
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	2.6
Mean Depth at Bankfull (ft)	1.0
W/D Ratio	28.8
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C

Cross-Section 7: View Upstream

Cross-Section 7: View Downstream



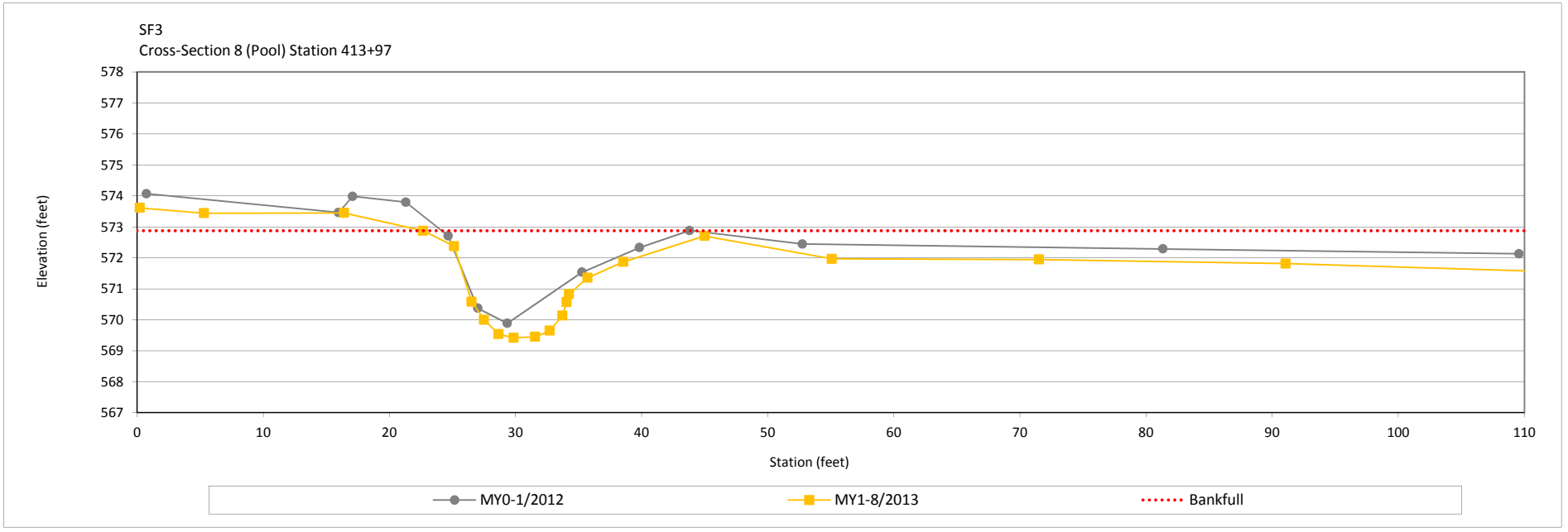
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3, Cross-Section 8 (Pool)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	8
Drainage Area	1,056 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	572.9
Bankfull Cross-Sectional Area (ft2)	36.9
Bankfull Width (ft)	22.3
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	3.5
Mean Depth at Bankfull (ft)	1.7
W/D Ratio	13.5
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A

Cross-Section 8: View Upstream

Cross-Section 8: View Downstream



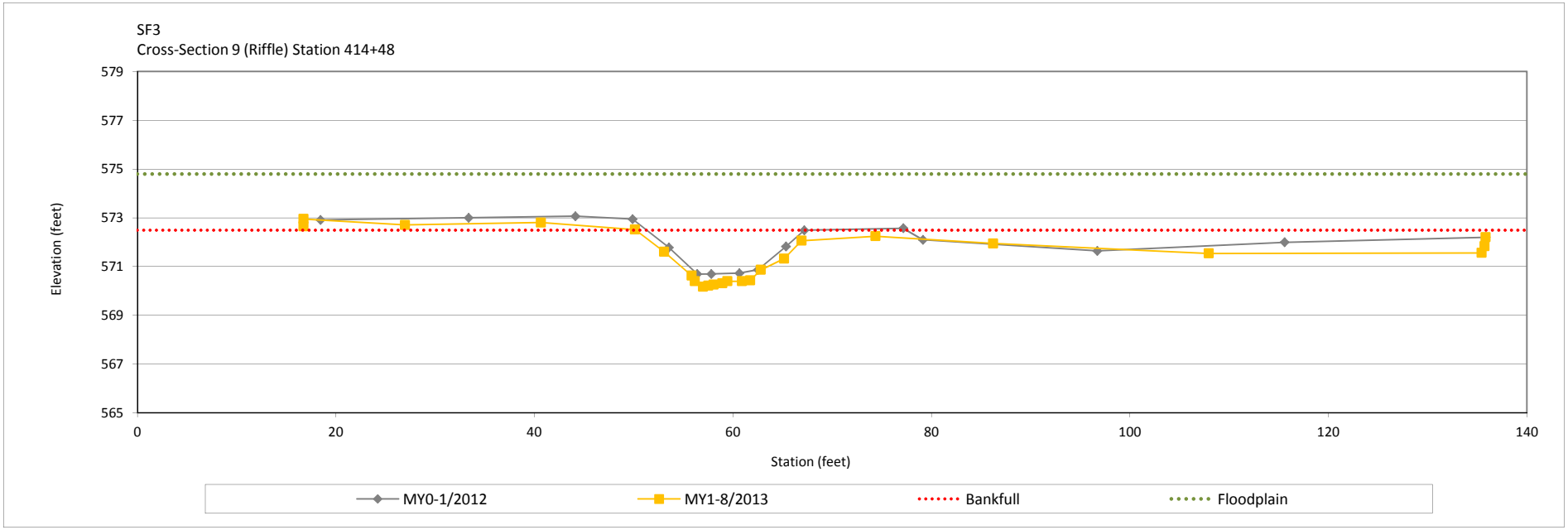
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3, Cross-Section 9 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	9
Drainage Area	1,056 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	572.5
Bankfull Cross-Sectional Area (ft2)	27.0
Bankfull Width (ft)	24.2
Flood Prone Area Elevation (ft)	574.8
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	2.3
Mean Depth at Bankfull (ft)	1.1
W/D Ratio	21.6
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C

Cross-Section 9: View Upstream

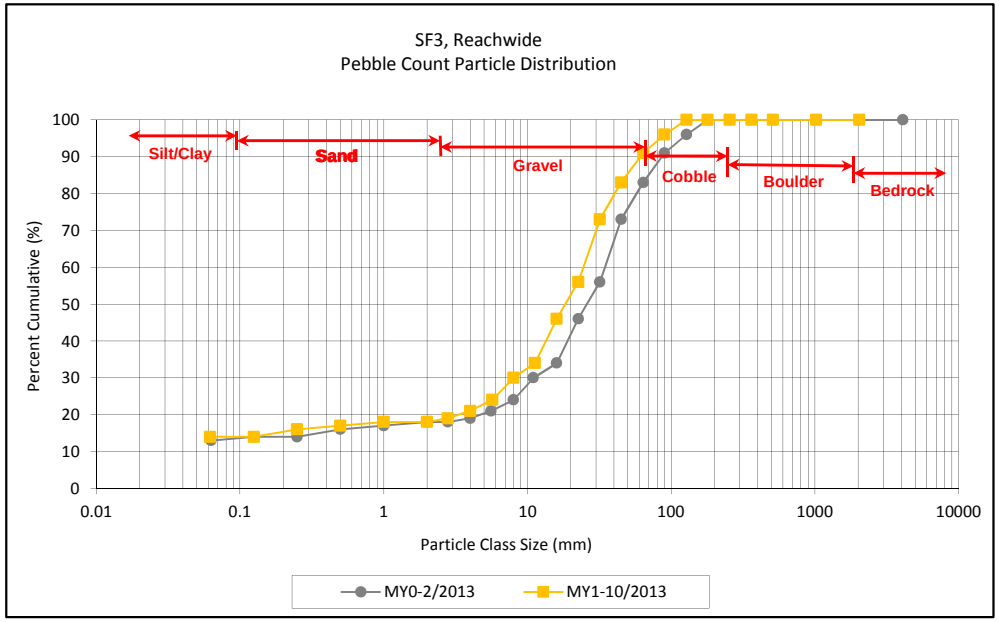
Cross-Section 9: View Downstream

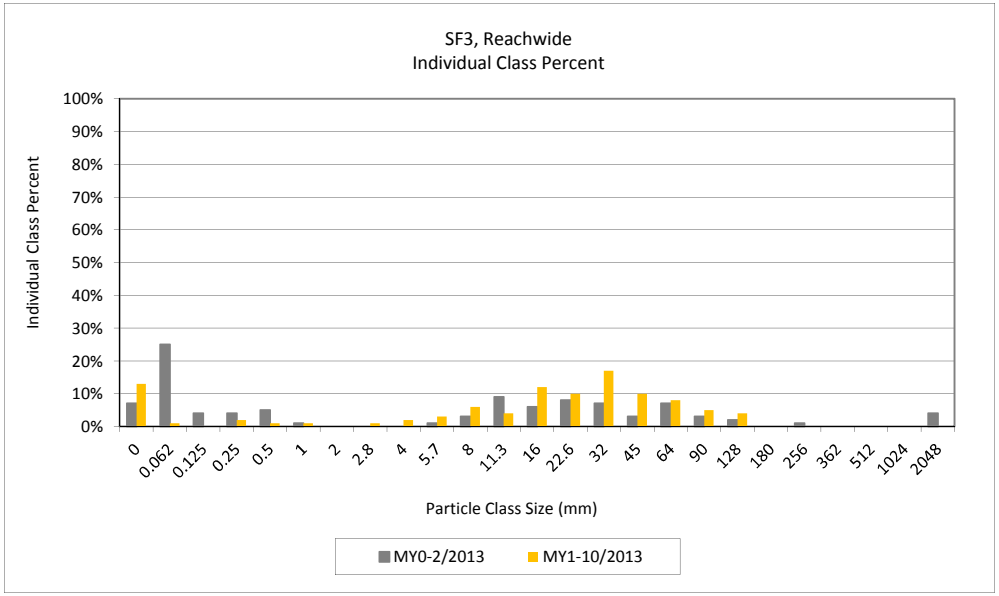


Reachwide and Cross-Section Pebble Count Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3, Reachwide
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count			SF3 Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		13	13	13	13
SAND	Very fine	0.062	0.125		1	1	1	14
	Fine	0.125	0.250					14
	Medium	0.250	0.500		2	2	2	16
	Coarse	0.5	1.0		1	1	1	17
	Very Coarse	1.0	2.0		1	1	1	18
GRAVEL	Very Fine	2.0	2.8					18
	Very Fine	2.8	4.0	1		1	1	19
	Fine	4.0	5.7	2		2	2	21
	Fine	5.7	8.0		3	3	3	24
	Medium	8.0	11.3	3	3	6	6	30
	Medium	11.3	16.0	2	2	4	4	34
	Coarse	16.0	22.6	9	3	12	12	46
	Coarse	22.6	32	5	5	10	10	56
	Very Coarse	32	45	6	11	17	17	73
	Very Coarse	45	64	8	2	10	10	83
COBBLE	Small	64	90	7	1	8	8	91
	Small	90	128	4	1	5	5	96
	Large	128	180	3	1	4	4	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.50
D_{35} =	16.47
D_{50} =	26.0
D_{84} =	66.8
D_{95} =	119.3
D_{100} =	180.0

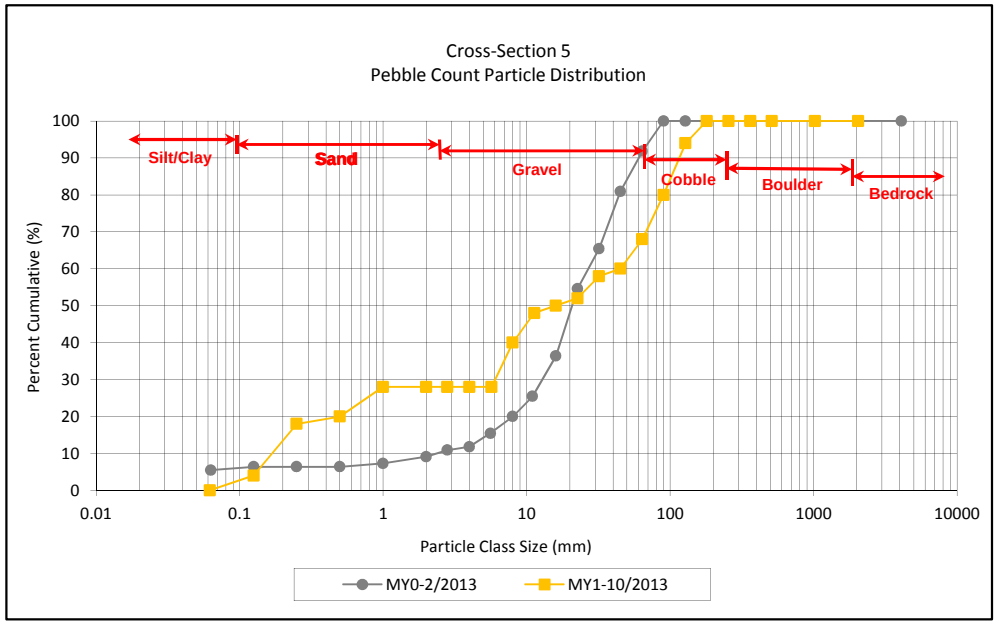


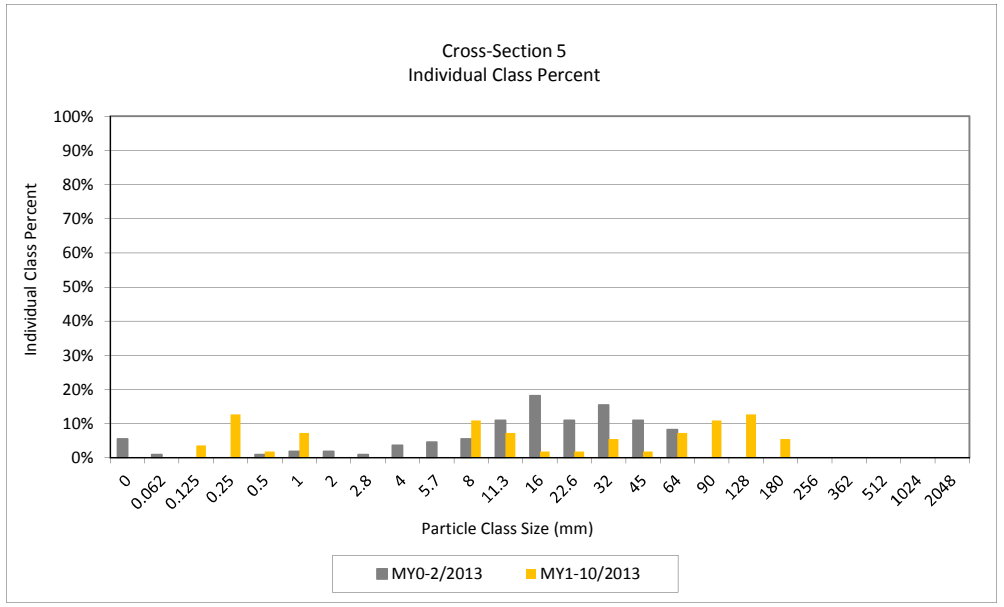


Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3, Cross-Section 5
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 5 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	4	4	4
	Medium	0.250	0.500	14	14	18
	Coarse	0.5	1.0	2	2	20
	Very Coarse	1.0	2.0	8	8	28
GRAVEL	Very Fine	2.0	2.8			28
	Very Fine	2.8	4.0			28
	Fine	4.0	5.7			28
	Fine	5.7	8.0			28
	Medium	8.0	11.3	12	12	40
	Medium	11.3	16.0	8	8	48
	Coarse	16.0	22.6	2	2	50
	Coarse	22.6	32	2	2	52
	Very Coarse	32	45	6	6	58
	Very Coarse	45	64	2	2	60
COBBLE	Small	64	90	8	8	68
	Small	90	128	12	12	80
	Large	128	180	14	14	94
	Large	180	256	6	6	100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross-Section 5	
Channel materials (mm)	
D_{16} =	0.5
D_{35} =	9.6
D_{50} =	22.6
D_{84} =	141.1
D_{95} =	190.9
D_{100} =	256.0

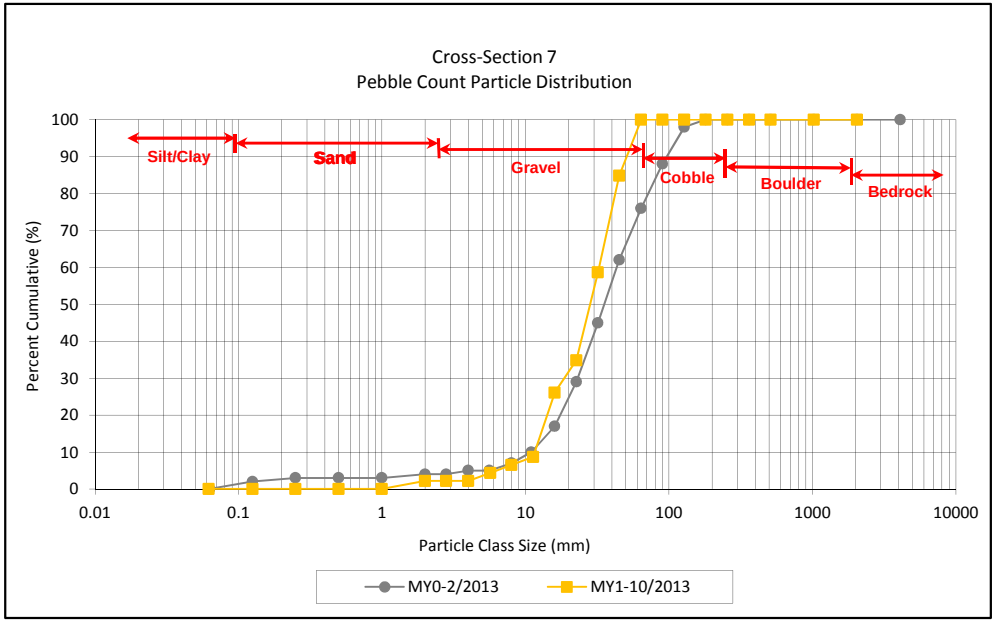


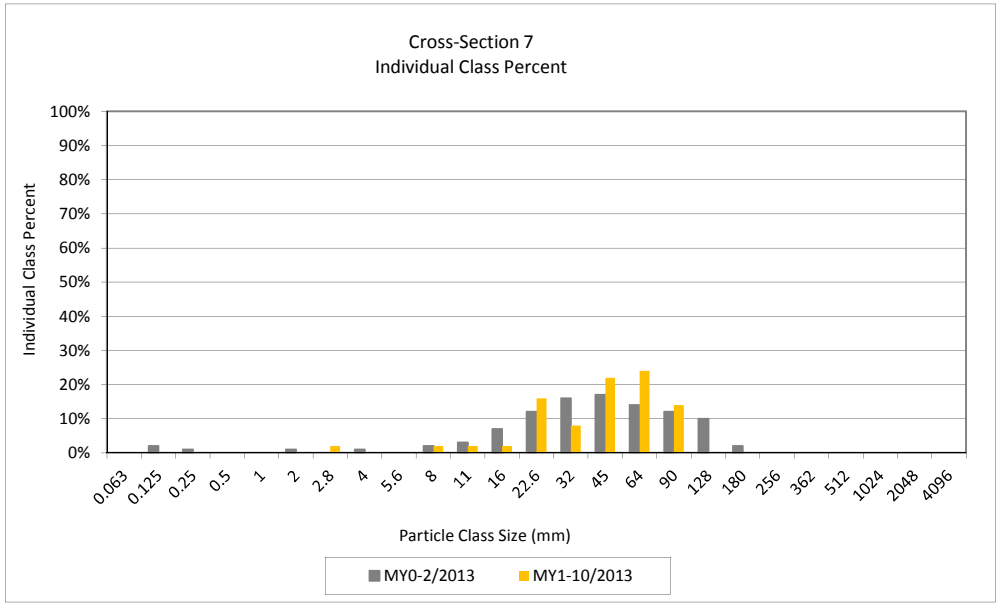


Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3, Cross-Section 7
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 7 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.250	0.500			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8	2	2	2
	Very Fine	2.8	4.0			2
	Fine	4.0	5.7			2
	Fine	5.7	8.0	2	2	4
	Medium	8.0	11.3	2	2	7
	Medium	11.3	16.0	2	2	9
	Coarse	16.0	22.6	16	17	26
	Coarse	22.6	32	8	9	35
	Very Coarse	32	45	22	24	59
	Very Coarse	45	64	24	26	85
COBBLE	Small	64	90	14	15	100
	Small	90	128			100
	Large	128	180			100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**92**	**100**	**100**

