

**LYLE CREEK MITIGATION SITE**  
*Catawba County, NC*  
*DENR Contract 003241*  
*NCEEP Project Number 94643*

**Monitoring Year 1 Annual Report**  
**FINAL**

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## 1.0 Executive Summary

The Lyle Creek Mitigation Site, hereafter referred to as the Site, is a full-delivery stream and wetland restoration project for the North Carolina Ecosystem Enhancement Program (NCEEP) in Catawba County, NC. The Site is located west of NC Highway 10/ North Main Street in the Town of Catawba, NC (Figure 1). The project is located in the Catawba River Basin Hydrologic Unit Code (HUC) 03050101140010, and North Carolina Division of Water Quality (NCDWQ) Subbasin 03-08-32, which is within a NCEEP Targeted Local Watershed. This HUC qualifies as a service area for an adjacent HUC; therefore, the Lyle Creek Mitigation Site was submitted for mitigation credit in the Catawba River Basin HUC 03050103.

The Site is 18 miles east of Hickory, 15 miles southwest of Statesville and approximately 2 miles south of I-40. The Site is located on an active tree farm surrounded by woods and residential land use. The Site is bounded by Lyle Creek to the north, NC Highway 10/ North Main Street to the east and an elevated railroad right-of-way to the south. The Site is located on one parcel owned by the Garmon Family. A Conservation Easement held by the State of North Carolina has been recorded with the Catawba County Register of Deeds on the 26.62-acre Lyle Creek project study area within the Garmon parcel. The conservation easement allows the restoration work to occur and protects the project area in perpetuity. Signage and demarcation were placed along the easement per current NCEEP guidance.

Lyle Creek flows into the Catawba River less than a mile downstream of the proposed mitigation site. The NCDWQ assigns best usage classifications to State Waters that reflect water quality conditions and potential resource usage. Lyle Creek (NCDWQ Index No. 11-76-4.5) is the main receiving tributary of the project reaches and has been classified as Class WS-IV; CA waters. Class WS-IV waters are used as sources of water supply for drinking or food processing purposes where a more restrictive WS-I, WS-II, or WS-III classification is not feasible. These waters are also protected for Class C uses such as secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival and agriculture. WS-IV waters are generally in moderately to highly-developed watersheds or Protected Areas. This portion of Lyle Creek is also located within the Critical Area (CA) of the Catawba River/ Lake Norman. Directions and a map of the Site are provided in Figure 1.

### 1.1 Project Goals and Objectives

Prior to construction activities, the onsite UTs to Lyle Creek were regularly modified and maintained and therefore lacked bedform diversity, habitat, and riparian buffer. The primary impacts to the project channels were the result of mowing, ditching, vegetation maintenance, and dredging associated with tree farming activities. As a result of the aforementioned land activities, the onsite streams were incised and overly wide with shallow flow. These stream conditions resulted in many of the onsite streams being unable to maintain channel form and subsequently filled in with sediment, organic matter and vegetation. In-stream bedform diversity was extremely poor and the longitudinal profile was dominated by shallow runs. The lack of bedform diversity combined with continued anthropogenic disturbance resulted in degraded aquatic habitat, altered hydrology (related to loss of floodplain connection and

lowered water table) and water quality concerns such as lower dissolved oxygen levels (due to shallow flow with few re-aeration points). Tables 1-4 in Appendix 1 present the pre-restoration conditions in detail for the Site.

The primary objectives of the project were to provide ecological and water quality enhancements to the Catawba River Basin while creating a functional riparian corridor at the site level, providing wetland habitat and ecological function, and restoring a Piedmont Bottomland Forest as described by Schafale and Weakley (1990). These objectives were achieved by restoring 5,411 linear feet (LF) of perennial and intermittent stream channel and 6.6 acres (ac) of wetland area, enhancing 1,384 LF of intermittent stream channel and creating 2.9 ac of wetland area. Approximately 179 LF of stream was excluded from the total project credit calculations from crossings (farm roads and power line easements). The Site's riparian areas were also planted to stabilize streambanks and wetland areas, improve habitat, and protect water quality. The ecological uplift can be summarized as starting from tree farming-impacted streams and wetlands and moving to stable channels and wetlands in a protected riparian corridor. Restoration of dimension, pattern, and profile was implemented for UT<sub>1</sub>, UT<sub>1a</sub>, and UT<sub>1b</sub>; enhancement of profile and dimension was implemented for UT<sub>1c</sub> and UT<sub>1d</sub>. Wetland restoration and creation included RW<sub>1</sub> and RW<sub>2</sub>. UT<sub>1a</sub> and UT<sub>1b</sub> discharge into an anastomosed wetland complex upstream of their confluence with UT<sub>1</sub> as depicted in Figure 2. This anastomosed wetland complex was not proposed for stream mitigation credit. Figure 2 and Table 1 present the implemented design for the Site.

Monitored enhancements to water quality and ecological processes established in the mitigation plan are outlined below, followed by expected project benefits which are associated with restoration, but will not be monitored as part of this project:

#### *Monitored Project Goals*

- Wetland areas will be disked to increase surface roughness and better capture rainfall which will improve connection with the water table for groundwater recharge. Adjacent streams will be stabilized and established with a floodplain elevation to promote hydrologic transfer between wetland and stream.
- A channel with riffle-pool sequences and some rock and wood structures will be created in the steeper project reaches and a channel with run-pool sequences and woody debris structures will be created in the low sloped project reaches for macroinvertebrate and fish habitat. Introduction of wood including root wads and woody 'riffles' along with native stream bank vegetation will substantially increase habitat value. Gravel areas will be added as appropriate to further diversify available habitats.
- Adjacent buffer areas will be restored by removing invasive vegetation and planting native vegetation. These areas will be allowed to receive more regular and inundating flows. Riparian wetland areas will be restored and enhanced to provide wetland habitat.
- Sediment input from eroding stream banks will be reduced by installing bioengineering and in-stream structures while creating a stable channel form using geomorphic design principles.

### *Expected Project Benefits*

- Chemical fertilizer and pesticide levels will be decreased by filtering runoff from adjacent tree farm operations through restored native buffer zones and wetlands. Offsite nutrient input will be absorbed onsite by filtering flood flows through restored floodplain areas and wetlands, where flood flows can disperse through native vegetation and be captured in vernal pools. Increased surface water residency time will provide contact treatment time and groundwater recharge potential.
- Sediment from offsite sources will be captured during bankfull or greater flows by deposition on restored floodplain areas where native vegetation will slow overland flow velocities.
- Restored riffle/step-pool sequences on the upper reach of UT<sub>1a</sub>, where distinct points of re-aeration can occur, will allow for oxygen levels to be maintained in the perennial reaches. Small log steps on the upstream portion of UT<sub>1b</sub> and UT<sub>1</sub> Reach 1 Upper will also provide re-aeration points.
- Creation of deep pool zones will lower temperature, helping to maintain dissolved oxygen concentrations. Pools will form below drops on the steeper project reaches and around areas of woody debris on the low-sloped project reaches. Establishment and maintenance of riparian buffers will create long-term shading of the channel flow to minimize thermal heating.

The stream restoration success criteria for the Site follows the approved performance criteria presented in the NCEEP Mitigation Plan Template (version 1.0, 11/20/2009) and the Stream Mitigation Guidelines issued in April 2003 by the USACE and NCDWQ. Annual monitoring and quarterly site visits will be conducted to assess the condition of the finished project for five years, or until success criteria are met. The stream restoration reaches (UT<sub>1</sub>, UT<sub>1a</sub>, and UT<sub>1b</sub>) of the project were assigned specific performance criteria components for stream morphology, hydrology, and vegetation. The enhancement reaches (UT<sub>1c</sub> and UT<sub>1d</sub>) were documented through photographs and visual assessments to verify that no significant degradational changes are occurring in the stream channel or riparian corridor. Monitoring for wetland vegetation will extend seven years beyond completion of construction. The wetland restoration and creation sections have been assigned specific performance criteria for hydrology and vegetation.

#### *1.2 Monitoring Year 1 Data Assessment*

The final mitigation plan was submitted and accepted by the NCEEP in August 2011. Construction activities were completed by River Works, Inc. in April 2012. The baseline monitoring (Year 0 of 5) and as-built survey were conducted in April and May 2012. The first annual monitoring assessment (Year 1 of 5) was completed in October 2012. The Site will be monitored for a total of seven (7) years; the stream and vegetation assessment will be monitored for five (5) years and the wetland assessment will be monitored for seven (7) years. The final monitoring activities will be conducted in 2018 and the close-out in 2019. Monitoring consists of collecting morphological, vegetative, and hydrological data on an annual basis to assess the project success based on the restoration goals and objectives. The success of the Site will be assessed using measurements of the stream channel's dimension, pattern, and

profile, permanent photographs, stream and wetland vegetation, and groundwater and surface water hydrology. Any areas with identified high priority problems, such as stream bank instability, aggradation/degradation, lack of vegetation establishment, or failure to meet groundwater hydrology success criteria, will be evaluated on a case-by-case basis. The problem areas will be visually noted and remedial actions will be discussed with NCEEP staff to determine a plan of action.

#### 1.2.1 Vegetative Assessment

A total of 35 vegetation monitoring plots were installed and evaluated within the restoration, enhancement, and creation areas to measure the survival of the planted trees. The number of monitoring quadrants required is based on the NCEEP monitoring guidance documents (version 2.0, 10/14/10). The size of individual quadrants is 100 square meters for woody tree species and shrubs. Vegetation assessments were conducted following the Carolina Vegetation Survey (CVS) Level 2 Protocol for Recording Vegetation (Lee et al., 2008).

The initial baseline survey was conducted within 21 days from completion of site planting and will be used for subsequent monitoring year comparisons. The plot corners were marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs at the origin looking diagonally across the plot to the opposite corner were taken to capture the same reference photograph locations as the as-built. 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 (5) 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 (3) of the monitoring period.

The monitoring year 1 (MY-1) vegetative survey was completed in September 2012. The 2012 annual vegetation monitoring resulted in an average survivability of 372 stems per acre, which is greater than the interim requirement of 320 stems/acre, but approximately 30% less than the baseline density recorded (531 stems/acre) in April 2012. There was an average of 9 stems per plot compared to 13 stems per plot in MY-0. A total of 26 out of 35 plots were on track to meet the success criteria required for MY-3 (Table 7, Appendix 3). A vegetative maintenance plan is presented below to address the low stem density observed during MY-1. Please refer to Appendix 3 for vegetation summary tables and raw data tables and Appendix 2 for vegetation plot photographs and the vegetation condition assessment table.

#### *Maintenance Plan*

The Site will be re-planted in late winter 2012 in response to the quantity of dead bare roots observed during the 2012 vegetative survey. Most likely, the high mortality of the planted stems was a result of dry soil conditions, low precipitation, and/or from grass suffocation or crowding of planted stems. To promote better success, the planting list will be modified slightly to account for species that were not successful in the initial planting. The small

areas where invasive species have been noted will continue to be monitored and treated on a regular basis.

#### 1.2.2 Stream Assessment

In order to monitor the channel dimension, a total of 12 permanent cross-sections have been installed along the UTs to Lyle Creek; 8 on UT<sub>1</sub>, 2 on UT<sub>1a</sub>, and 2 on UT<sub>1b</sub>. Cross-sections are located at representative riffle/run and pool sections on each monitored reach. Each cross-section is permanently marked with pins to establish its location. Cross-section surveys will be performed annually and will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg.

A longitudinal profile was completed for 4,460 LF of the restoration reaches (3,000 LF on UT<sub>1</sub>, 615 LF on UT<sub>1a</sub> and 845 LF on UT<sub>1b</sub>) on the Site immediately post-construction and will be repeated annually throughout the five year monitoring period. The initial as-built survey will be used for baseline comparisons. Measurements in the survey will include thalweg, water surface, bankfull, and top of low bank. These profile measurements will be taken at the head of each riffle, run, pool, and glide, as well as at the maximum pool depth. The survey will be tied to a permanent benchmark and NC State Plane coordinates.