Cross-Section 7	
Channel materials (mm)	
D_{16} =	18.5
D_{35} =	32.1
D_{50} =	39.8
D_{84} =	63.3
D_{95} =	80.5
D_{100} =	90.0

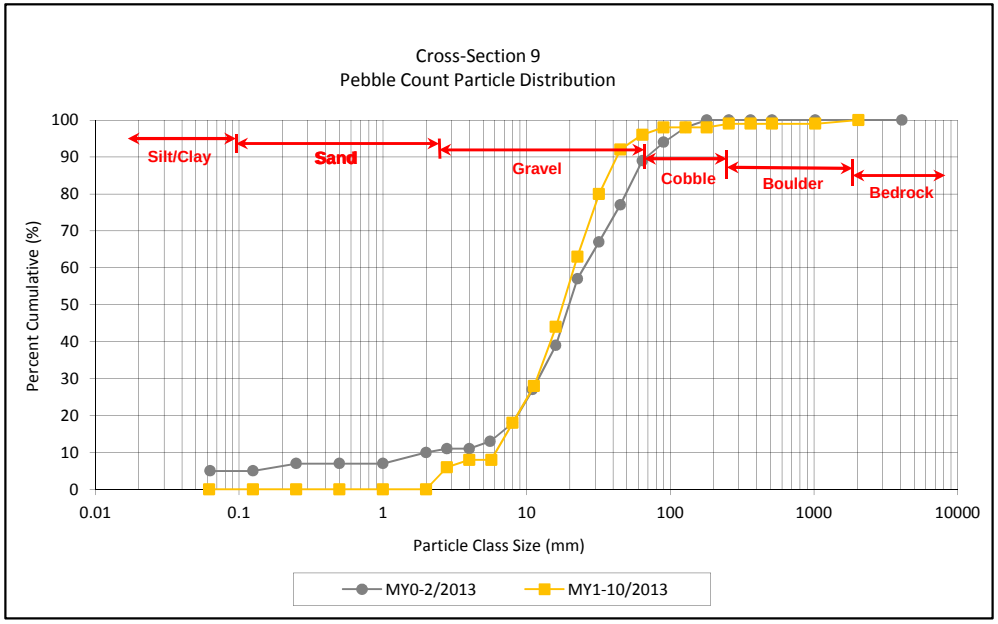




Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; SF3, Cross-Section 9
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 9 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.250	0.500			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8			0
	Very Fine	2.8	4.0	6	6	6
	Fine	4.0	5.7	2	2	8
	Fine	5.7	8.0			8
	Medium	8.0	11.3	10	10	18
	Medium	11.3	16.0	10	10	28
	Coarse	16.0	22.6	16	16	44
	Coarse	22.6	32	19	19	63
	Very Coarse	32	45	17	17	80
	Very Coarse	45	64	12	12	92
COBBLE	Small	64	90	4	4	96
	Small	90	128	2	2	98
	Large	128	180			98
	Large	180	256			98
BOULDER	Small	256	362	1	1	99
	Small	362	512			99
	Medium	512	1024			99
	Large/Very Large	1024	2048			99
BEDROCK	Bedrock	2048	>2048	1	1	100
			Total	100	100	100

Cross-Section 9	
Channel materials (mm)	
D_{16} =	10.3
D_{35} =	18.6
D_{50} =	25.2
D_{84} =	50.6
D_{95} =	82.6
D_{100} =	>2048



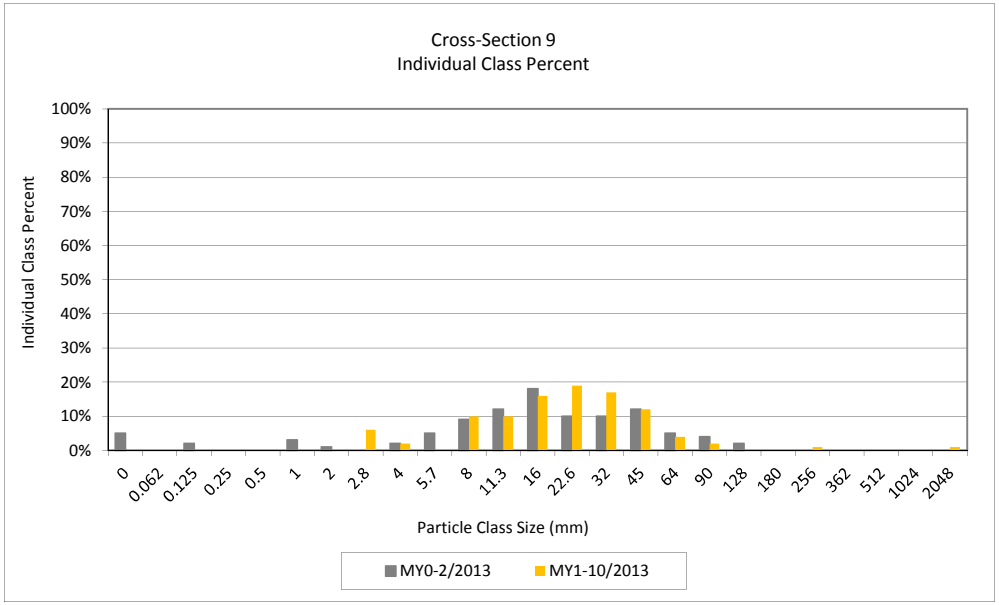
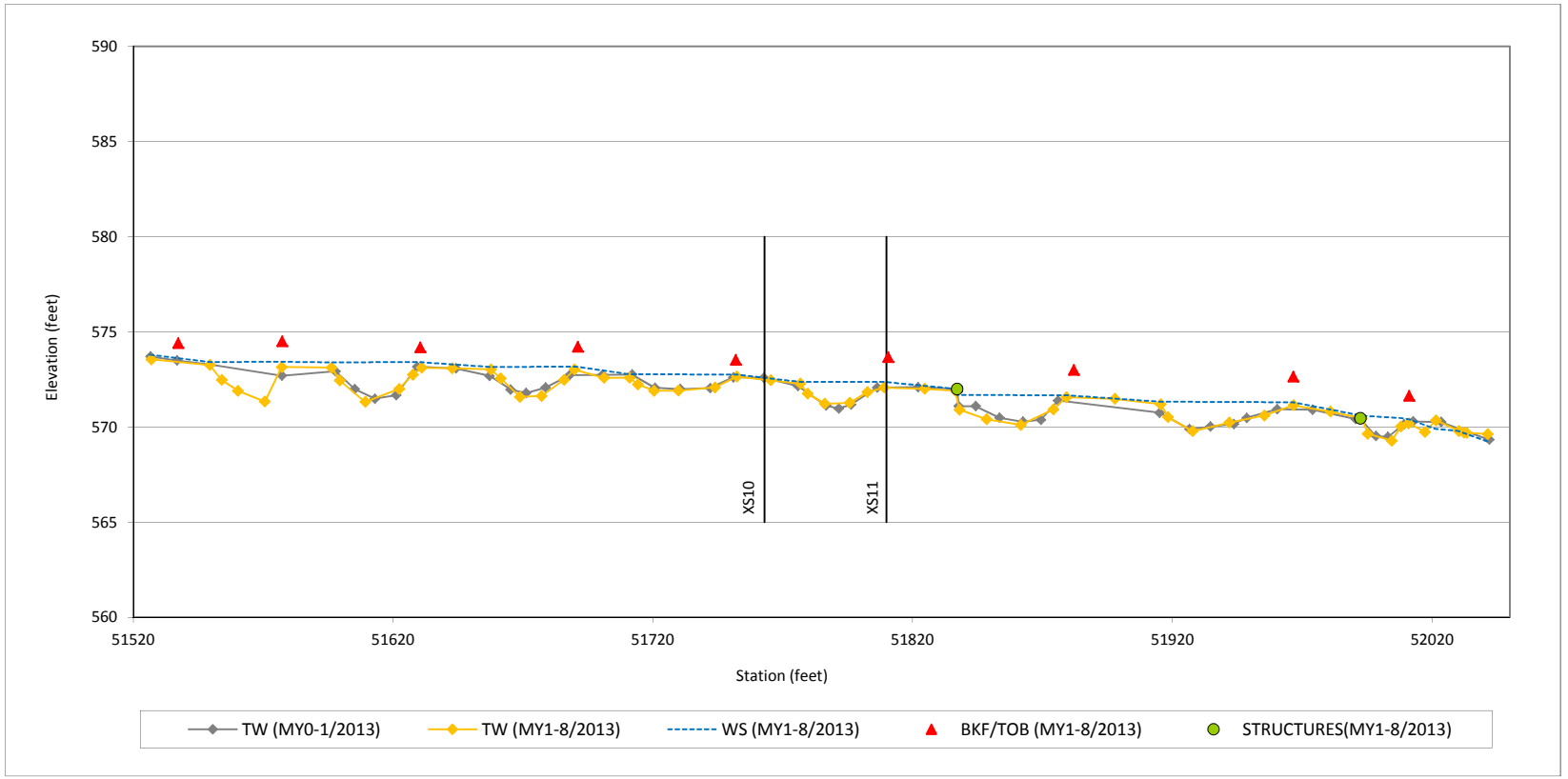


Table 12d. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT1
Monitoring Year 1

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	12.7		10.1									
Floodprone Width (ft)	100+		100+									
Bankfull Mean Depth	0.8		1.5									
Bankfull Max Depth	1.5		2.1									
Bankfull Cross-sectional Area (ft^2)	10.5		14.9									
Width/Depth Ratio	15.1		6.8									
Entrenchment Ratio	2.2+		2.2+									
Bank Height Ratio	1.0		1.0									
D50 (mm)												
Profile												
Riffle Length (ft)	11	39	19	36								
Riffle Slope (ft/ft)	0.0023	0.0185	0.0016	0.0258								
Pool Length (ft)	20	80	18	51								
Pool Max Depth (ft)	3.1		2.8									
Pool Spacing (ft)	58	76	39	76								
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	32	54										
Radius of Curvature (ft)	21	30										
Rc:Bankfull Width (ft/ft)	2.0	2.8										
Meander Wave Length (ft)	75	129										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C5		C5									
Channel Thalweg Length (ft)	2038.2		2038.2									
Sinuosity (ft)	1.2		1.2									
Water Surface Slope (ft/ft)	0.0075		0.0078									
Bankfull Slope (ft/ft)	0.0083		0.0058									
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.07/0.16/0.3/26.9/71.7/256		SC/1.15/11/67.2/87.8/180									
% of Reach with Eroding Banks			0%									

Longitudinal Profile Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT1
Monitoring Year 1



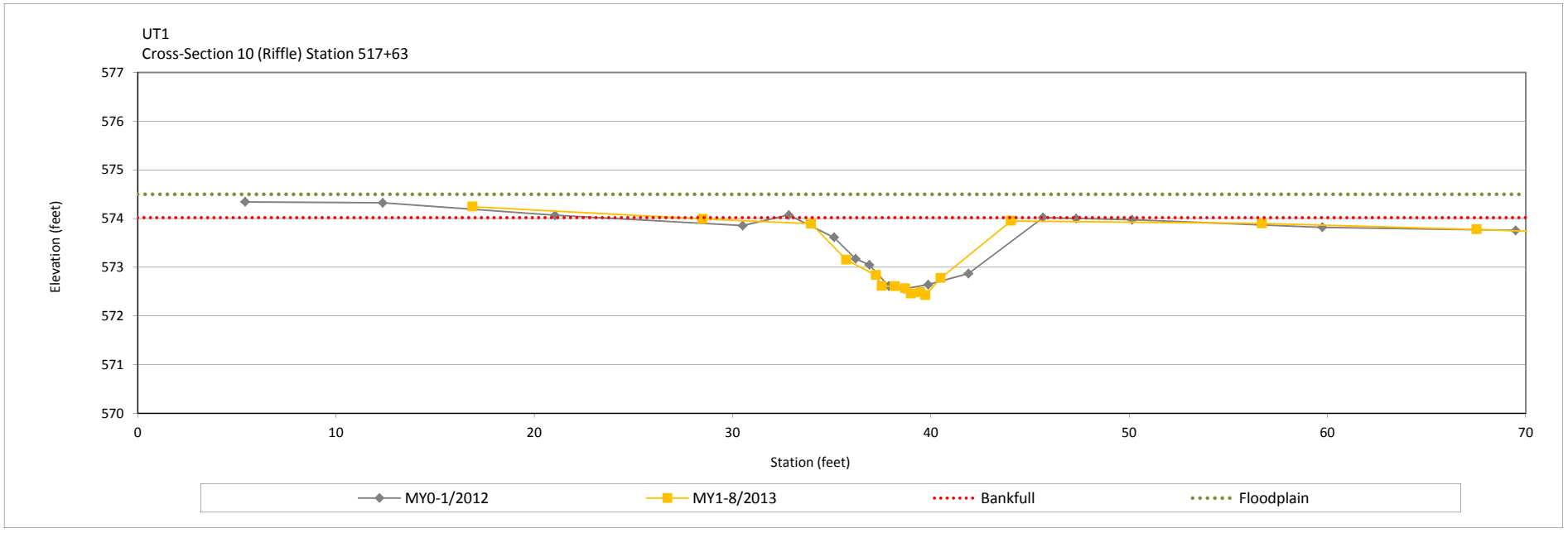
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT1, Cross-Section 10 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	10
Drainage Area	230 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	574.0
Bankfull Cross-Sectional Area (ft2)	1.2
Bankfull Width (ft)	4.1
Flood Prone Area Elevation (ft)	574.5
Flood Prone Width (ft)	100+
Max Depth at Bankfull (ft)	0.5
Mean Depth at Bankfull (ft)	0.3
W/D Ratio	14.2
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C

Cross-Section 10: View Upstream

Cross-Section 10: View Downstream



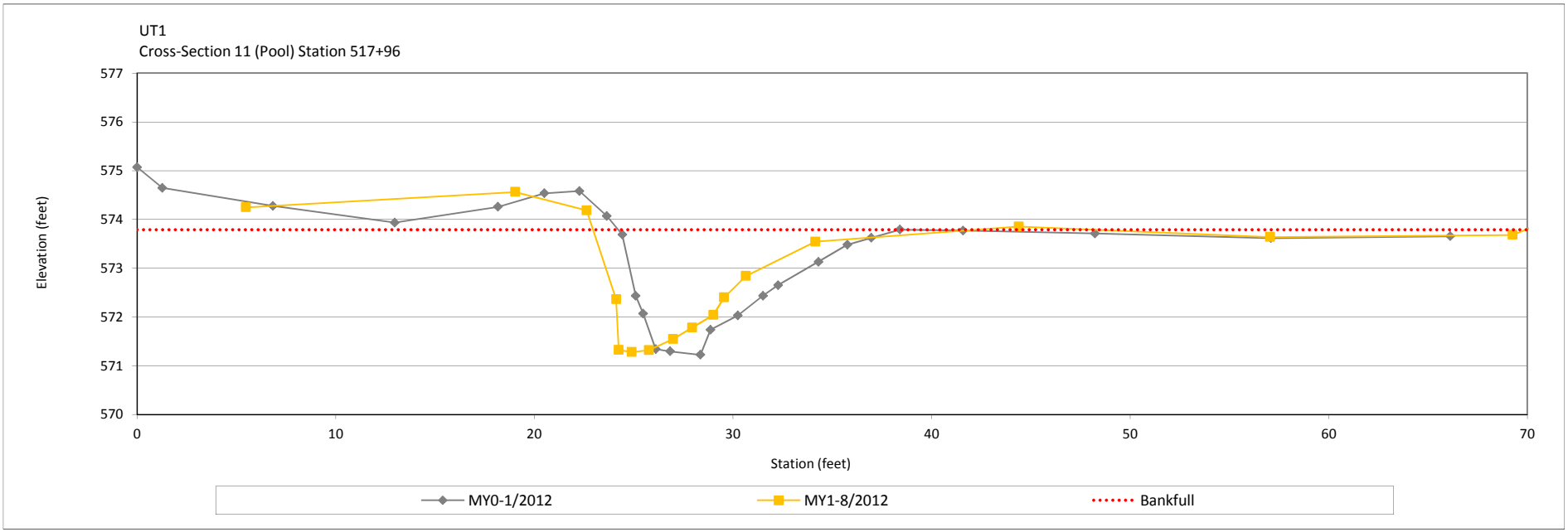
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT1, Cross-Section 11 (Pool)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	11
Drainage Area	230 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	573.8
Bankfull Cross-Sectional Area (ft2)	18.3
Bankfull Width (ft)	9.4
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	3.1
Mean Depth at Bankfull (ft)	2.0
W/D Ratio	4.8
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A

Cross-Section 11: View Upstream

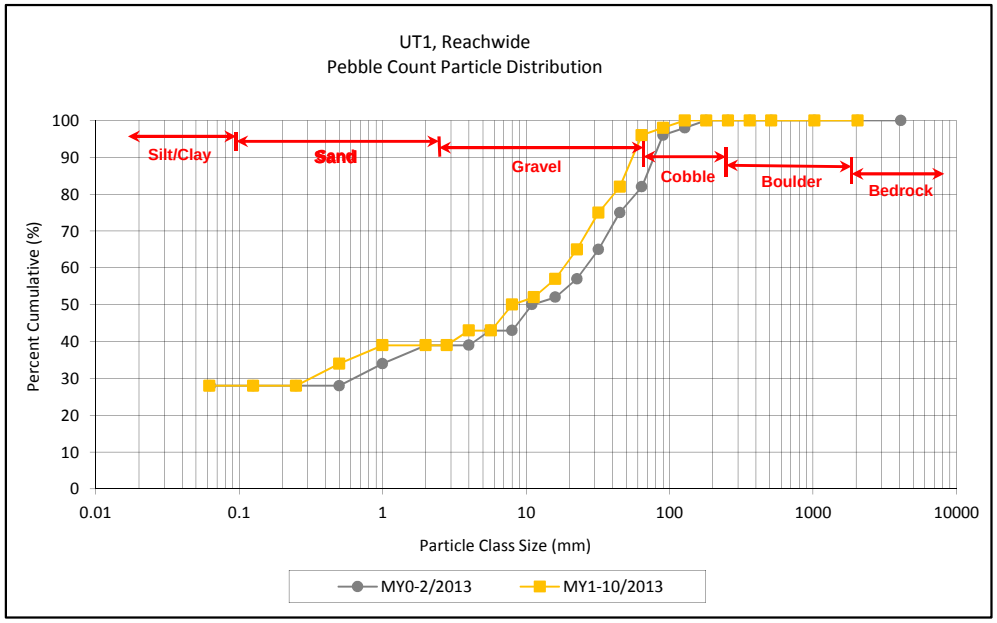
Cross-Section 11: View Downstream

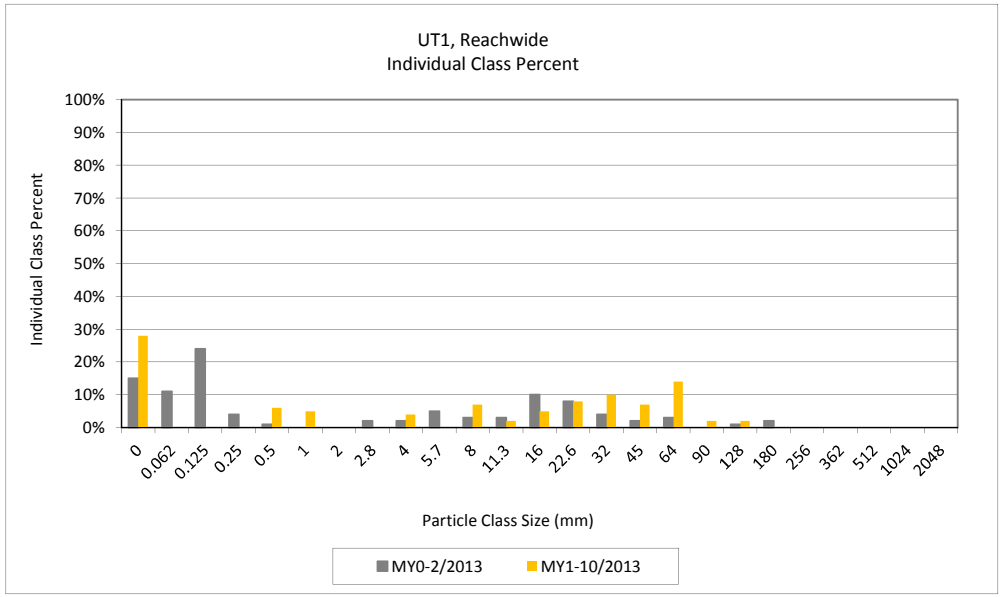


Reachwide and Cross-Section Pebble Count Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT1, Reachwide
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count			UT1 Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		28	28	28	28
SAND	Very fine	0.062	0.125					28
	Fine	0.125	0.250					28
	Medium	0.250	0.500					28
	Coarse	0.5	1.0		6	6	6	34
	Very Coarse	1.0	2.0		5	5	5	39
GRAVEL	Very Fine	2.0	2.8					39
	Very Fine	2.8	4.0					39
	Fine	4.0	5.7	4		4	4	43
	Fine	5.7	8.0					43
	Medium	8.0	11.3	4	3	7	7	50
	Medium	11.3	16.0	2		2	2	52
	Coarse	16.0	22.6	2	3	5	5	57
	Coarse	22.6	32	4	4	8	8	65
	Very Coarse	32	45	10		10	10	75
	Very Coarse	45	64	6	1	7	7	82
COBBLE	Small	64	90	14		14	14	96
	Small	90	128	2		2	2	98
	Large	128	180	2		2	2	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	1.15
D_{50} =	11.0
D_{84} =	67.2
D_{95} =	87.8
D_{100} =	180.0

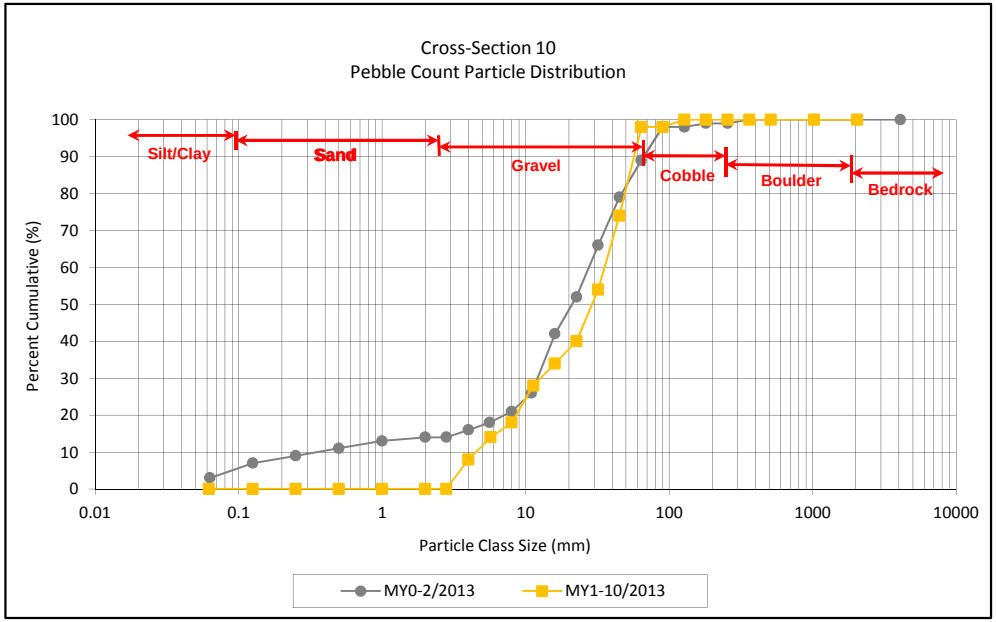




Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Harris Site; UT1, Cross-Section 10
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 10 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.250	0.500			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8			0
	Very Fine	2.8	4.0			0
	Fine	4.0	5.7	4	8	8
	Fine	5.7	8.0	3	6	14
	Medium	8.0	11.3	2	4	18
	Medium	11.3	16.0	5	10	28
	Coarse	16.0	22.6	3	6	34
	Coarse	22.6	32	3	6	40
	Very Coarse	32	45	7	14	54
	Very Coarse	45	64	10	20	74
COBBLE	Small	64	90	12	24	98
	Small	90	128			98
	Large	128	180	1	2	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	50	100	100

Cross-Section 10	
Channel materials (mm)	
D_{16} =	9.4
D_{35} =	23.9
D_{50} =	40.8
D_{84} =	73.8
D_{95} =	86.2
D_{100} =	180.0



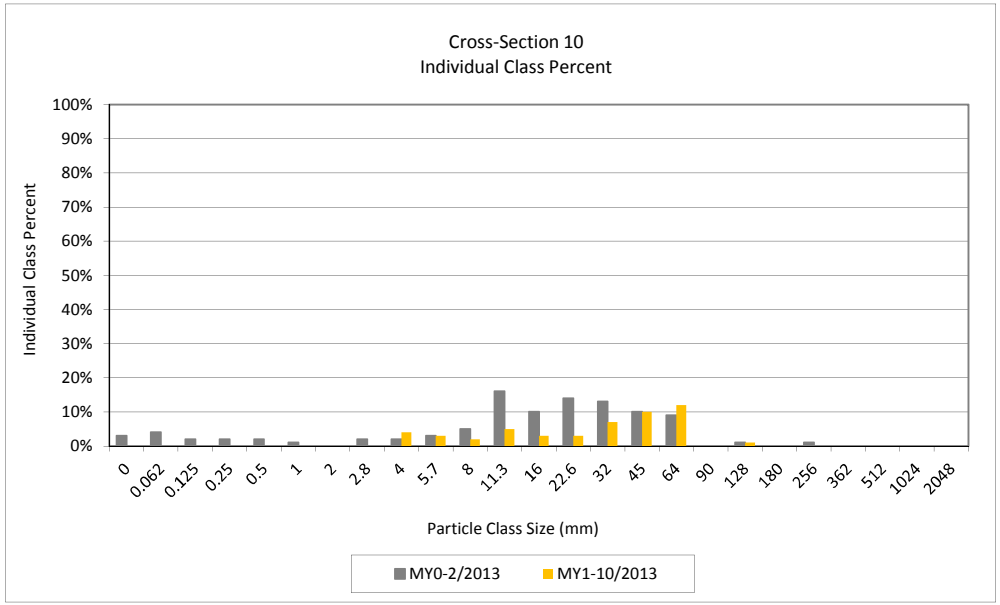
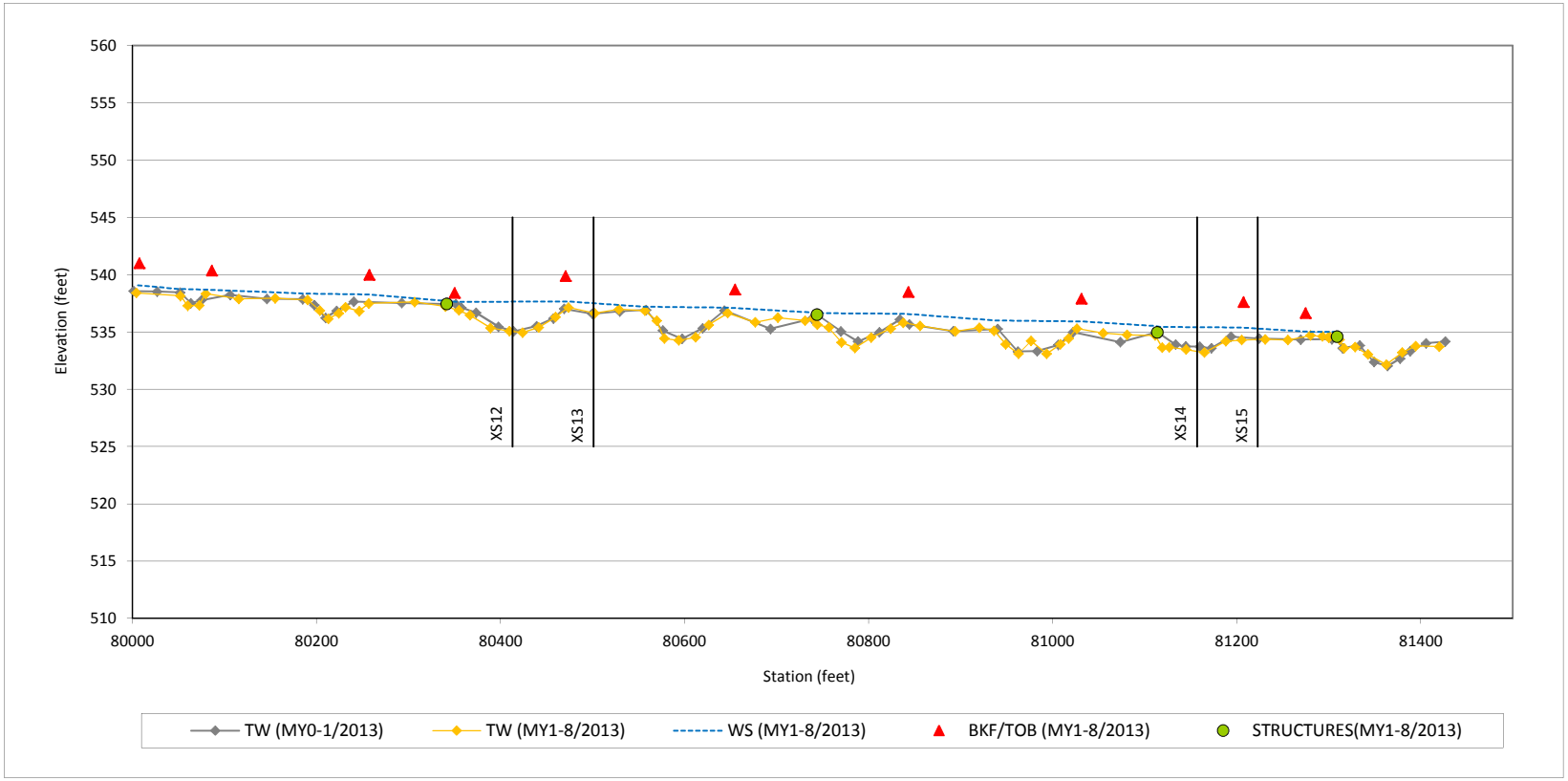


Table 12e. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4
Monitoring Year 1

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	27.3	27.6	26.7	27.3								
Floodprone Width (ft)	200+	200+	200+	200+								
Bankfull Mean Depth	1.8	1.9	2.0	2.9								
Bankfull Max Depth	3.0	3.2	2.9	3.0								
Bankfull Cross-sectional Area (ft^2)	49.5	51.2	49.0	53.8								
Width/Depth Ratio	14.9	15.1	13.8	14.6								
Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+								
Bank Height Ratio	1.0	1.0	1.0	1.0								
D50 (mm)												
Profile												
Riffle Length (ft)	51	112	31	111								
Riffle Slope (ft/ft)	0.0010	0.0098	0.0034	0.0119								
Pool Length (ft)	54	123	27	169								
Pool Max Depth (ft)	2.9	3.0	3.1	5.2								
Pool Spacing (ft)	146	210	151	211								
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	82	136										
Radius of Curvature (ft)	46	76										
Rc:Bankfull Width (ft/ft)	1.7	2.8										
Meander Wave Length (ft)	191	327										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C4		C4									
Channel Thalweg Length (ft)	1428.75		1428.75									
Sinuosity (ft)	1.2		1.2									
Water Surface Slope (ft/ft)	0.0033		0.0031									
Bankfull Slope (ft/ft)	0.0034		0.0034									
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.13/0.36/5.3/102.5/320.7/>2048		SC/0.25/5.1/72.7/139.4/256									
% of Reach with Eroding Banks			0%									

Longitudinal Profile Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4
Monitoring Year 1



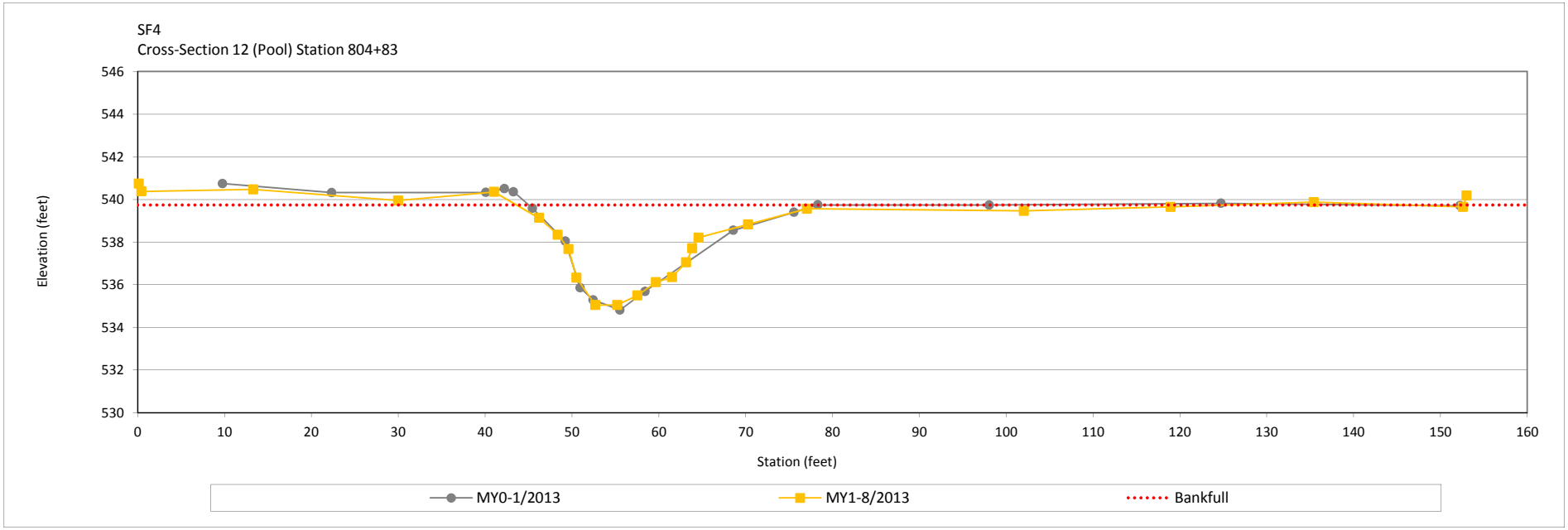
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4, Cross-Section 12 (Pool)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	12
Drainage Area	3,362 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	539.7
Bankfull Cross-Sectional Area (ft2)	72.2
Bankfull Width (ft)	34.1
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	4.7
Mean Depth at Bankfull (ft)	2.1
W/D Ratio	16.2
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A

Cross-Section 12: View Upstream

Cross-Section 12: View Downstream



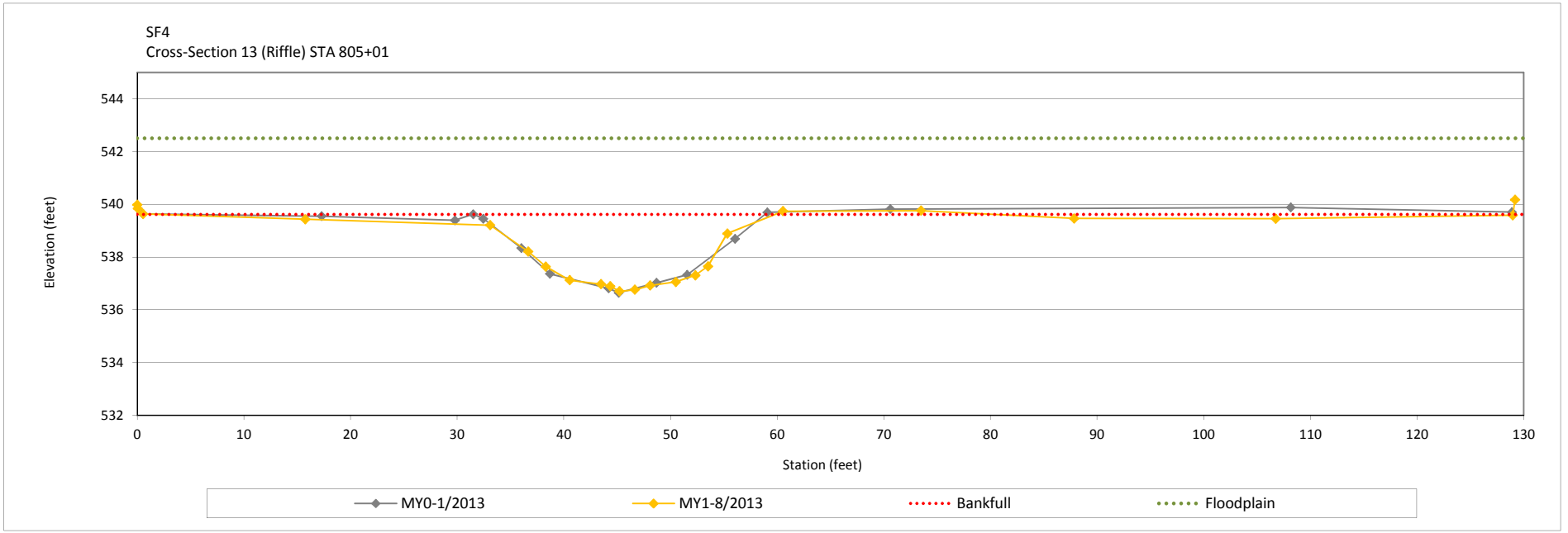
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4, Cross-Section 13 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	13
Drainage Area	3,362 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	539.6
Bankfull Cross-Sectional Area (ft2)	49.0
Bankfull Width (ft)	26.7
Flood Prone Area Elevation (ft)	542.5
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	2.92
Mean Depth at Bankfull (ft)	2.92
W/D Ratio	14.6
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C

Cross-Section 13: View Upstream

Cross-Section 13: View Downstream



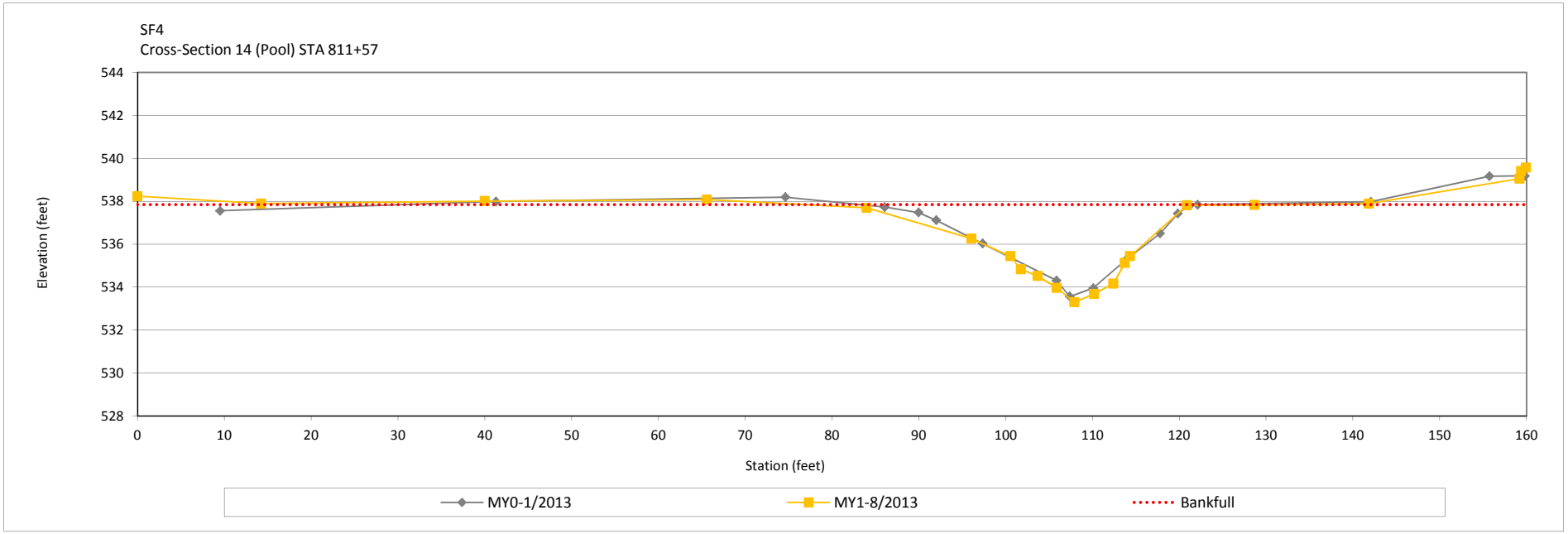
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4, Cross-Section 14 (Pool)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	14
Drainage Area	3,362 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	537.8
Bankfull Cross-Sectional Area (ft2)	78.1
Bankfull Width (ft)	44.4
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	4.6
Mean Depth at Bankfull (ft)	1.8
W/D Ratio	25.3
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A