A total of 34 permanent photographs were established within the project stream and wetland areas after construction. Photographs will be taken once a year to visually document stability for five years following construction. Permanent markers were established so that the same locations and view directions on the site are monitored each year. Photographs will be used to monitor restoration, enhancement, and creation stream and wetland areas as well as vegetation plots. The photographer will make every effort to maintain the same area in each photo over time. Reference photos were also taken for each of the vegetation plots and cross-sections. The representative digital photo(s) will be taken on the same day the surveys are conducted.

Because the streams through the project site are dominated by sand and silt-size particles, pebble count and/or bulk sampling procedures would not show a significant change in bed material size or distribution over the monitoring period; therefore, bed material analyses will not be conducted for this project.

Bankfull events will be documented using a crest gage, photographs, and visual assessments such as debris lines. Three crest gages were installed; one on UT<sub>1</sub>, one on UT<sub>1a</sub>, and one on UT<sub>1b</sub>. The crest gages were installed in a permanent riffle cross-section of the restored channels. The gages will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition.



Visual assessments will be conducted along all reaches each year to obtain qualitative geomorphic data. Each visual assessment evaluation after the baseline survey will include re-evaluation along the same profile.

Morphological surveys for the MY-1 were conducted in October 2012. All streams within the Site met the success criteria for MY-1. Please refer to Appendix 2 for the visual assessment table, current condition plan view (CCPV), and photographs and Appendix 4 for 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. However due to the sand/silt nature of the substrate throughout the project, fluctuations in bed elevations are expected. These fluctuations should be temporary and likely correspond to storm events. Surveyed riffle cross-sections fell within the parameters defined for channels of the appropriate Rosgen stream type. Cross-sections 9 and 10 along UT1A experienced sedimentation from the contributing offsite watershed. The sedimentation has not impacted channel stability. These cross-sections will be monitored with the expectation that the channel will reestablish dimension and stable channel form.

The surveyed longitudinal profile data for the stream restoration reaches 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. Aggradation was documented in the upper extent of UT1A. The adjustments in profile are the result of observed sediment input from the contributing watershed. In-stream structures, such as brush mattresses and sod mats used to enhance channel habitat and stability on the outside bank of meander bends are providing stability and habitat as designed. 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.

At the end of the five (5) year monitoring period, two (2) or more bankfull events must occur in separate years within the restoration reach. Bankfull events were recorded across the site (UT1, UT1A, and UT1B) with crest gages during the MY-1 data gathering. Please refer to Appendix 5 for hydrologic data.

### 1.2.3 Wetland Assessment

Groundwater monitoring gages were established throughout the wetland restoration and creation areas. The gages were installed at appropriate locations so that the data collected will provide an indication of groundwater levels throughout the wetland project area. A total of 8 groundwater gages were installed within the wetland areas; 5 in RW1 and 3 in RW2. Historical growing season data wasn't available for Catawba County therefore the growing season currently used for success criteria was applied from nearby Iredell County

growing season data. This growing season runs from April 7<sup>th</sup> to October 28<sup>th</sup> (203 days). However, additional growing season data is being collected by two soil temperature loggers that were installed one within each wetland. These probes will be used to better define the growing season using the threshold soil temperature of 41 degrees or higher measured at a depth of 12 inches (USACE, 2010) in subsequent monitoring years. The probes indicate a longer growing season than that adapted from Iredell County. A barrotroll logger and a rain gage were also installed onsite. All monitoring gages were downloaded on a quarterly basis and will be maintained on an as needed basis. Monitoring gage locations are depicted on the CCPV maps in Appendix 2.

The success criteria for wetland hydrology is to have a free groundwater surface within 12 inches of the ground surface for 7 percent of the growing season, which is measured on consecutive days under typical precipitation conditions. Since being installed in late March 2012 an onsite rainfall gage has recorded 13.38 inches of precipitation through mid-November. This is significantly lower than the historic annual precipitation average of 44.76 inches collected by nearby weather station Catawba 3 NNW, NC1579 (USDA, 2002). 3 of 8 gages met the annual wetland hydrology success criteria. The inconsistent range of wetland hydrology success across the site is likely due to drier than normal weather. Please refer to Appendix 5 for wetland hydrology data and plots. Two additional groundwater gages have recently been installed to provided better coverage in the wetlands areas. The locations of these gages will be included in future reports.

### *1.3 Monitoring Year 1 Summary*

All streams within the Site are stable and functioning as designed. Aggradation observed on UT1A will be monitored for indications of long term instability but over time the channel is expected to transport the additional sediment. The average stem density for the entire Site is on track to meeting the overall success criteria; however, a portion of the individual vegetation plots did not meet the MY-3 success criteria as seen in the CCPV. A vegetation maintenance plan has been proposed and will be implemented in late winter 2012. There has been one (1) bankfull event recorded along each restored project reach since construction commenced; therefore, the MY-5 stream hydrology attainment requirement has been partially met for the Site at this time. Currently 3 of 8 groundwater gages are meeting the success criteria for wetland hydrology. This is likely due to below normal precipitation. It is anticipated that success criteria will be met using a growing season interval defined by the onsite soil temperature loggers during years of typical rainfall.

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 *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-eeep-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://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. 2011. Lyle Creek Mitigation Plan. NCEEP, Raleigh, NC.

Wildlands Engineering, Inc. 2012. Lyle Creek Mitigation Site Baseline Monitoring Document and As-Built Baseline Report. NCEEP, Raleigh, NC.