Cross-Section 14: View Upstream

Cross-Section 14: View Downstream



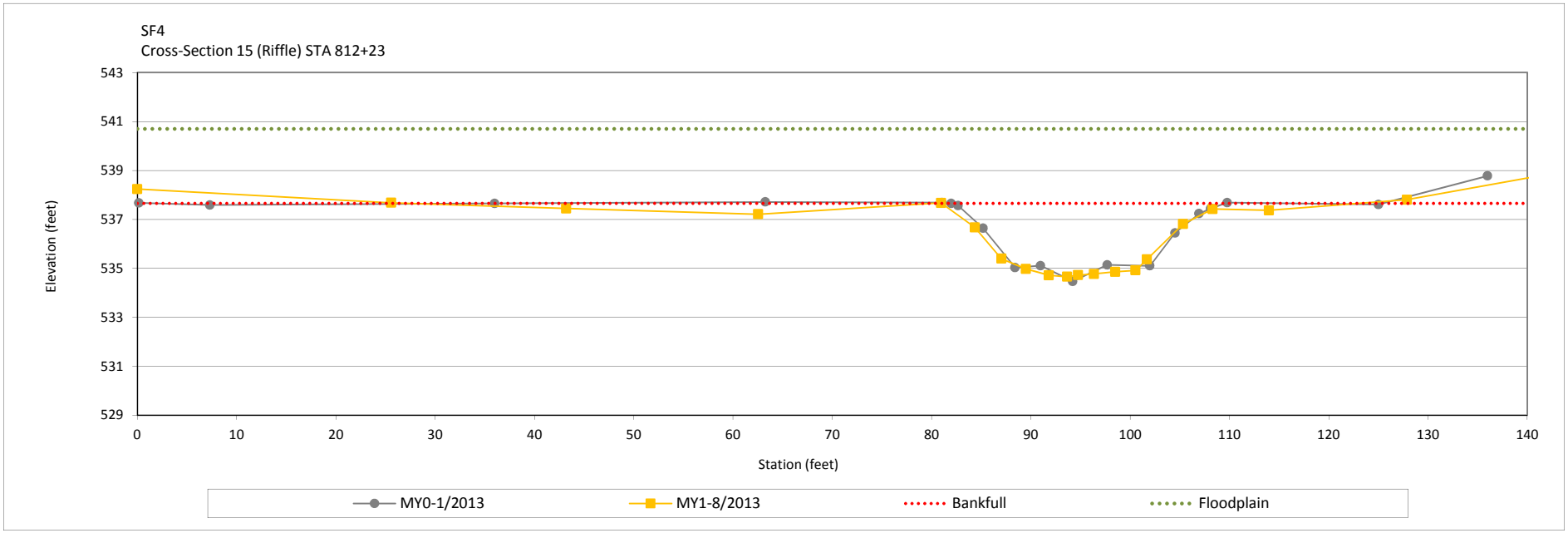
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4, Cross-Section 15 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	15
Drainage Area	3,362 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	537.7
Bankfull Cross-Sectional Area (ft2)	53.8
Bankfull Width (ft)	27.3
Flood Prone Area Elevation (ft)	540.7
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	3.0
Mean Depth at Bankfull (ft)	2.0
W/D Ratio	13.8
Entrenchment Ratio	2.2+
Bank Height Ratio	0.9
Stream Type	C

Cross-Section 15: View Upstream

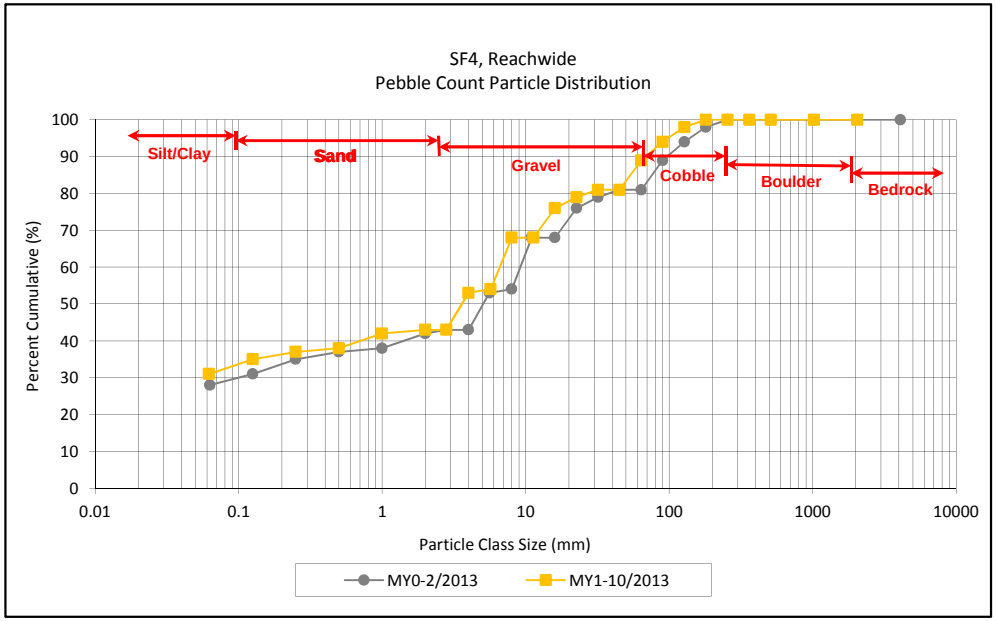
Cross-Section 15: View Downstream

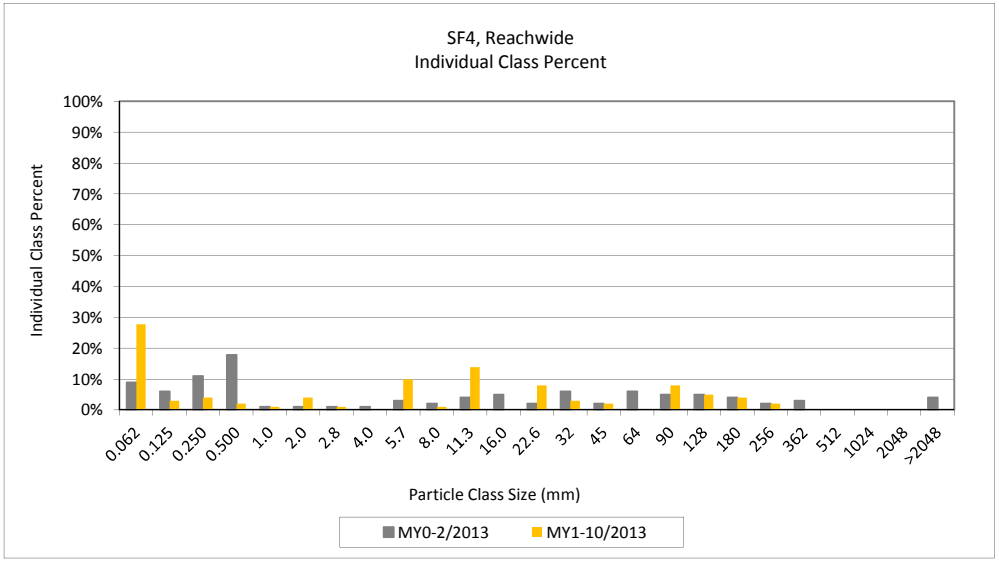


Reachwide and Cross-Section Pebble Count Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4, Reachwide
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count			SF4 Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	27	28	28	28
SAND	Very fine	0.062	0.125	1	2	3	3	31
	Fine	0.125	0.250	2	2	4	4	35
	Medium	0.250	0.500		2	2	2	37
	Coarse	0.5	1.0		1	1	1	38
	Very Coarse	1.0	2.0	2	2	4	4	42
GRAVEL	Very Fine	2.0	2.8	1		1	1	43
	Very Fine	2.8	4.0					43
	Fine	4.0	5.7	8	2	10	10	53
	Fine	5.7	8.0		1	1	1	54
	Medium	8.0	11.3	7	7	14	14	68
	Medium	11.3	16.0					68
	Coarse	16.0	22.6	6	2	8	8	76
	Coarse	22.6	32	1	2	3	3	79
	Very Coarse	32	45	2		2	2	81
	Very Coarse	45	64					81
COBBLE	Small	64	90	8		8	8	89
	Small	90	128	5		5	5	94
	Large	128	180	4		4	4	98
	Large	180	256	2		2	2	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	50	50	100	100	100

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.25
D_{50} =	5.1
D_{84} =	72.7
D_{95} =	139.4
D_{100} =	256.0

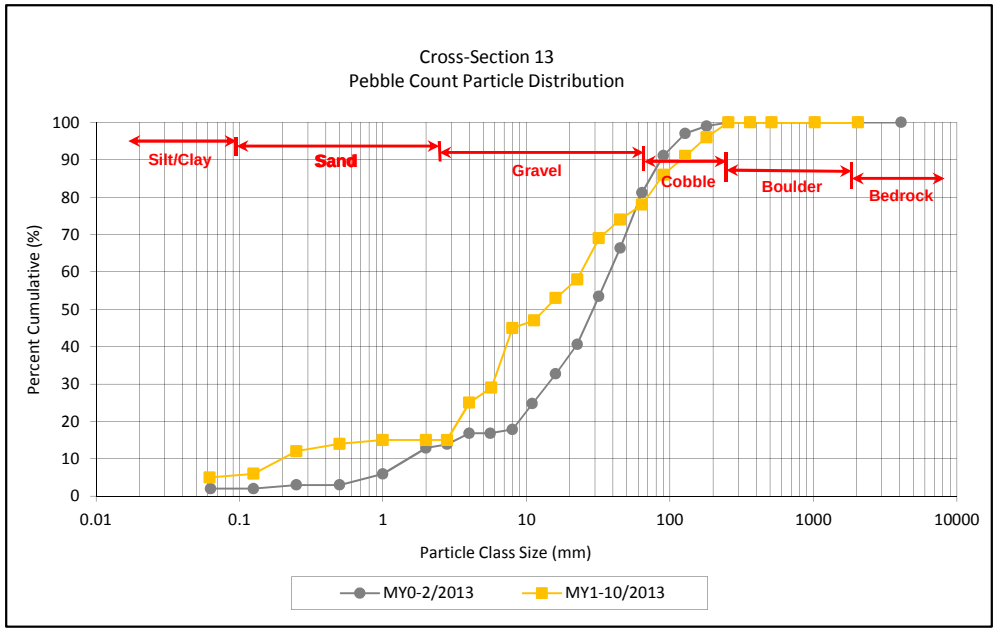


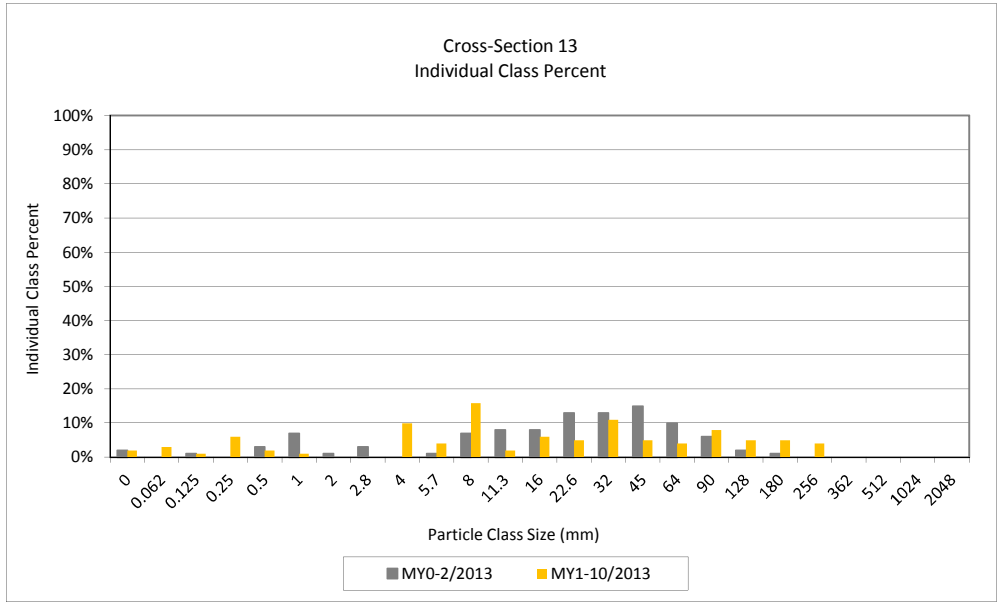


Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4, Cross-Section 13
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 13 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	2	2
SAND	Very fine	0.062	0.125	3	3	5
	Fine	0.125	0.250	1	1	6
	Medium	0.250	0.500	6	6	12
	Coarse	0.5	1.0	2	2	14
	Very Coarse	1.0	2.0	1	1	15
GRAVEL	Very Fine	2.0	2.8			15
	Very Fine	2.8	4.0			15
	Fine	4.0	5.7	10	10	25
	Fine	5.7	8.0	4	4	29
	Medium	8.0	11.3	16	16	45
	Medium	11.3	16.0	2	2	47
	Coarse	16.0	22.6	6	6	53
	Coarse	22.6	32	5	5	58
	Very Coarse	32	45	11	11	69
	Very Coarse	45	64	5	5	74
COBBLE	Small	64	90	4	4	78
	Small	90	128	8	8	86
	Large	128	180	5	5	91
	Large	180	256	5	5	96
BOULDER	Small	256	362	4	4	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 13	
Channel materials (mm)	
D_{16} =	4.1
D_{35} =	9.0
D_{50} =	19.0
D_{84} =	117.2
D_{95} =	238.6
D_{100} =	362.0

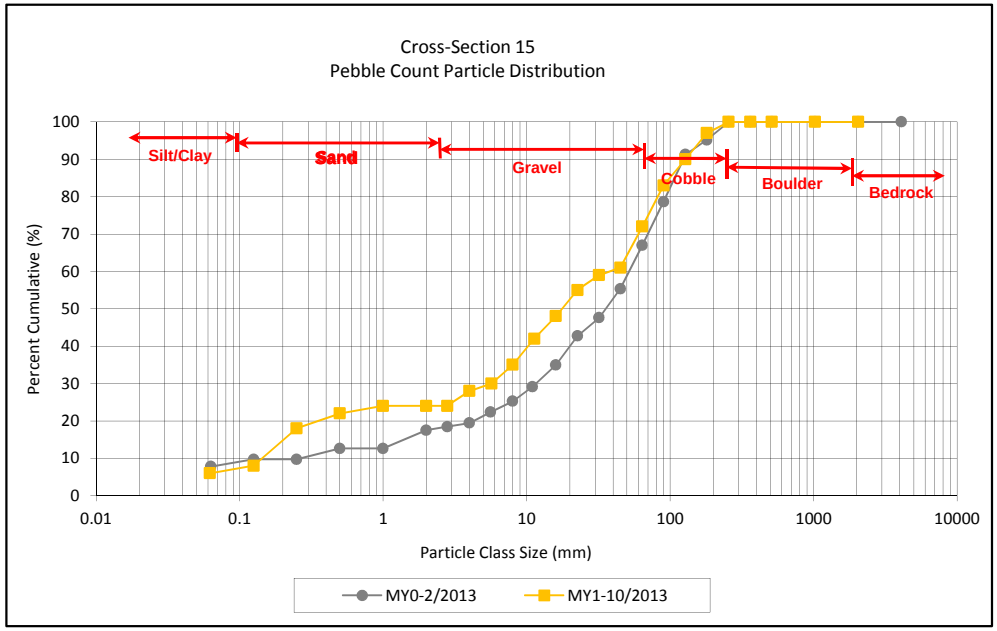




Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4, Cross-Section 15
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 15 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	4	4
SAND	Very fine	0.062	0.125	2	2	6
	Fine	0.125	0.250	2	2	8
	Medium	0.250	0.500	10	10	18
	Coarse	0.5	1.0	4	4	22
	Very Coarse	1.0	2.0	2	2	24
GRAVEL	Very Fine	2.0	2.8			24
	Very Fine	2.8	4.0			24
	Fine	4.0	5.7	4	4	28
	Fine	5.7	8.0	2	2	30
	Medium	8.0	11.3	5	5	35
	Medium	11.3	16.0	7	7	42
	Coarse	16.0	22.6	6	6	48
	Coarse	22.6	32	7	7	55
	Very Coarse	32	45	4	4	59
	Very Coarse	45	64	2	2	61
COBBLE	Small	64	90	11	11	72
	Small	90	128	11	11	83
	Large	128	180	7	7	90
	Large	180	256	7	7	97
BOULDER	Small	256	362	3	3	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross-Section 15	
Channel materials (mm)	
D_{16} =	0.4
D_{35} =	11.0
D_{50} =	25.0
D_{84} =	134.4
D_{95} =	231.5
D_{100} =	362.0



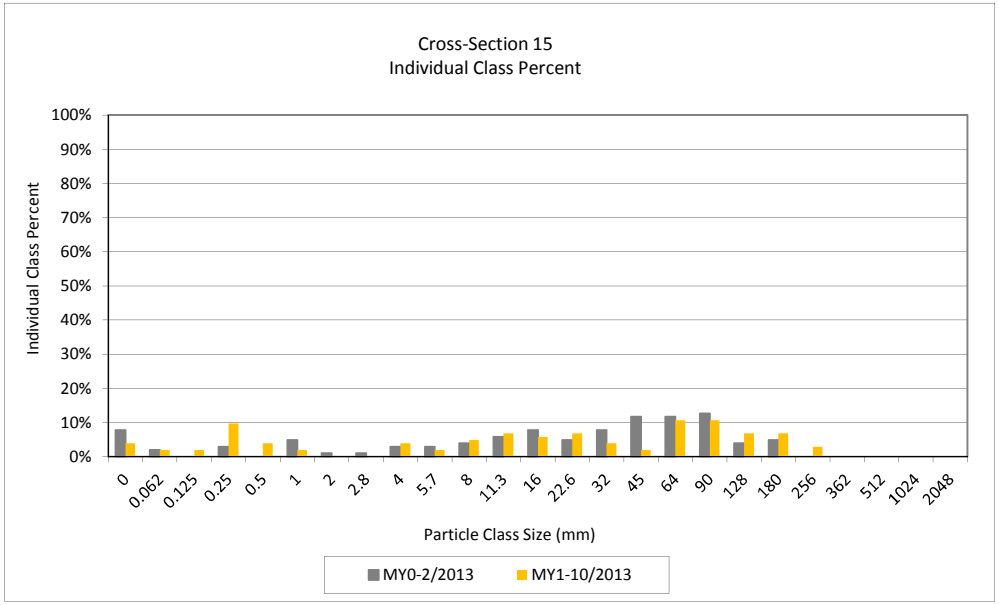
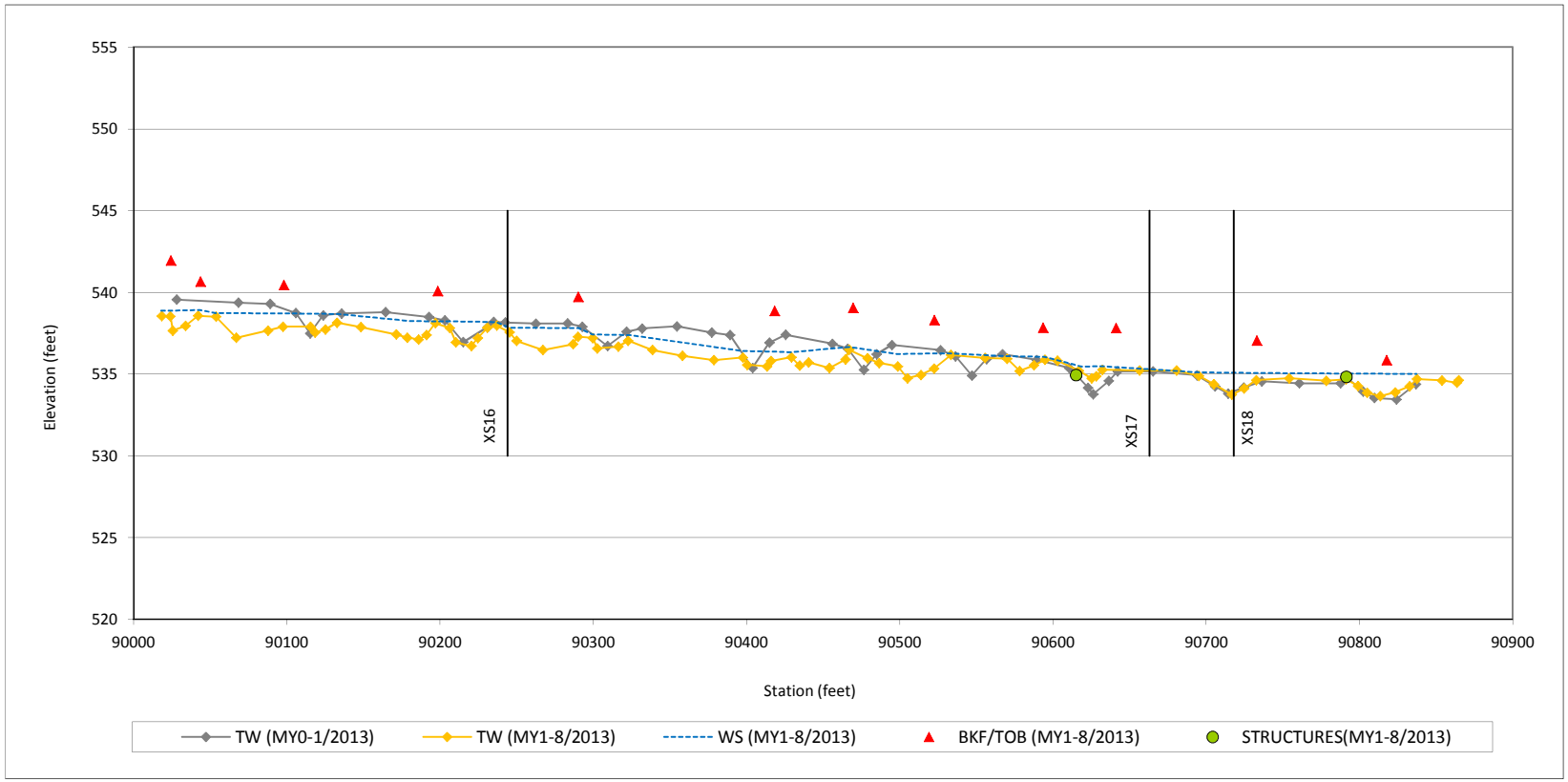


Table 12f. Monitoring Data - Stream Reach Data Summary
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4A
Monitoring Year 1

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	13.9	23.7	13.6	15.4								
Floodprone Width (ft)	200+	200+	200+	200+								
Bankfull Mean Depth	0.9	1.3	1.2	1.7								
Bankfull Max Depth	2.1	2.3	2.1	2.8								
Bankfull Cross-sectional Area (ft^2)	17.5	20.4	16.1	26.3								
Width/Depth Ratio	11.0	27.5	9.0	11.5								
Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+								
Bank Height Ratio	1.0	1.0	1.0	1.0								
D50 (mm)												
Profile												
Riffle Length (ft)	41	79	6	75								
Riffle Slope (ft/ft)	0.0001	0.0210	0.0177	0.0321								
Pool Length (ft)	28	79	15	46								
Pool Max Depth (ft)	2.1	2.8	2.8	3.8								
Pool Spacing (ft)	71	110	32	111								
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	44	74										
Radius of Curvature (ft)	25	41										
Rc:Bankfull Width (ft/ft)	1.7	2.8										
Meander Wave Length (ft)	103	177										
Meander Width Ratio	3.0	5.0										
Additional Reach Parameters												
Rosgen Classification	C5		C5									
Channel Thalweg Length (ft)	866.44		866.44									
Sinuosity (ft)	1.1		1.1									
Water Surface Slope (ft/ft)	0.0070		0.0047									
Bankfull Slope (ft/ft)	0.0067		0.0077									
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/0.12/1.4/44/71.3/362		SC/0.10/0.3/48.8/123.6/256									
% of Reach with Eroding Banks			43%									

Longitudinal Profile Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4A
Monitoring Year 1



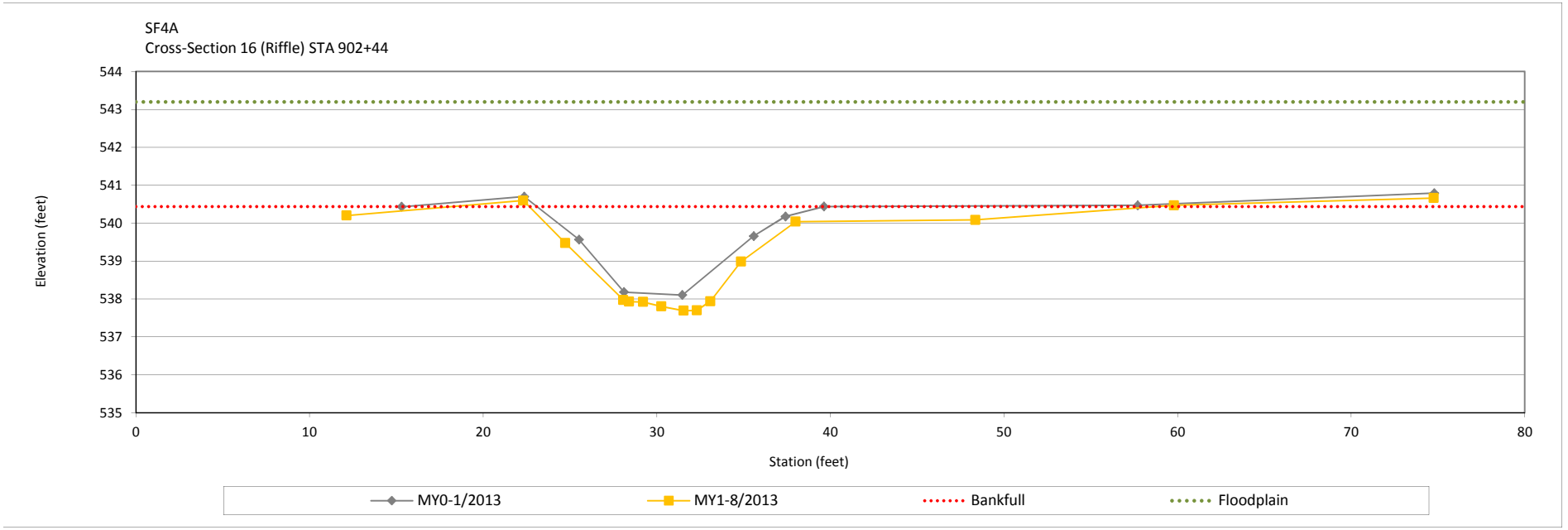
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4A, Cross-Section 16 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	16
Drainage Area	637 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	540.4
Bankfull Cross-Sectional Area (ft2)	27.1
Bankfull Width (ft)	17.3
Flood Prone Area Elevation (ft)	543.2
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	2.8
Mean Depth at Bankfull (ft)	1.6
W/D Ratio	11.1
Entrenchment Ratio	2.2+
Bank Height Ratio	0.9
Stream Type	C

Cross-Section 16: View Upstream

Cross-Section 16: View Downstream



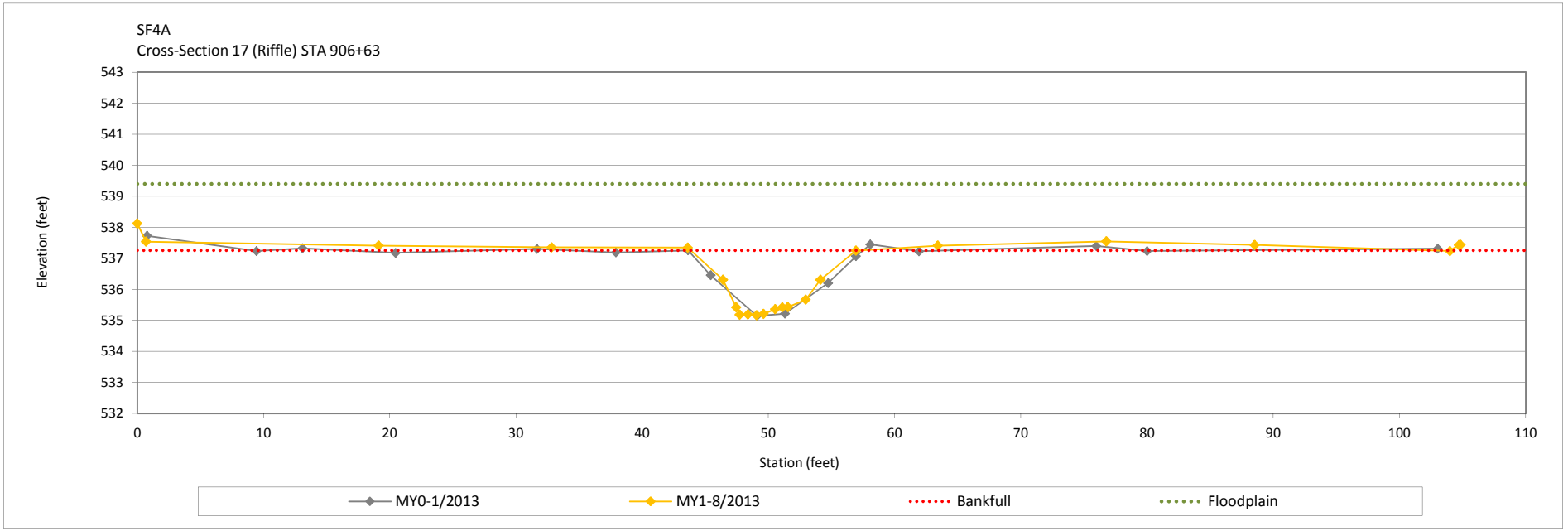
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4A, Cross-Section 17 (Riffle)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	17
Drainage Area	637 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	537.3
Bankfull Cross-Sectional Area (ft2)	16.1
Bankfull Width (ft)	13.6
Flood Prone Area Elevation (ft)	539.4
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	2.1
Mean Depth at Bankfull (ft)	1.2
W/D Ratio	11.5
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	E

Cross-Section 17: View Upstream

Cross-Section 17: View Downstream



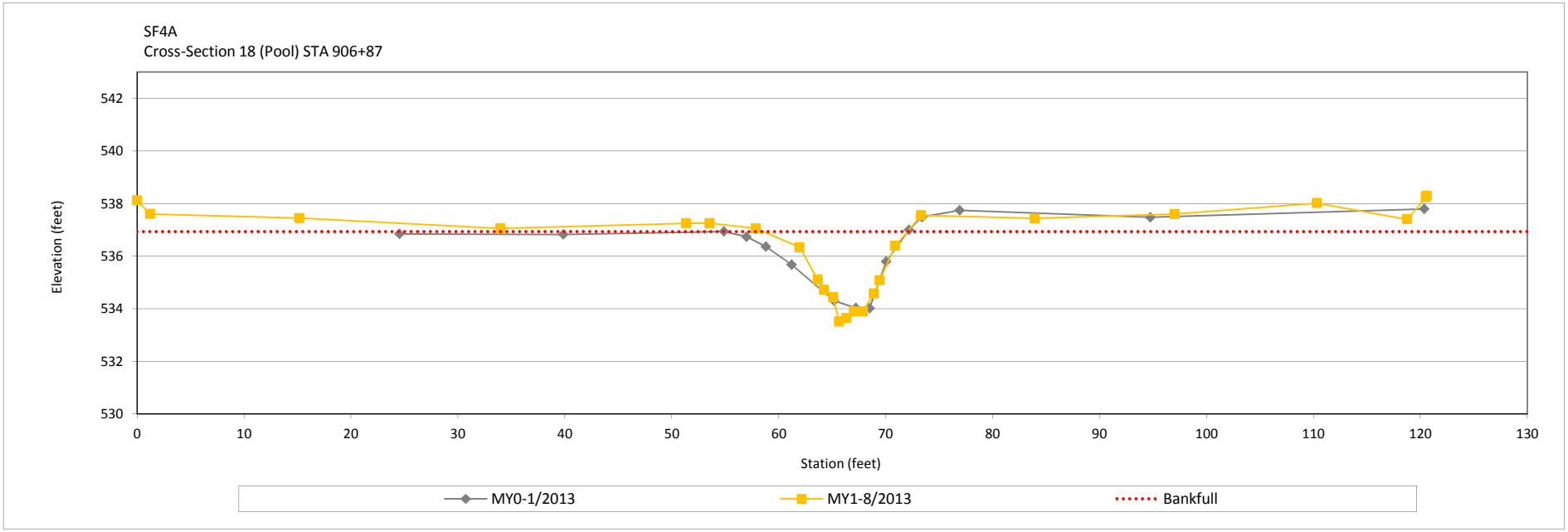
Cross-Section Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4A, Cross-Section 18 (Pool)
Monitoring Year 1

River Basin	Cape Fear
Watershed HUC	303002050050
XS ID	18
Drainage Area	637 acres
Date	08/05/2013
Field Crew	JL, CM

Summary Data	
Bankfull Elevation (ft)	536.9
Bankfull Cross-Sectional Area (ft2)	21.0
Bankfull Width (ft)	13.5
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	3.4
Mean Depth at Bankfull (ft)	1.6
W/D Ratio	8.6
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A

Cross-Section 18: View Upstream

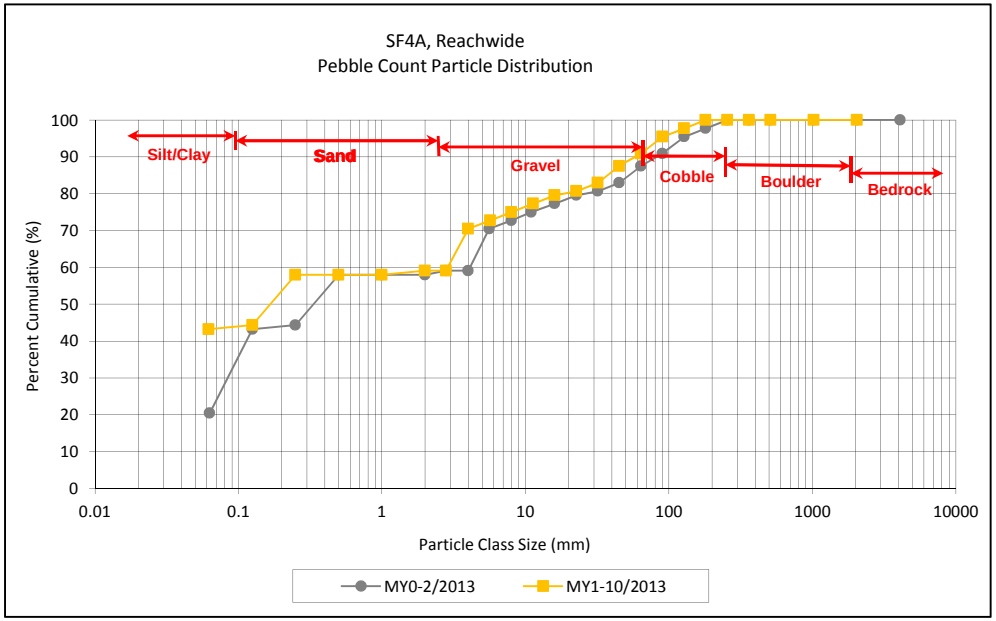
Cross-Section 18: View Downstream

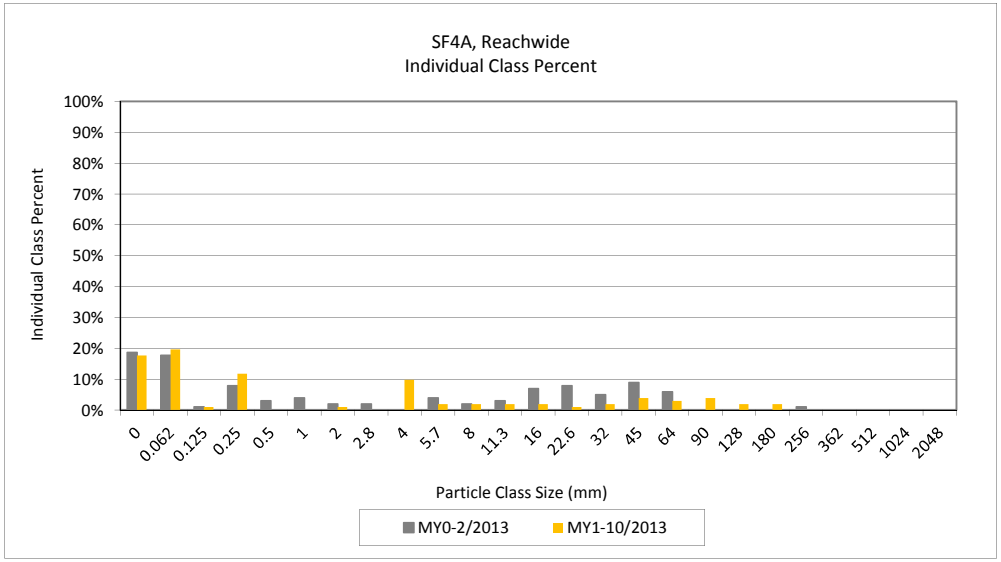


Reachwide and Cross-Section Pebble Count Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4A, Reachwide
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count			SF4A Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	5	13	18	20	20
SAND	Very fine	0.062	0.125	8	12	20	23	43
	Fine	0.125	0.250	1		1	1	44
	Medium	0.250	0.500	2	10	12	14	58
	Coarse	0.5	1.0					58
	Very Coarse	1.0	2.0					58
GRAVEL	Very Fine	2.0	2.8	1		1	1	59
	Very Fine	2.8	4.0					59
	Fine	4.0	5.7	10		10	11	70
	Fine	5.7	8.0	2		2	2	73
	Medium	8.0	11.3	2		2	2	75
	Medium	11.3	16.0	2		2	2	77
	Coarse	16.0	22.6	1	1	2	2	80
	Coarse	22.6	32		1	1	1	81
	Very Coarse	32	45	1	1	2	2	83
	Very Coarse	45	64	4		4	5	88
COBBLE	Small	64	90	3		3	3	91
	Small	90	128	4		4	5	95
	Large	128	180	2		2	2	98
	Large	180	256	2		2	2	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**38**	**88**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	silt/clay
D_{35} =	0.10
D_{50} =	0.3
D_{84} =	48.8
D_{95} =	123.6
D_{100} =	256.0

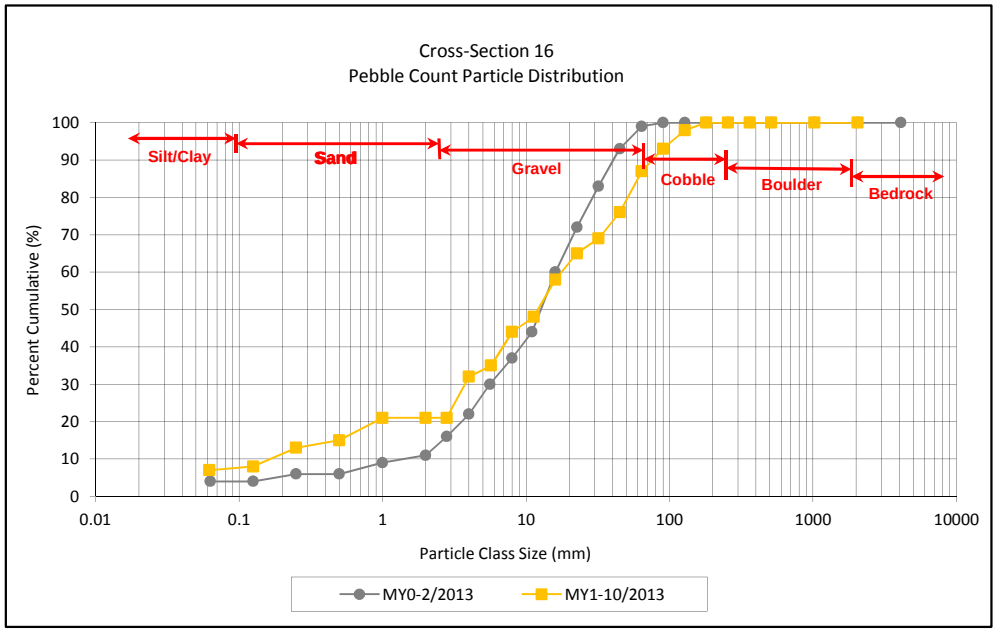


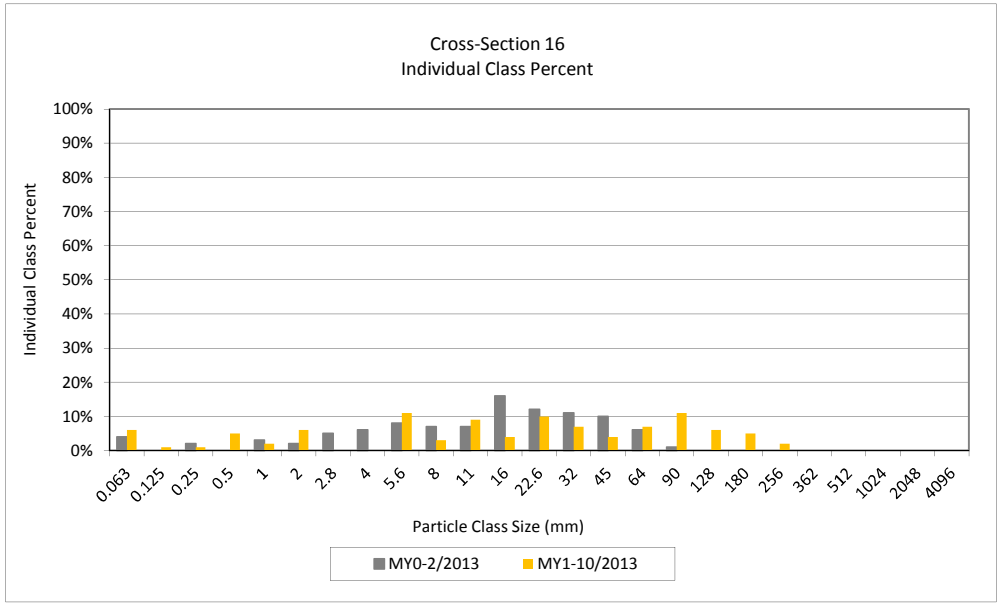


Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4A, Cross-Section 16
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 16 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	6	6
SAND	Very fine	0.062	0.125	1	1	7
	Fine	0.125	0.250	1	1	8
	Medium	0.250	0.500	5	5	13
	Coarse	0.5	1.0	2	2	15
	Very Coarse	1.0	2.0	6	6	21
GRAVEL	Very Fine	2.0	2.8			21
	Very Fine	2.8	4.0			21
	Fine	4.0	5.7	11	11	32
	Fine	5.7	8.0	3	3	35
	Medium	8.0	11.3	9	9	44
	Medium	11.3	16.0	4	4	48
	Coarse	16.0	22.6	10	10	58
	Coarse	22.6	32	7	7	65
	Very Coarse	32	45	4	4	69
	Very Coarse	45	64	7	7	76
COBBLE	Small	64	90	11	11	87
	Small	90	128	6	6	93
	Large	128	180	5	5	98
	Large	180	256	2	2	100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross-Section 16	
Channel materials (mm)	
D_{16} =	1.1
D_{35} =	8.0
D_{50} =	17.1
D_{84} =	82.0
D_{95} =	146.7
D_{100} =	256.0