## **APPENDIX 1. General Tables and Figures**

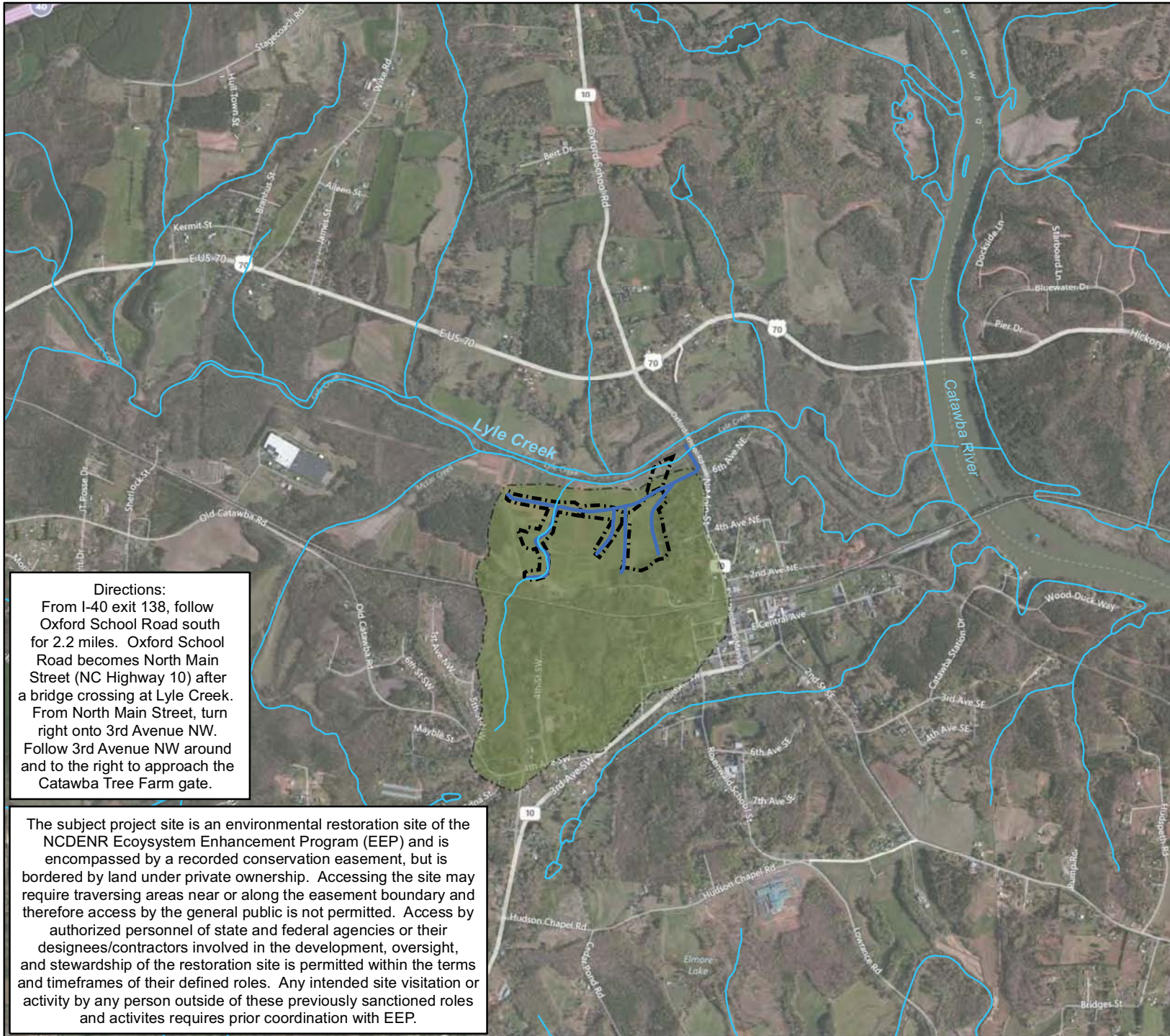



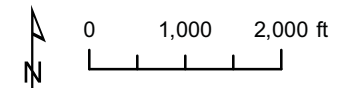


Figure 1 Project Vicinity Map  
 Lyle Creek Mitigation Site  
 NCEEP Project Number 94643  
 Monitoring Year 1 of 5

Catawba County, NC

-  Easement Area
-  Project Area Watershed
-  Project Streams



**Directions:**  
 From I-40 exit 138, follow Oxford School Road south for 2.2 miles. Oxford School Road becomes North Main Street (NC Highway 10) after a bridge crossing at Lyle Creek. From North Main Street, turn right onto 3rd Avenue NW. Follow 3rd Avenue NW around and to the right to approach the Catawba Tree Farm gate.

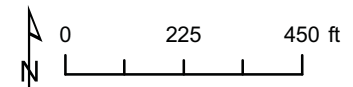
The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary 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 activities requires prior coordination with EEP.





Figure 2 Project Component/  
Asset Map  
Lyle Creek Mitigation Site  
NCEEP Project Number 94643  
Monitoring Year 1 of 5  
Catawba County, NC

-  Stream Restoration
-  Stream Enhancement
-  Braided Reach (no credit)
-  Wetland Restoration
-  Wetland Creation
-  Conservation Easement
-  Railroad
-  Power Lines



**Appendix 1. General Tables and Figures**  
**Table 1. Project Components and Mitigation Credits**  
**Lyle Creek Mitigation Site (NCEEP Project No.94643)**  
**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	5,411	554	6.6	1.0	N/A	N/A	N/A	N/A	N/A
Project Components									
Reach ID	As-Built Stationing/ Location	Existing Footage (LF)	Approach	Restoration or Restoration Equivalent	As-Built Mitigation Length/Area (LF/acres)	Mitigation Ratio			
UT1	100+00-141+30	4,071 LF	Priority 1/2	Restoration	3,951 LF <sup>1</sup>	1:1			
UT1a	300+00-306+15	1,141 LF	Priority 1	Restoration	615 LF <sup>2</sup>	1:1			
UT1b	201+52-209+97	890 LF	Priority 1/2	Restoration	845 LF <sup>3</sup>	1:1			
UT1c	400+00-406+77	695 LF	in-stream structures, grading, planting	Enhancement II	677 LF <sup>4</sup>	2.5:1			
UT1d	500+00-507+07	760 LF	in-stream structures, grading, planting	Enhancement II	707 LF	2.5:1			
RW1	N/A	N/A	grading, planting	Restoration	5.8 AC	1:1			
RW1	N/A	N/A	grading, planting	Creation	1.1 AC	3:1			
RW2	N/A	N/A	grading, planting	Restoration	0.8 AC	1:1			
RW2	N/A	N/A	grading, planting	Creation	1.8 AC	3:1			
Component Summation									
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)			
		Riverine	Non-Riverine						
Restoration	5,411	6.6							
Enhancement									
Enhancement I									
Enhancement II	1,384								
Creation		2.9							
Preservation									
High Quality Preservation									
BMP Elements									
Elements	Location		Purpose/Function		Notes				