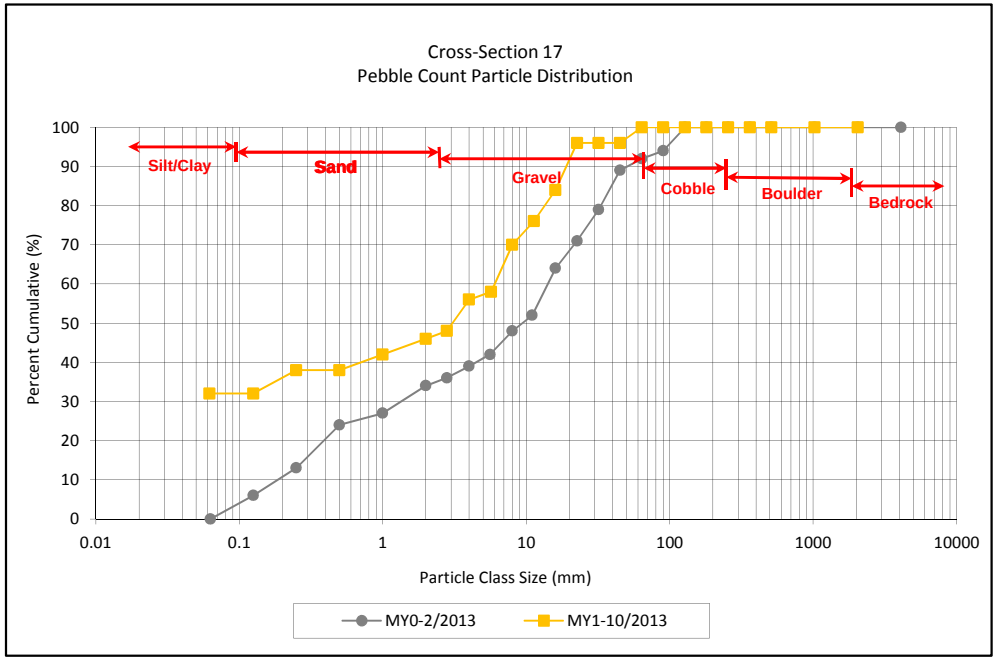


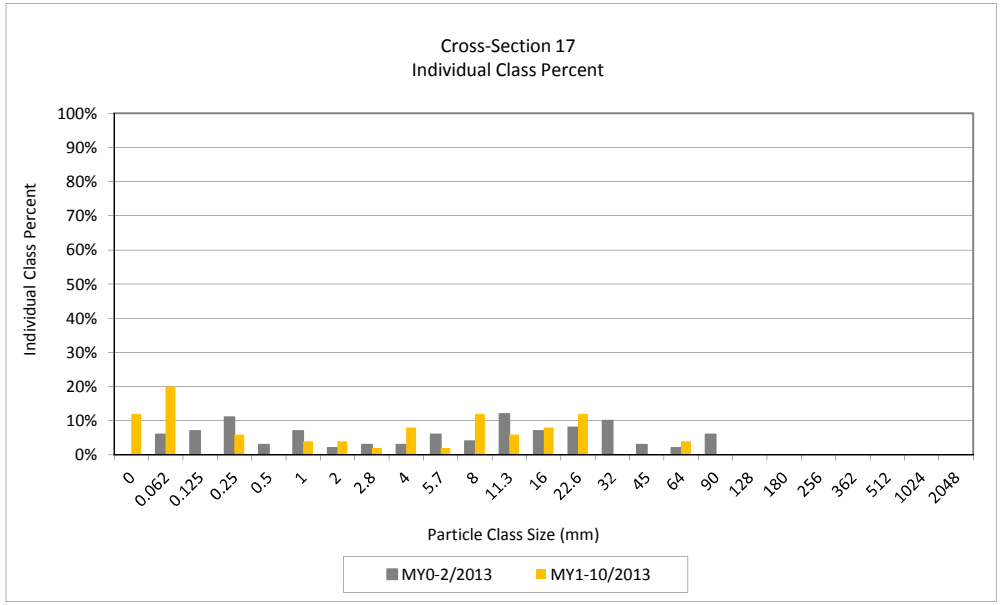


Reachwide and Cross-Section Substrate Plots
Underwood Mitigation Site (NCEEP Project No. 94641)
Lindley Site; SF4A, Cross-Section 17
Monitoring Year 1

Particle Class		Diameter (mm)		Particle Count	Cross-Section 17 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	12	12	12
SAND	Very fine	0.062	0.125	20	20	32
	Fine	0.125	0.250			32
	Medium	0.250	0.500	6	6	38
	Coarse	0.5	1.0			38
	Very Coarse	1.0	2.0	4	4	42
GRAVEL	Very Fine	2.0	2.8	4	4	46
	Very Fine	2.8	4.0	2	2	48
	Fine	4.0	5.7	8	8	56
	Fine	5.7	8.0	2	2	58
	Medium	8.0	11.3	12	12	70
	Medium	11.3	16.0	6	6	76
	Coarse	16.0	22.6	8	8	84
	Coarse	22.6	32	12	12	96
	Very Coarse	32	45			96
	Very Coarse	45	64			96
COBBLE	Small	64	90	4	4	100
	Small	90	128			100
	Large	128	180			100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross-Section 17 Channel materials (mm)	
D_{16} =	0.1
D_{35} =	0.4
D_{50} =	4.4
D_{84} =	22.6
D_{95} =	31.1
D_{100} =	90.0





APPENDIX 5. Hydrology Summary Data and Plots

Table 13. Verification of Bankfull Events
Underwood Mitigation Site (EEP Project No. 94641)
Monitoring Year 1

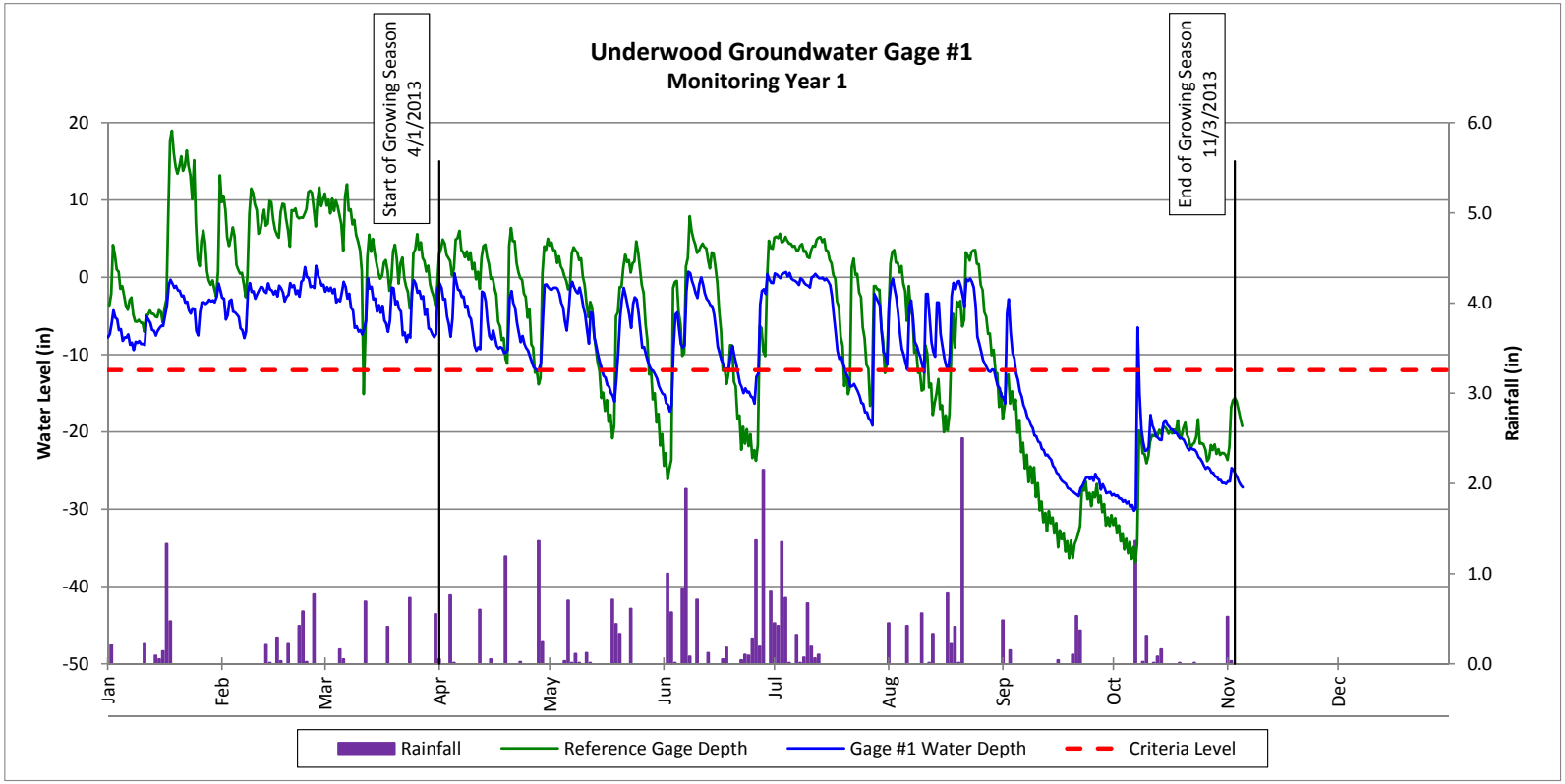
Reach	Date of Data Collection	Approximate Date of Occurrence	Method
SF1	10/13/2013	6/2013-10/2013	Crest Gage
UT2	*		
SF3	7/1/2013	5/2013-6/2013	Crest Gage
	8/8/2013	7/2013	Crest Gage
	10/13/2013	8/2013-10/2013	Crest Gage
UT1	7/1/2013	5/2013-6/2013	Crest Gage
	8/1/2013	7/2013	Crest Gage
	10/13/2013	8/2013-10/2013	Crest Gage
SF4	8/1/2013	7/2013	Visual
	10/13/2013	8/2013-10/2013	Crest Gage
SF4A	8/1/2013	7/2013	Visual
	10/13/2013	8/2013-10/2013	Crest Gage

*data collected, but level was below bankfull elevation

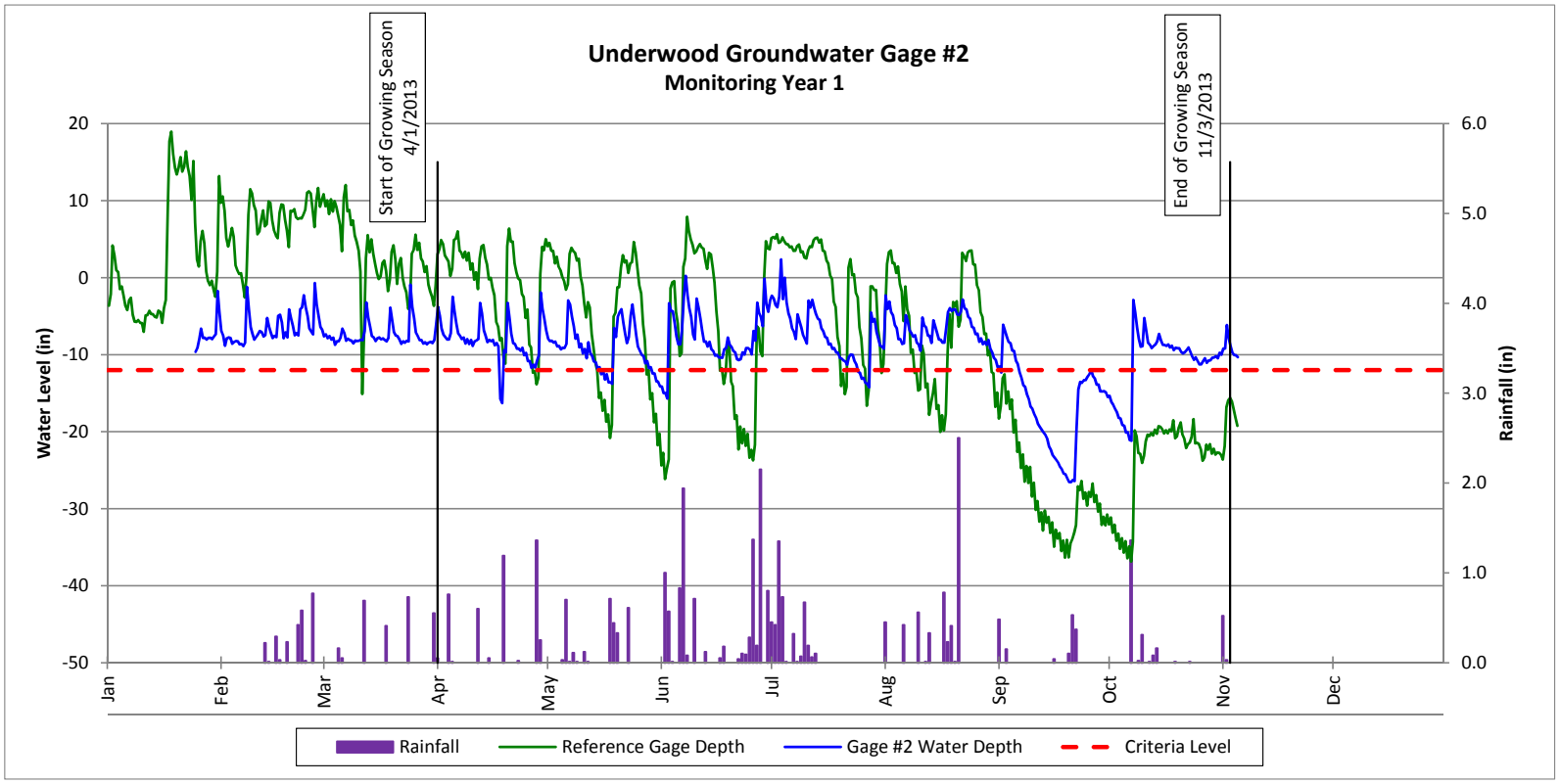
Table 14. Wetland Gage Attainment Summary
Underwood Mitigation Site (EEP Project No. 94641)
Monitoring Year 1

Summary of Groundwater Gage Results for Years 1 through 7							
Gage	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)	Year 6 (2018)	Year 7 (2019)
1	Yes/44.5 Days (20.6 %)						
2	Yes/51.5 Days (23.8 %)						
3	Yes/23.5 Days (10.9 %)						
4	Yes/19.5 Days (9.0 %)						
5	Yes/25 Days (11.6 %)						
6	Yes/22.5 Days (10.4 %)						
7	Yes/44.5 Days (20.6 %)						
8	Yes/22 Days (10.2 %)						
9	Yes/98 Days (45.4 %)						
10	Yes/96.5 Days (44.7 %)						
11	Yes/66 Days (30.6 %)						
12	Yes/23 Days (10.6 %)						
13	Yes/22 Days (10.2 %)						
14	Yes/21 Days (9.7 %)						
15	Yes/163 Days (75.5 %)						

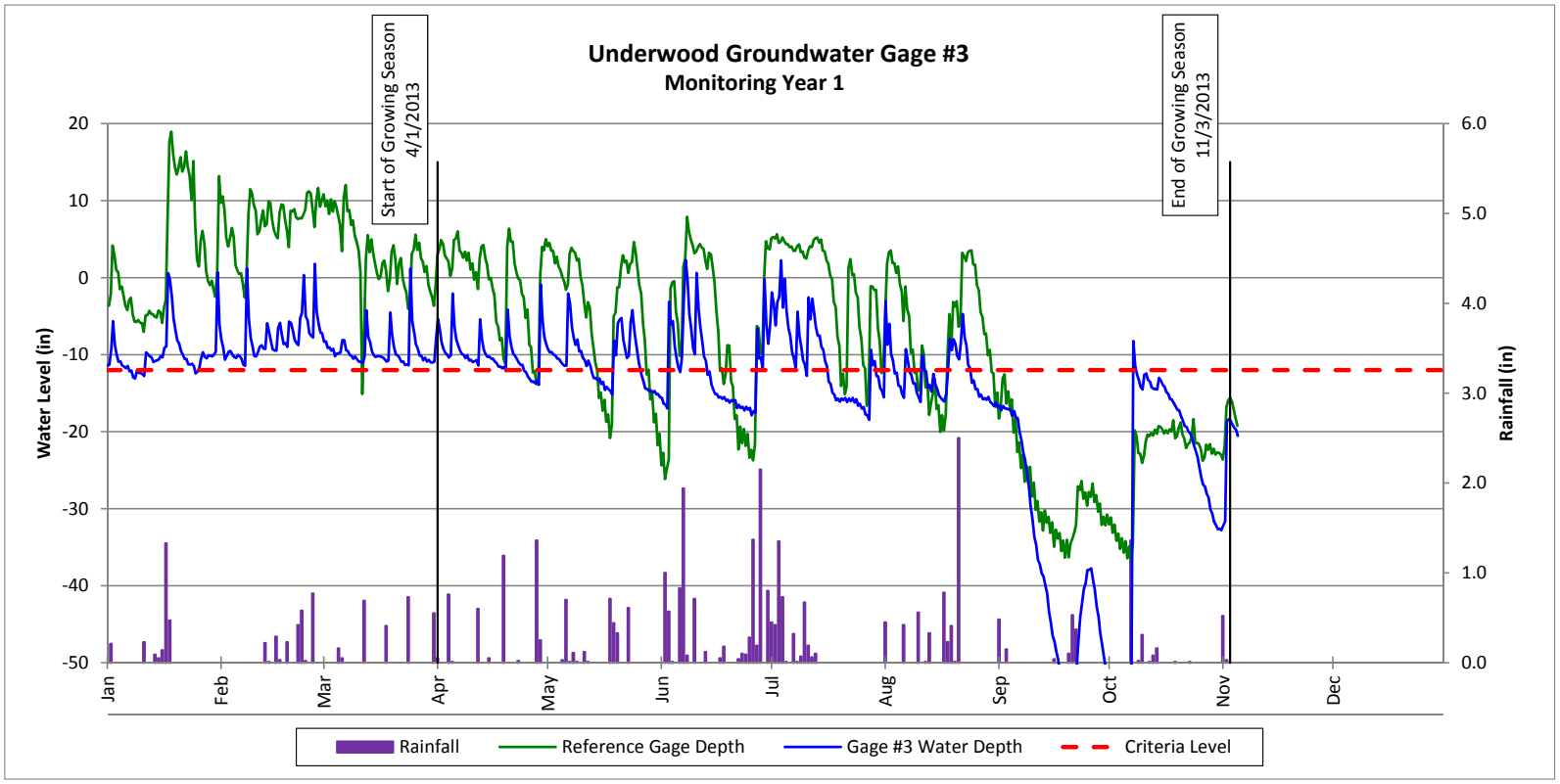
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; RW1
Monitoring Year 1