BR = Bioretention Cell; S F= Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spreader; NI = Natural Infiltration Area; FB = Forested Buffer

<sup>1</sup> Excludes 179 LF in crossings (farm road and power line easements). Includes length from station 125+42 to 125+60 where left bank buffer width ranges from 48.5' to 50'. The right bank buffer width in this area exceeds 100'.

<sup>2</sup> Excludes downstream 306 LF of UT1a that is in the anastomosed wetland complex.

<sup>3</sup> Excludes downstream 243 LF of UT1b that is in the anastomosed wetland complex.

<sup>4</sup> Includes length from station 4+48 to 6+11 where left bank buffer width ranges from 28.7' to 50'. The right bank buffer width in this area ranges from 65.5' to 102.6'.



**Appendix 1. General Tables and Figures**

**Table 2. Project Activity and Reporting History**

**Lyle Creek Mitigation Site (NCEP Project No.94643)**

**Monitoring Year 1**

<b>Activity or Report</b>	<b>Date Collection Complete</b>	<b>Completion or Scheduled Delivery</b>
Mitigation Plan	May 2011	August 2011
Final Design - Construction Plans	October 2011	December 2011
Construction	Jan-Apr 2012	April 2012
Temporary S&E mix applied to entire project area*	April 2012	April 2012
Permanent seed mix applied to reach/segments	April 2012	April 2012
Bare root and live stake plantings for reach/segments	April 2012	April 2012
Baseline Monitoring Document (Year 0 Monitoring - baseline)	April 2012	July 2012
Year 1 Monitoring	October 2012	December 2012
Year 2 Monitoring	2013	December 2013
Year 3 Monitoring	2014	December 2014
Year 4 Monitoring	2015	December 2015
Year 5 Monitoring	2016	December 2016
Year 6 Monitoring	2017	December 2017
Year 7 Monitoring	2018	December 2018

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

**Appendix 1. General Tables and Figures**  
**Table 3. Project Contact Table**  
**Lyle Creek Mitigation Site (NCEEP Project No.94643)**  
**Monitoring Year 1**

<b>Designer</b>	<b>Wildlands Engineering, Inc.</b>
Emily Reinicker, PE, CFM	1430 S. Mint St, Suite 104 Charlotte, NC 28203 704.332.7754
<b>Construction Contractor</b>	<b>River Works, Inc.</b>
Bill Wright	6105 Chapel Hill Rd Raleigh, NC 27607 336.279.1002
<b>Planting Contractor</b>	<b>River Works, Inc.</b>
George Morris	6105 Chapel Hill Rd Raleigh, NC 27607 336.279.1002
<b>Seeding Contractor</b>	<b>River Works, Inc.</b>
George Morris	6105 Chapel Hill Rd Raleigh, NC 27607 336.279.1002
<b>Seed Mix Sources</b>	<b>Green Resource</b>
<b>Nursery Stock Suppliers</b>	<b>ArborGlen</b> <b>Superior Tree</b> <b>Mellow Marsh Farm</b>
<b>Monitoring Performers</b>	<b>Wildlands Engineering, Inc.</b>
Stream, Vegetation, and Wetland Monitoring POC	Kirsten Y. Gimbert 704.332.7754, ext. 110

**Appendix 1. General Tables and Figures**  
**Table 4. Project Information and Attributes**  
**Lyle Creek Mitigation Site (NCEP Project No.94643)**  
**Monitoring Year 1**

Project Information							
Project Name	Lyle Creek Mitigation Site						
County	Catawba County, NC						
Project Area (acres)	26.62						
Project Coordinates (latitude and longitude)	35° 42' 39.218" N, 81° 4' 54.628" W						
Project Watershed Summary Information							
Physiographic Province	Piedmont						
River Basin	Catawba						
USGS Hydrologic Unit 8-digit	03050101						
USGS Hydrologic Unit 14-digit	03050101140010						
DWQ Sub-basin	Catawba River Subbasin 03-08-32						
Project Drainage Area (acres)	315						
Project Drainage Area Percentage of Impervious Area	5%						
CGIA Land Use Classification	50% Forested, 20% Developed, 17% Agricultural, 8% Shrubland, 5% Herbaceous Upland						
Reach Summary Information							
Parameters	UT1	UT1A	UT1B	UT1C	UT1D	RW1	RW2
Length of reach (linear feet) - Post-Restoration	3,941 <sup>1</sup>	615 <sup>2</sup>	845 <sup>3</sup>	677	707	N/A	N/A
Drainage area (acres)	315	56	78	26	9	96	134
NCDWQ stream identification score	Lyle Creek - 11-76-(4.5)						
NCDWQ Water Quality Classification	Lyle Creek - WS-IV:CA						
Morphological Description (stream type) of Pre-Existing	F5 <sup>4</sup> , F6 <sup>4</sup> , G6 <sup>4</sup>	F6 <sup>4</sup>	F6 <sup>4</sup>	F6 <sup>4</sup>	F6 <sup>4</sup>	N/A	N/A
Morphological Description (stream type) of Design	B5c, C6	B6c, C6	C6	C6	C6	N/A	N/A
Evolutionary trend (Simon's Model) - Pre- Restoration	Stage II - Channelized						
Underlying mapped soils	Chewacla loam	Chewacla loam	Wehadkee fine sandy loam	Chewacla loam	Congaree complex	Chewacla loam and Wehadkee fine sand	Chewacla loam
Drainage class	somewhat poorly drained	somewhat poorly drained	frequently flooded	somewhat poorly drained	moderately well drained	somewhat poorly drained and frequently flooded	somewhat poorly drained
Soil Hydric status	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Slope	0-2%	0-2%	0-2%	0-2%	0-2%	0-2%	0-2%
FEMA classification	AE <sup>5</sup>						
Native vegetation community	Palustrine Emergent System						
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	X					
Division of Land Quality (Dam Safety)	N/A	N/A	N/A				
Endangered Species Act	X	X	Lyle Creek Mitigation Plan: two federally listed species, the bald eagle ( <i>Haliaeetus leucocephalus</i> ) and dwarf-flowered hearleaf ( <i>Hexastylis naniflora</i> ), are currently listed in Catawba County. Studies found "no individual species, critical habitat, or suitable habitat was found to exist on the site" (letter to USFWS; no response was received within the 30-day time frame from USFWS)				
Historic Preservation Act	X	X					
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A				
FEMA Floodplain Compliance	X	X	No-rise certification and floodplain development permit approved by Catawba County floodplain administrator.				
Essential Fisheries Habitat	X	X	Project area has warm water fisheries; found no reason to object to the restoration project (letter from NCWRC)				

<sup>1</sup> Excludes 200 LF of crossings

<sup>2</sup> Excludes 306 LF of UT1a in the anastomosed wetlands complex

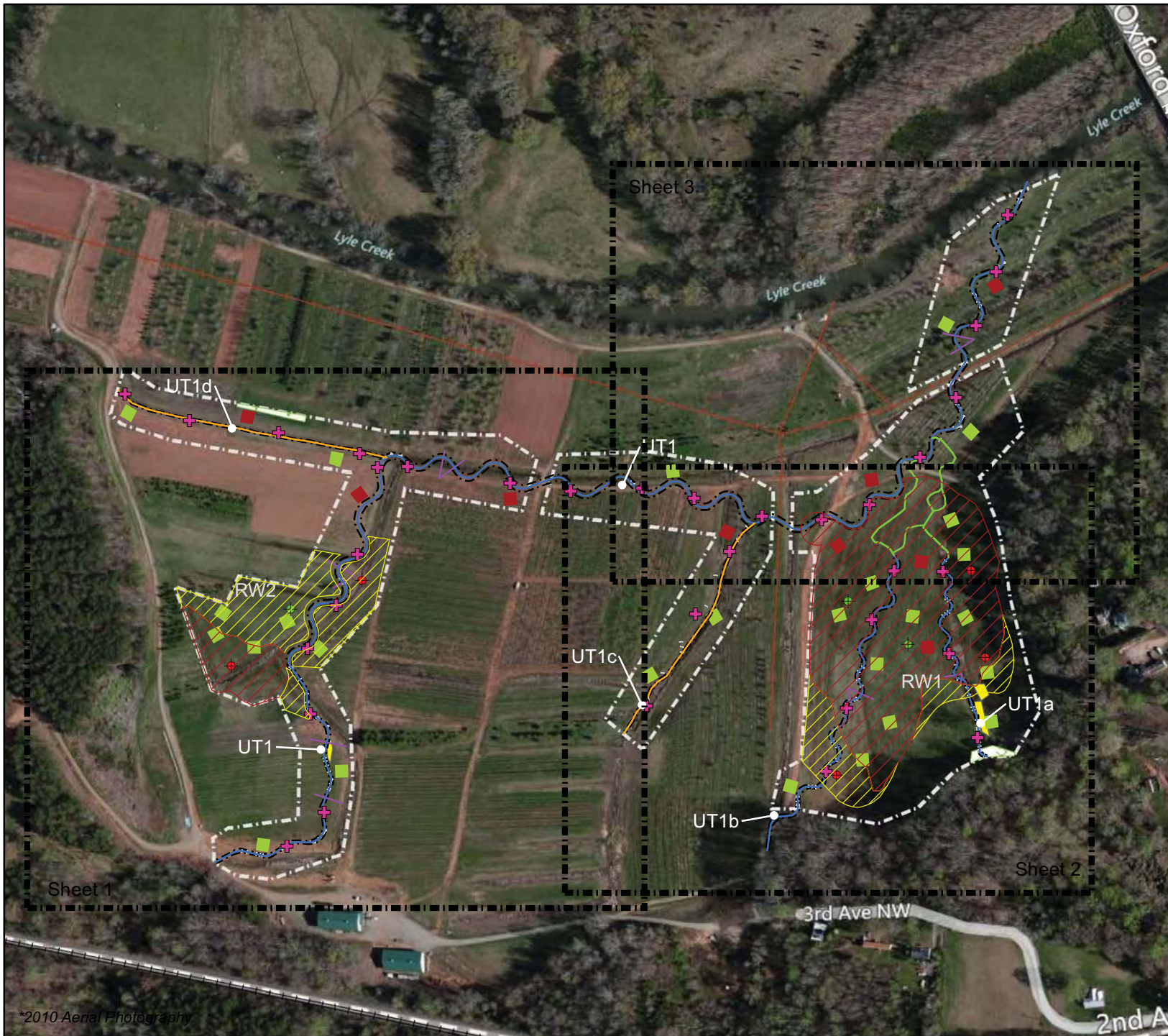
<sup>3</sup> Excludes 243 LF of UT1b in the anastomosed wetlands complex

<sup>4</sup> The Rosgen classification system is for natural streams. These channels have been heavily manipulated by man and therefore the Rosgen classification system is not applicable. These classifications are provided for illustrative purposes only.

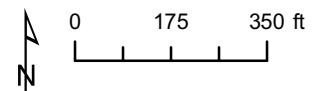
<sup>5</sup> The project area does not have an associate regulated floodplain; however, the project reaches and wetland areas area located within the floodway and flood fringe of Lyle Creek.