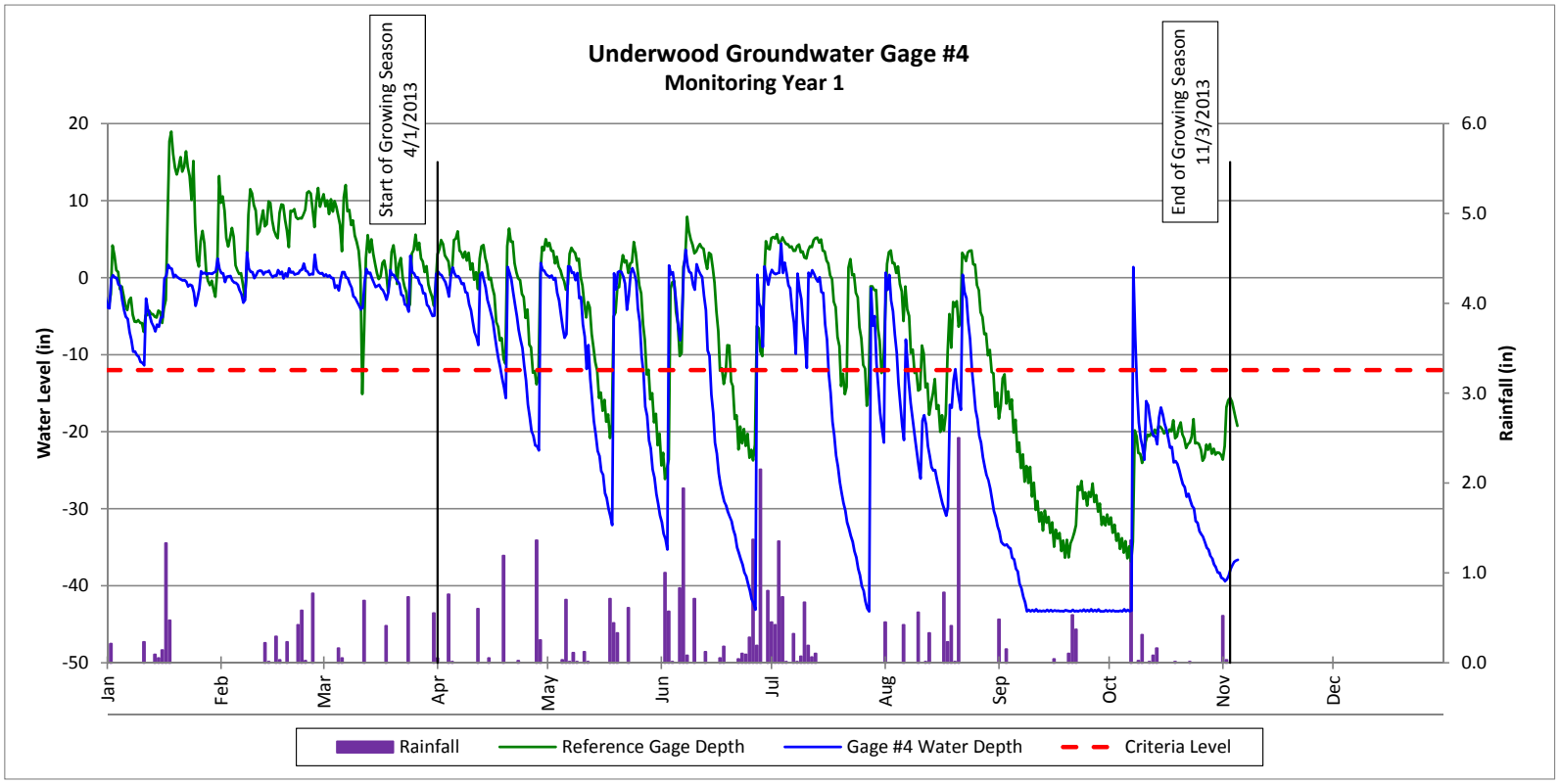
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; RW2
Monitoring Year 1



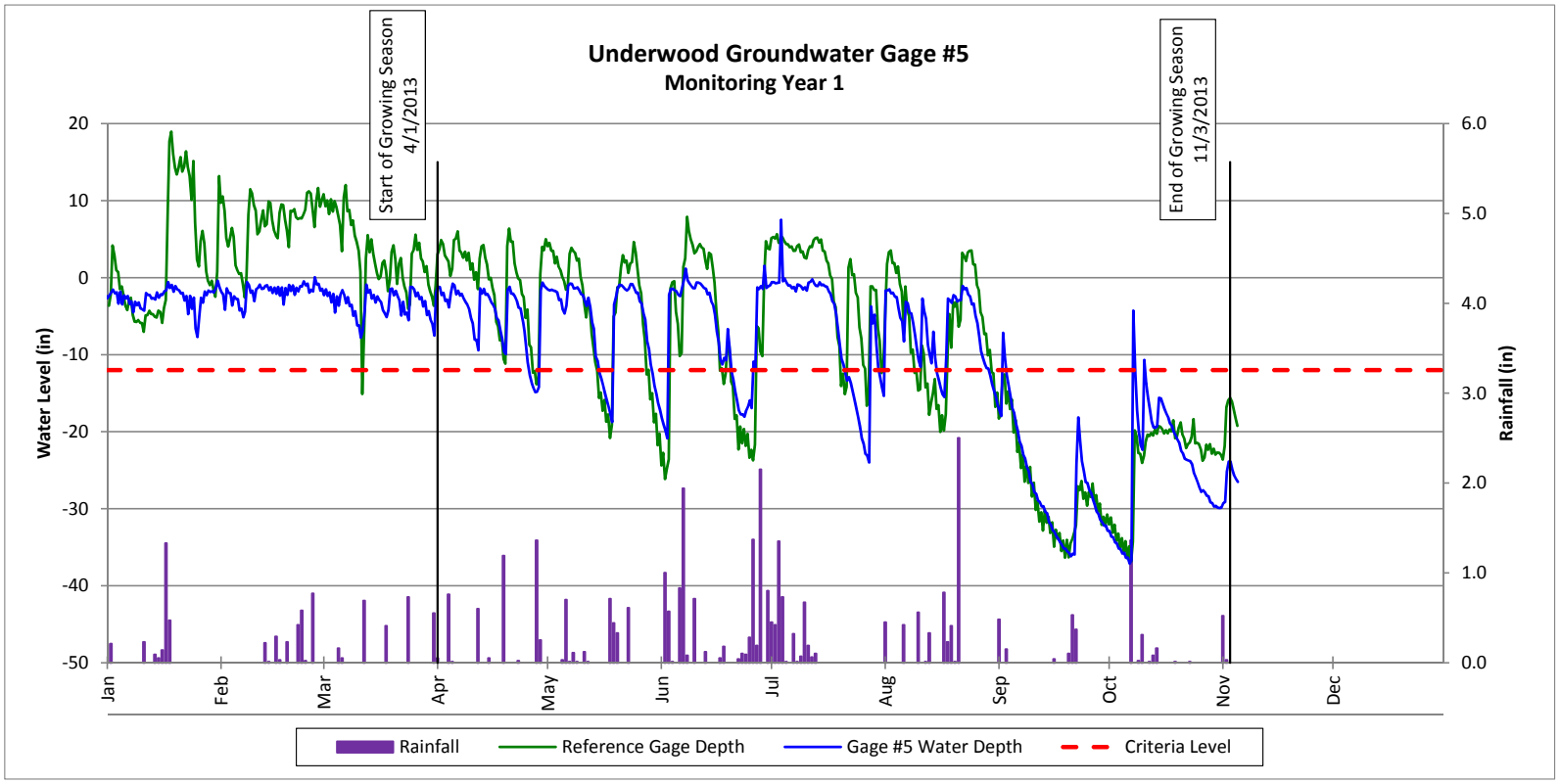
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; NRW1
Monitoring Year 1



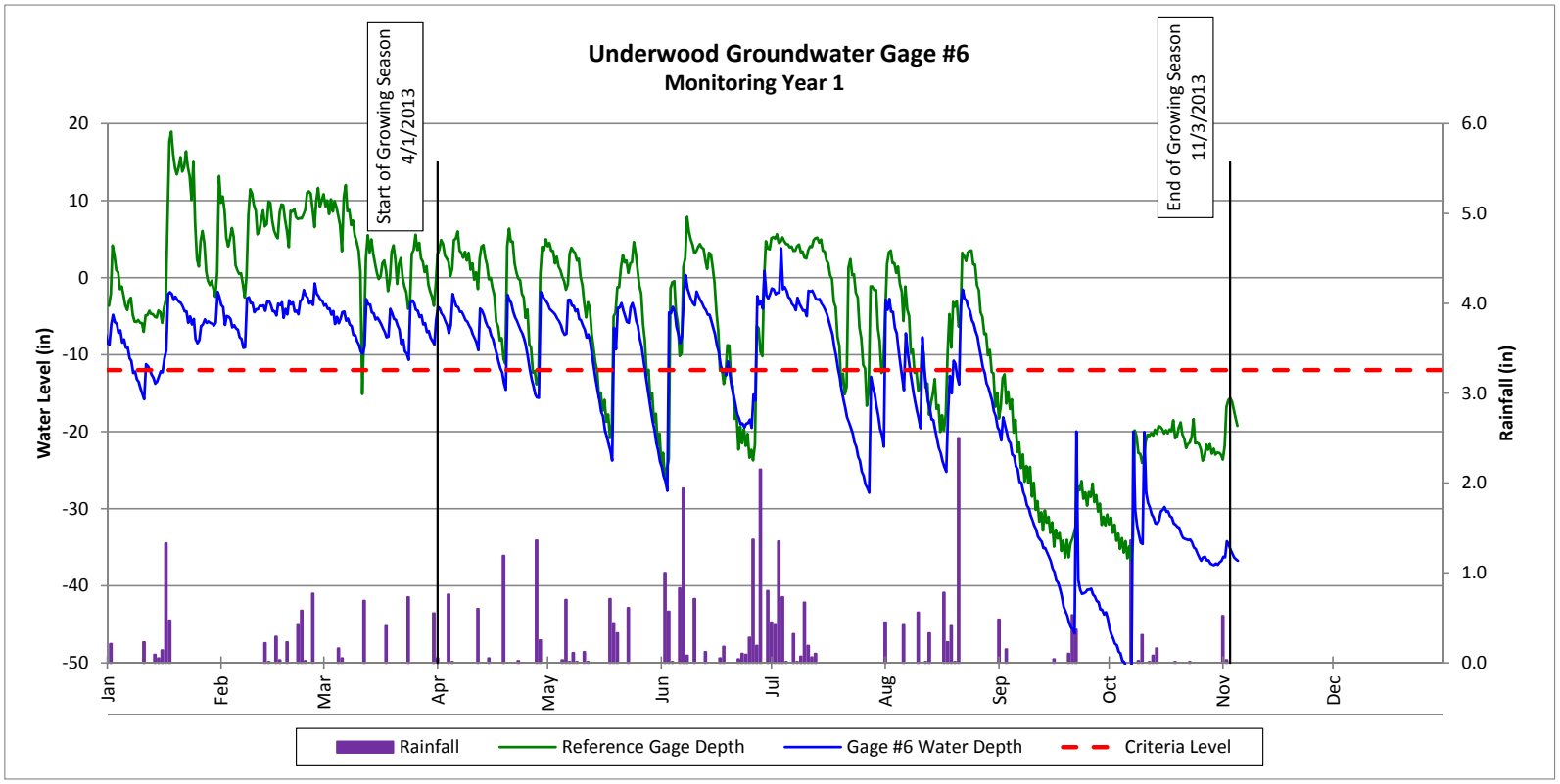
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; RW2
Monitoring Year 1



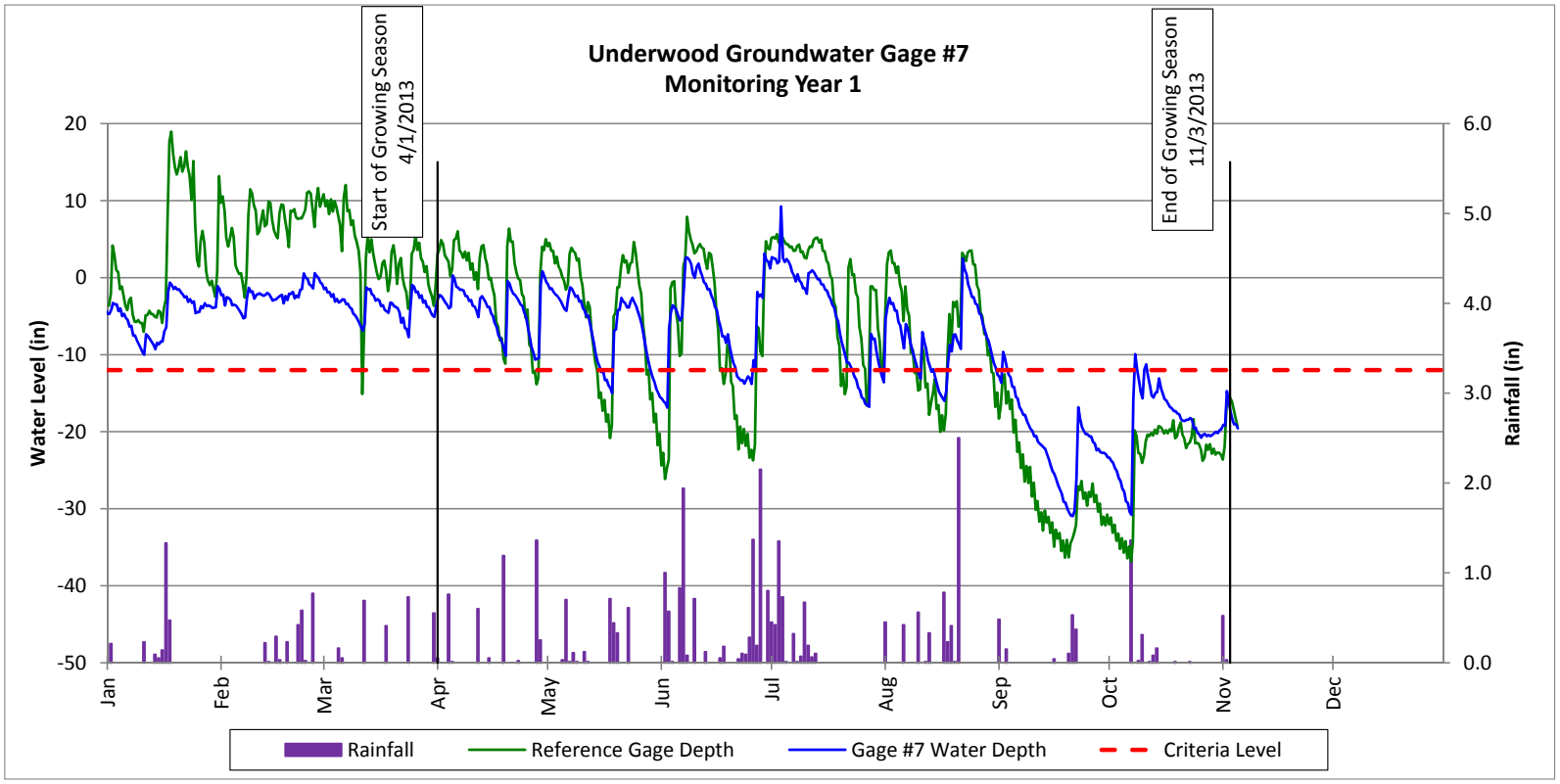
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; RW3
Monitoring Year 1



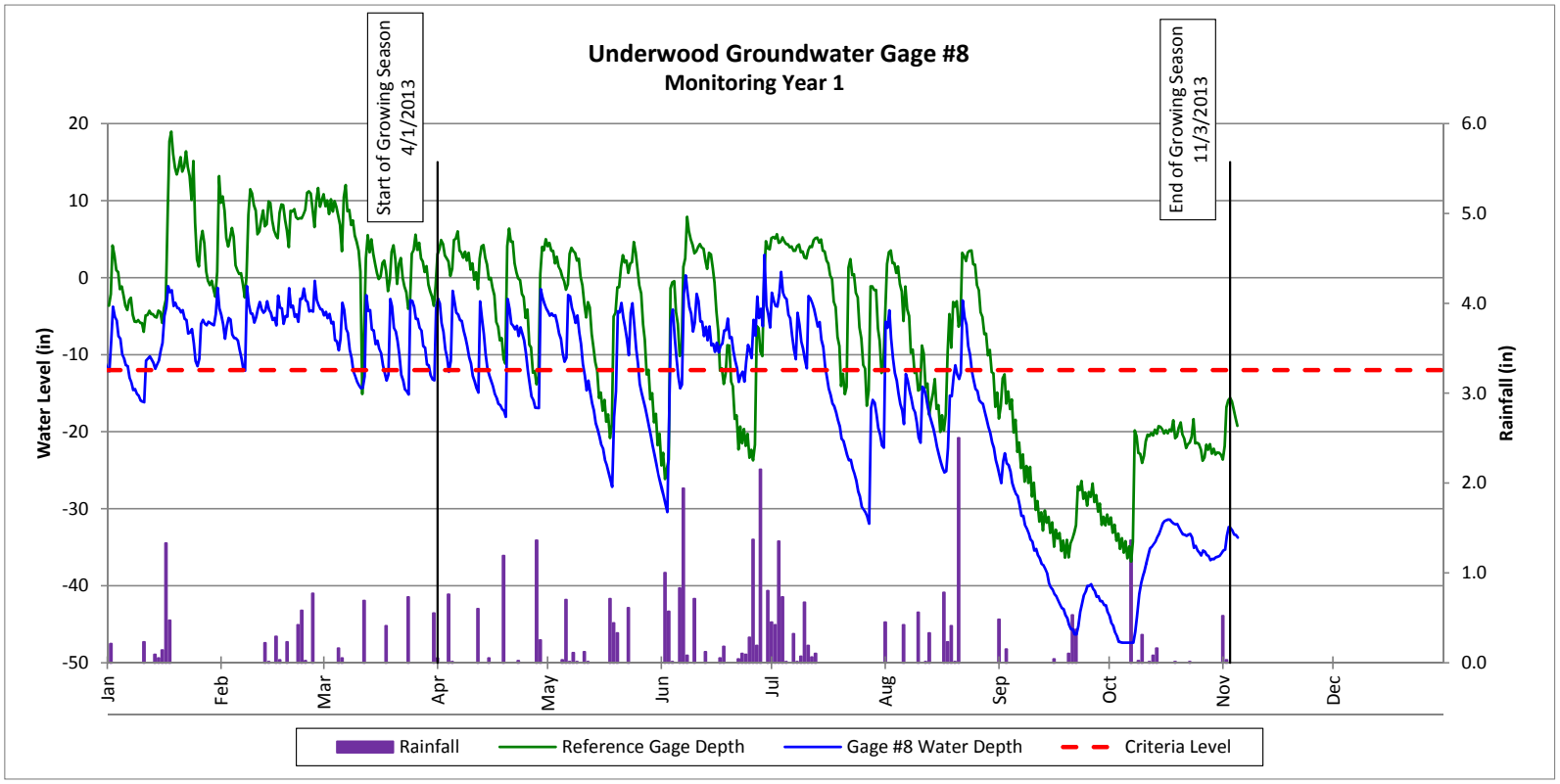
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; RW3
Monitoring Year 1



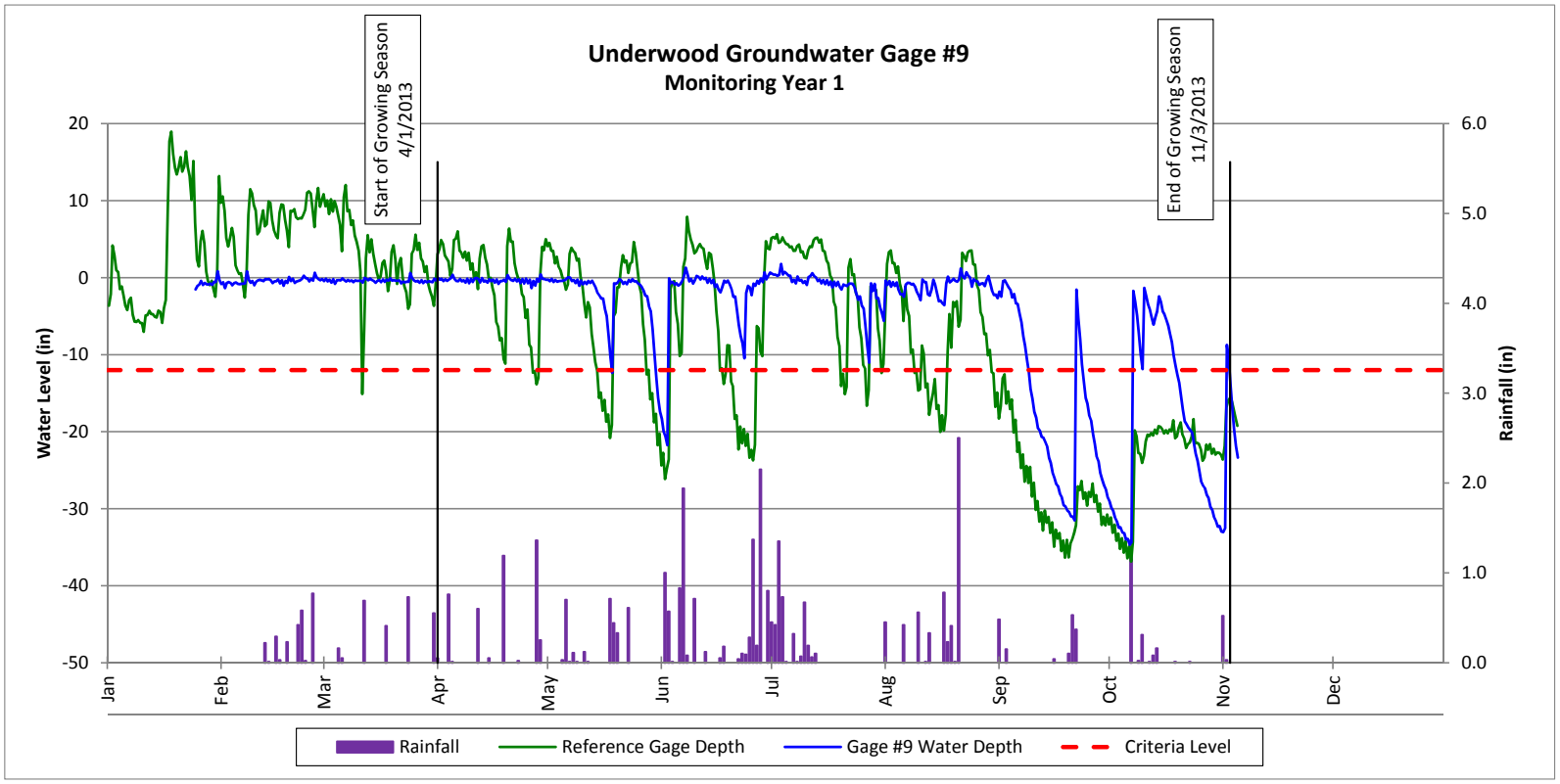
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; RW3
Monitoring Year 1