## APPENDIX 2. Visual Assessment Data

Figure 3 Integrated Current Condition Plan View (Key)  
 Lyle Creek Mitigation Site  
 NCEEP Project Number 94643  
 Monitoring Year 1 of 5  
 Catawba County, NC



- Conservation Easement
- Power Lines
- Railroad
- Wetland Restoration
- Wetland Creation
- Braided Reach (no credit)
- Stream Enhancement
- Stream Restoration
- Designed Bankfull
- Cross-Sections (XS)
- Structures
- Photo Points (PP)
- Groundwater Gage (GG)
  - Criteria Met
  - Criteria Not Met
- Vegetation Plot Condition - MY1
  - Criteria Met
  - Criteria Not Met
  - Bare Areas
  - Invasive Areas



\*2010 Aerial Photography



\*2010 Aerial Photography

Figure 3.1 Integrated Current Condition Plan View  
 (Sheet 1 of 3)  
 Lyle Creek Mitigation Site  
 NCEEP Project Number 94643  
 Monitoring Year 1 of 5  
 Catawba County, NC

- Conservation Easement
- Power Lines
- Railroad
- Wetland Restoration
- Wetland Creation
- Braided Reach (no credit)
- Stream Enhancement
- Stream Restoration
- Designed Bankfull
- Cross-Sections (XS)
- Structures
- Photo Points (PP)
- Groundwater Gage (GG)
- Criteria Met
- Criteria Not Met
- Vegetation Plot Condition - MY1**
- Criteria Met
- Criteria Not Met
- Bare Areas
- Invasive Areas

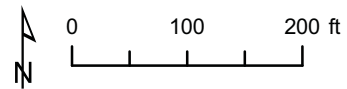
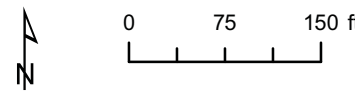


Figure 3.2 Integrated Current Condition Plan View  
 (Sheet 2 of 3)  
 Lyle Creek Mitigation Site  
 NCEEP Project Number 94643  
 Monitoring Year 1 of 5  
 Catawba County, NC



- Conservation Easement
- Power Lines
- Railroad
- Wetland Restoration
- Wetland Creation
- Braided Reach (no credit)
- Stream Enhancement
- Stream Restoration
- Designed Bankfull
- Cross-Sections (XS)
- Structures
- Photo Points (PP)
- Groundwater Gage (GG)
- Criteria Met
- Criteria Not Met
- Vegetation Plot Condition - MY1**
- Criteria Met
- Criteria Not Met
- Bare Areas
- Invasive Areas



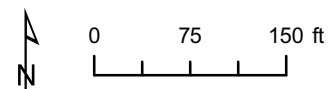
\*2010 Aerial Photography



\*2010 Aerial Photography

Figure 3.3 Integrated Current Condition Plan View  
 (Sheet 3 of 3)  
 Lyle Creek Mitigation Site  
 NCEEP Project Number 94643  
 Monitoring Year 1 of 5  
 Catawba County, NC

- Conservation Easement
- Power Lines
- Railroad
- Wetland Restoration
- Wetland Creation
- Braided Reach (no credit)
- Stream Enhancement
- Stream Restoration
- Designed Bankfull
- Cross-Sections (XS)
- Structures
- Photo Points (PP)
- Groundwater Gage (GG)**
- Criteria Met
- Criteria Not Met
- Vegetation Plot Condition - MY1**
- Criteria Met
- Criteria Not Met
- Bare Areas
- Invasive Areas





**Appendix 2. Visual Assessment Data**  
**Table 5a. Visual Stream Morphology Stability Assessment Table**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 1 Upper (700 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%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	15	15			100%			
	3. Meander Pool Condition	Depth Sufficient	6	9			67%			
		Length Appropriate	9	9			100%			
	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%					
<b>Totals</b>					0	0	100%	0	0	100%
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>					0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	40	40			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	39	39			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	24	24			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	40	40			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth $\geq$ 1.6 Rootwads/logs providing some cover at baseflow.	6	6			100%			

**Appendix 2. Visual Assessment Data**  
**Table 5b. Visual Stream Morphology Stability Assessment Table**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 1 Lower (2,558 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%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	24	24		100%				
	3. Meander Pool Condition	Depth Sufficient	29	29		100%				
		Length Appropriate	29	29		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	29	29		100%				
		Thalweg centering at downstream of meander bend (Glide)	29	29	100%					
<b>Totals</b>					0	0	100%	0	0	100%
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>					0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	34	34			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	30	30			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%.	34	34			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth $\geq$ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			

**Appendix 2. Visual Assessment Data**  
**Table 5c. Visual Stream Morphology Stability Assessment Table**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 2 (883 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%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	12	12		100%				
	3. Meander Pool Condition	Depth Sufficient	10	10		100%				
		Length 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%					
<b>Totals</b>					0	0	100%	0	0	100%
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>					0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	16	16			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	13	13			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	4	4			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	16	16			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth $\geq$ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			

**Appendix 2. Visual Assessment Data**

**Table 5d. Visual Stream Morphology Stability Assessment Table**

**Lyle Creek Mitigation Site (EEP Project No. 94643)**

**UT1A (615 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	8	8		100%				
	3. Meander Pool Condition	Depth Sufficient <sup>1</sup>	17	20		85%				
		Lenth Appropriate	11	11		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	11	11		100%				
		Thalweg centering at downstream of meander bend (Glide)	11	11		100%				
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>					0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	43	43			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	43	43			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	35	35			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	43	43			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow. <sup>1</sup>	6	10			60%			

<sup>1</sup> Pools are expected to fill in slightly and re-scour over time due to the fine-grained substrate in the system.