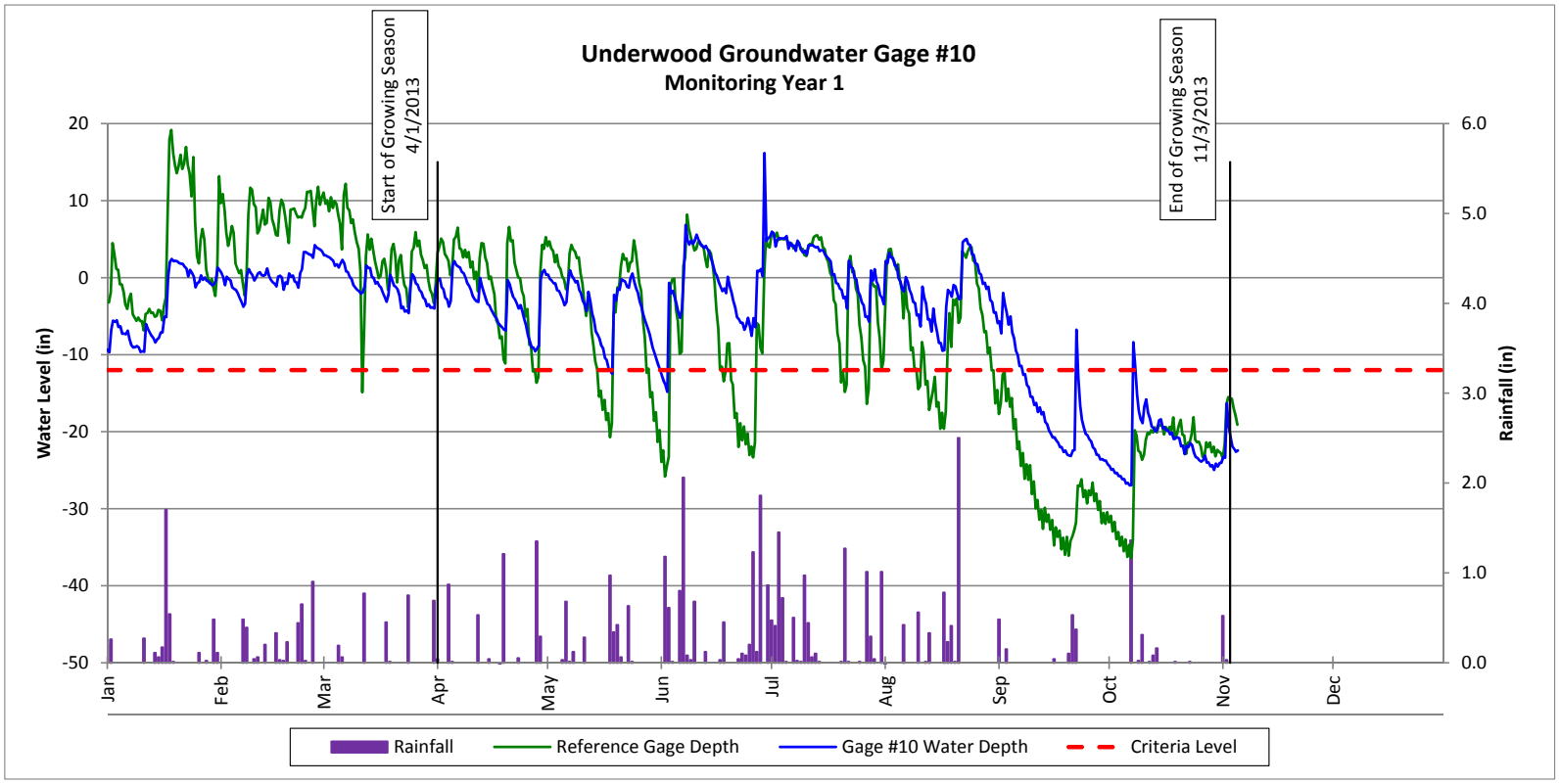
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; RW3
Monitoring Year 1



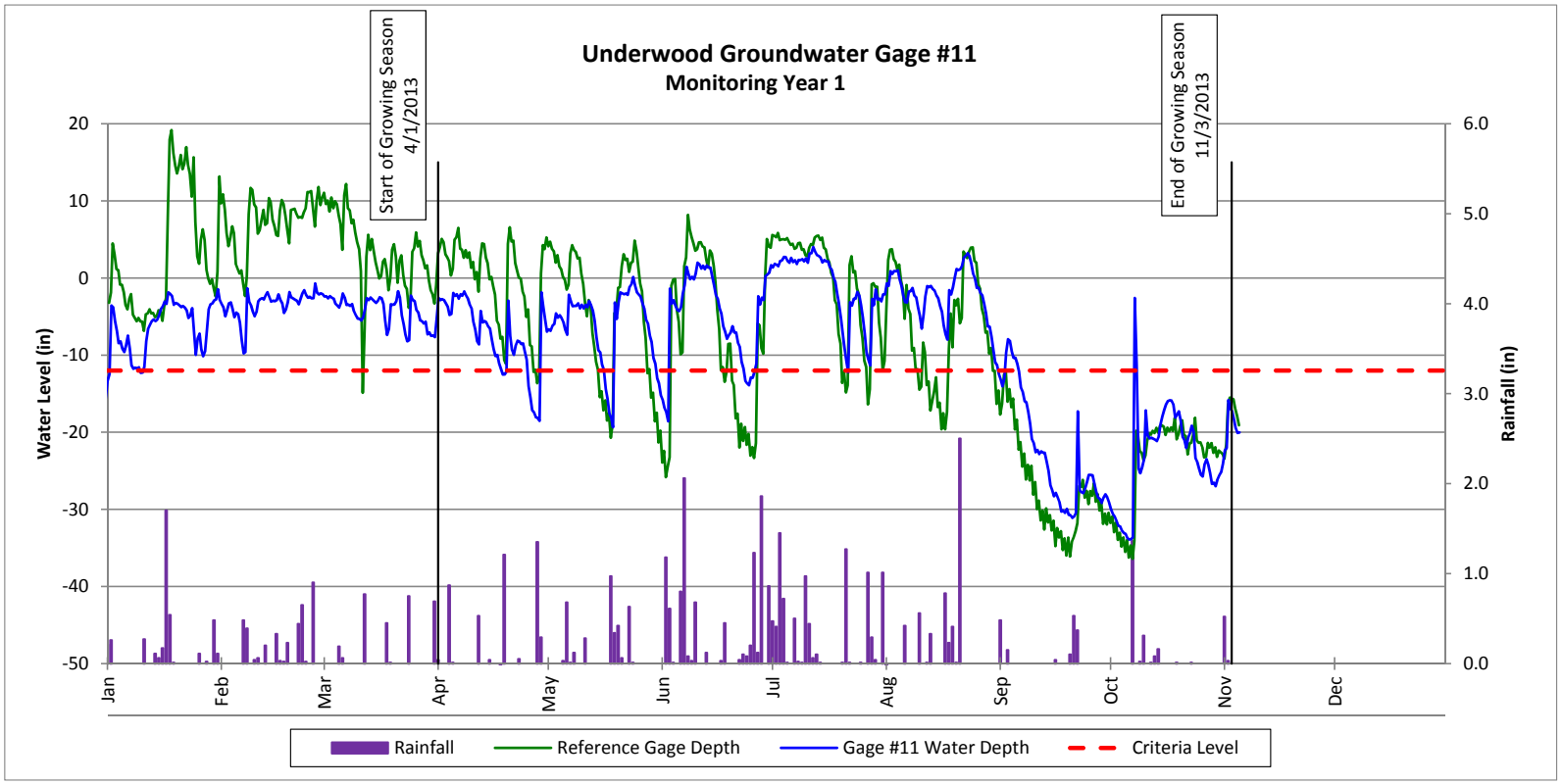
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Harris Site; NRW2
Monitoring Year 1



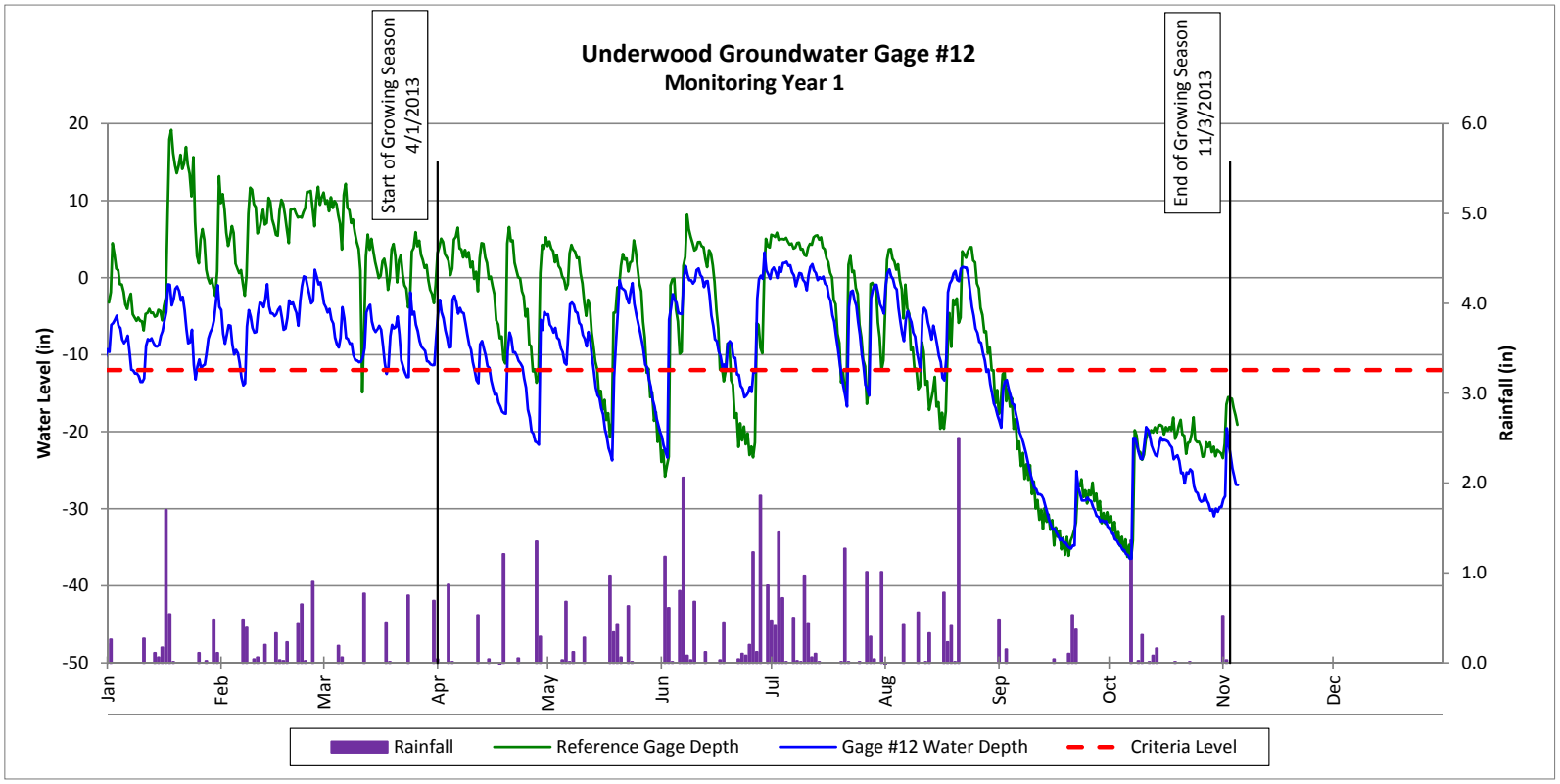
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Lindley Site; RW4
Monitoring Year 1



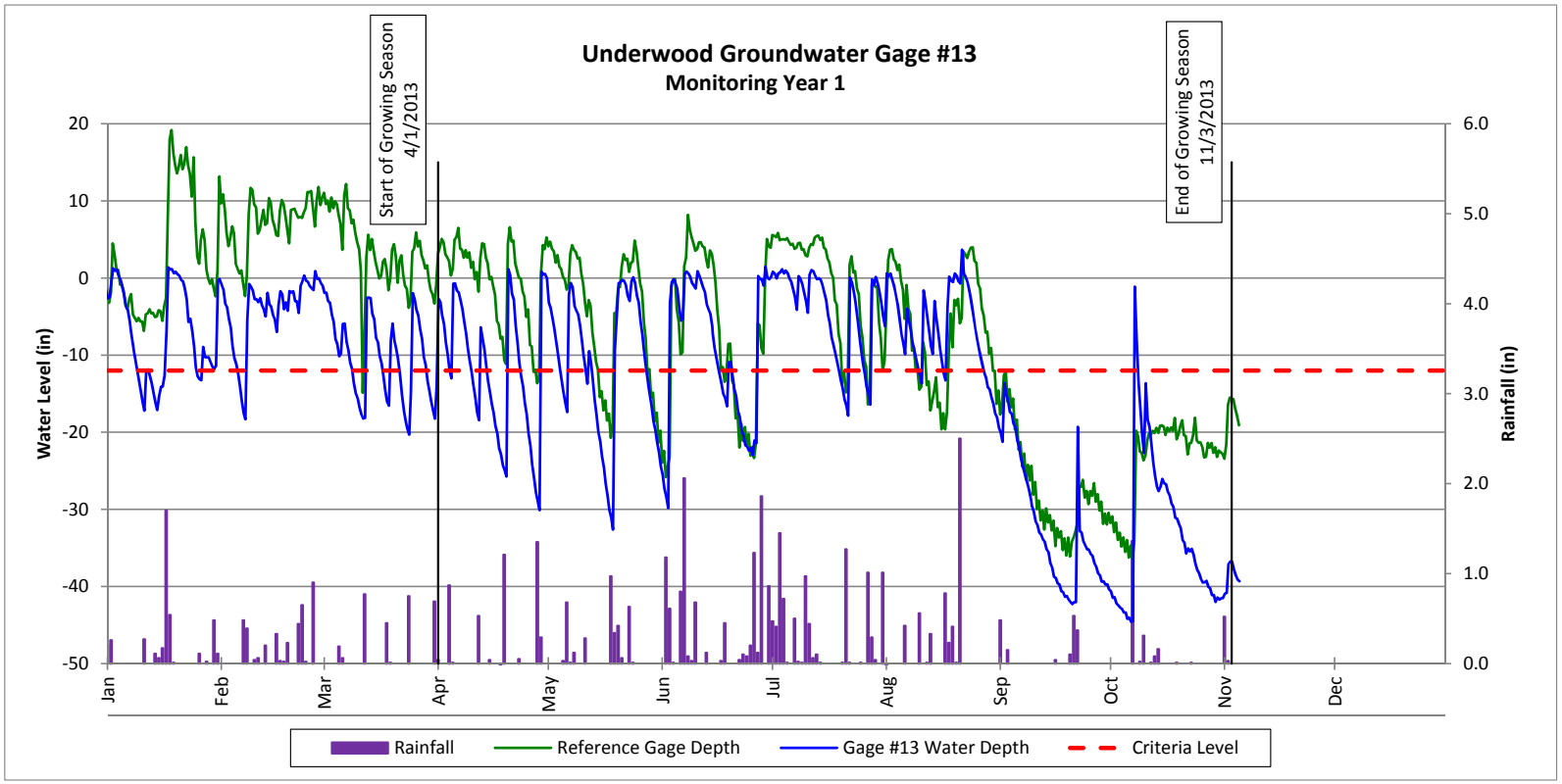
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Lindley Site; RW4
Monitoring Year 1



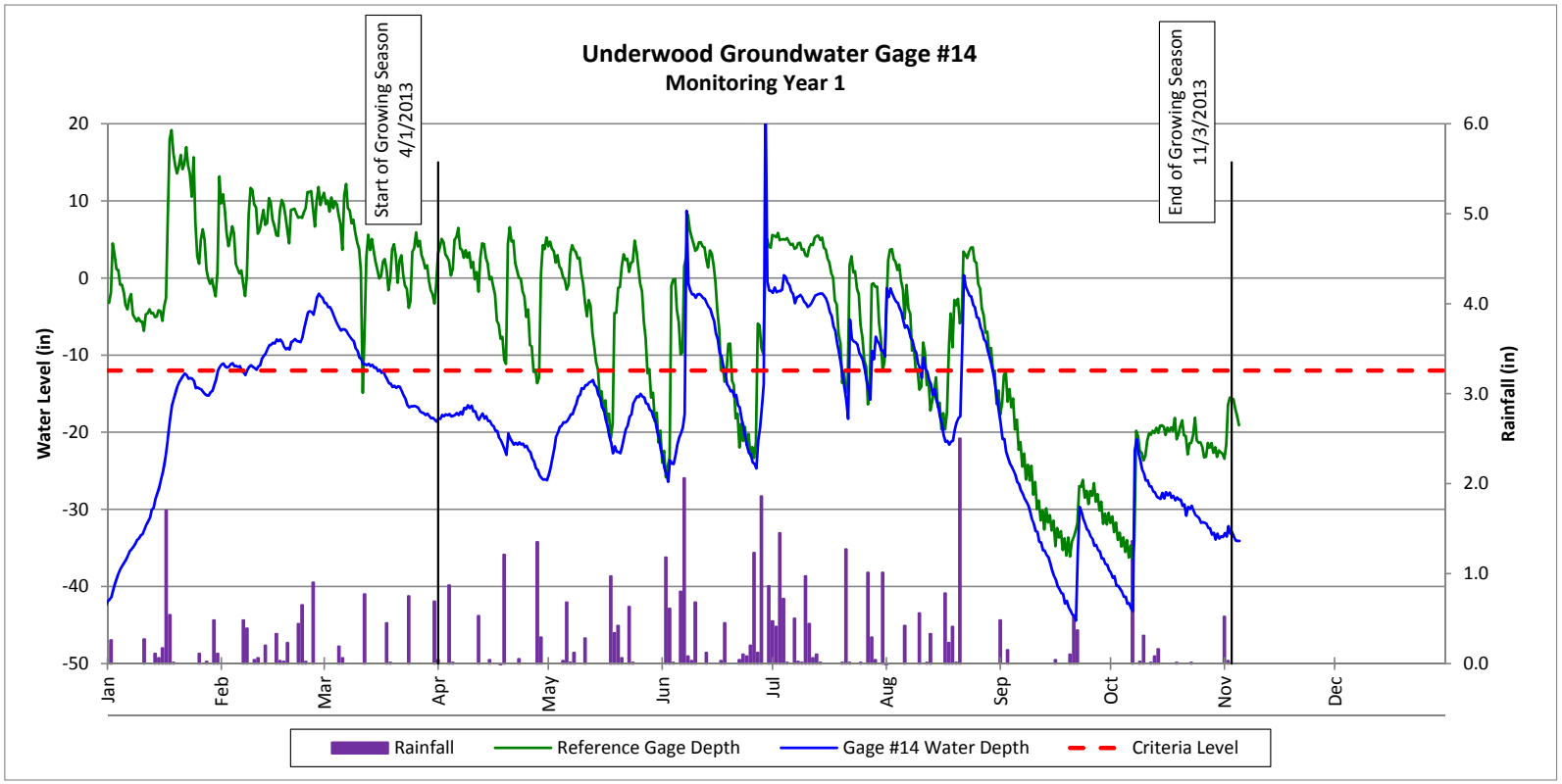
Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Lindley Site; RW4
Monitoring Year 1



Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Lindley Site; RW4
Monitoring Year 1



Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Lindley Site; RW4
Monitoring Year 1



Groundwater Gage Plots
Underwood Mitigation Site (EEP Project No. 94641)
Lindley Site; RW4
Monitoring Year 1