**Appendix 2. Visual Assessment Data**  
**Table 5e. Visual Stream Morphology Stability Assessment Table**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1B (997 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	11	11			100%			
	3. Meander Pool Condition	Depth Sufficient	18	19			95%			
		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%			
<b>Totals</b>										
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>										
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	31	31			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	31	31			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	21	21			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	31	31			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth $\geq$ 1.6 Rootwads/logs providing some cover at baseflow.	0	0			100%			

**Appendix 2. Visual Assessment Data**  
**Table 6. Vegetation Condition Assessment Table**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Monitoring Year 1**

Planted Acreage 26.2

Vegetation Category	Definitions	Mapping Threshold (acres)	Number of Polygons	Combined Acreage	% of Planted Acreage*
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	0	0	0.00%
Low Stem Density Areas^	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	7	0.2	0.7%
<b>Total</b>			<b>7</b>	<b>0.2</b>	<b>0.7%</b>
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 acres	0	0	0%
<b>Cumulative Total</b>			<b>7</b>	<b>0.2</b>	<b>1%</b>

Easement Acreage 26.62

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	2	0.12	0.5%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

^Acreage calculated from vegetation plots monitored for site.

## Stream Photographs

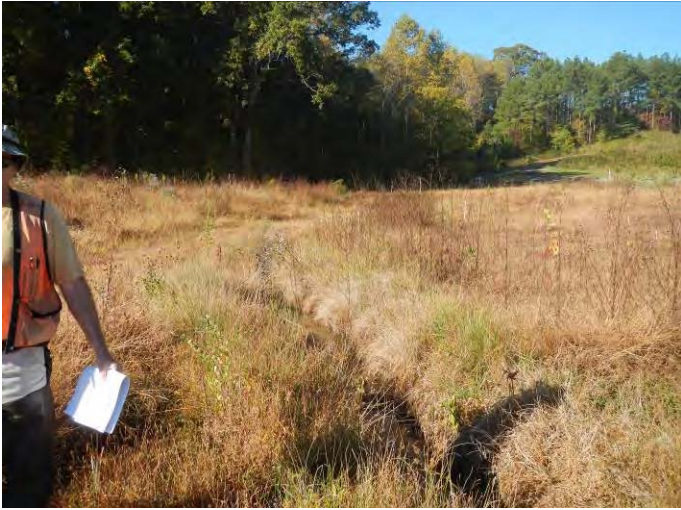


Photo Point 1 – looking upstream (10/16/2012)



Photo Point 1 – looking downstream (10/16/2012)



Photo Point 2 – looking upstream (10/16/2012)



Photo Point 2 – looking downstream (10/16/2012)



Photo Point 3 – looking upstream (10/16/2012)



Photo Point 3 – looking downstream (10/16/2012)





Photo Point 4 – looking upstream (10/16/2012)



Photo Point 4 – looking downstream (10/16/2012)



Photo Point 5 – looking upstream (10/16/2012)



Photo Point 5 – looking downstream (10/16/2012)



Photo Point 6 – looking upstream (10/16/2012)



Photo Point 6 – looking downstream (10/16/2012)



Photo Point 7 – looking upstream (10/16/2012)



Photo Point 7 – looking downstream (10/16/2012)



Photo Point 8 – looking upstream (10/16/2012)



Photo Point 8 – looking downstream (10/16/2012)



Photo Point 9 – looking upstream (10/16/2012)



Photo Point 9 – looking downstream (10/16/2012)



Photo Point 10 – looking upstream (10/16/2012)



Photo Point 10 – looking downstream (10/16/2012)



Photo Point 11 – looking upstream (10/16/2012)



Photo Point 11 – looking downstream (10/16/2012)



Photo Point 12 – looking upstream (10/16/2012)



Photo Point 12 – looking downstream (10/16/2012)



Photo Point 13 – looking upstream (10/16/2012)



Photo Point 13 – looking downstream (10/16/2012)



Photo Point 14 – looking upstream (10/16/2012)



Photo Point 14 – looking downstream (10/16/2012)



Photo Point 15 – looking upstream (10/16/2012)



Photo Point 15 – looking downstream (10/16/2012)



Photo Point 16 – looking upstream (10/16/2012)



Photo Point 16 – looking downstream (10/16/2012)



Photo Point 17 – looking upstream (10/16/2012)



Photo Point 17 – looking downstream (10/16/2012)



Photo Point 18 – looking upstream (10/16/2012)



Photo Point 18 – looking downstream (10/16/2012)



Photo Point 19 – looking upstream (10/16/2012)



Photo Point 19 – looking downstream (10/16/2012)



Photo Point 20 – looking upstream (10/16/2012)



Photo Point 20 – looking downstream (10/16/2012)



Photo Point 21 – looking upstream (10/16/2012)



Photo Point 21 – looking downstream (10/16/2012)



Photo Point 22 – looking upstream (10/16/2012)



Photo Point 22 – looking downstream (10/16/2012)



Photo Point 23 – looking upstream (10/16/2012)



Photo Point 23 – looking downstream (10/16/2012)



Photo Point 24 – looking upstream (10/16/2012)



Photo Point 24 – looking downstream (10/16/2012)



Photo Point 25 – looking upstream (10/16/2012)



Photo Point 25 – looking downstream (10/16/2012)



Photo Point 26 – looking upstream (10/16/2012)



Photo Point 26 – looking downstream (10/16/2012)



Photo Point 27 – looking upstream (10/16/2012)



Photo Point 27 – looking downstream (10/16/2012)





Photo Point 28 – looking upstream (10/16/2012)



Photo Point 28 – looking downstream (10/16/2012)



Photo Point 29 – looking upstream (10/16/2012)



Photo Point 29 – looking downstream (10/16/2012)



Photo Point 30 – looking upstream (10/16/2012)



Photo Point 30 – looking downstream (10/16/2012)



Photo Point 31 – looking upstream (10/16/2012)



Photo Point 31 – looking downstream (10/16/2012)



Photo Point 32 – looking upstream (10/16/2012)



Photo Point 32 – looking downstream (10/16/2012)



Photo Point 33 – looking upstream (10/16/2012)



Photo Point 33 – looking downstream (10/16/2012)

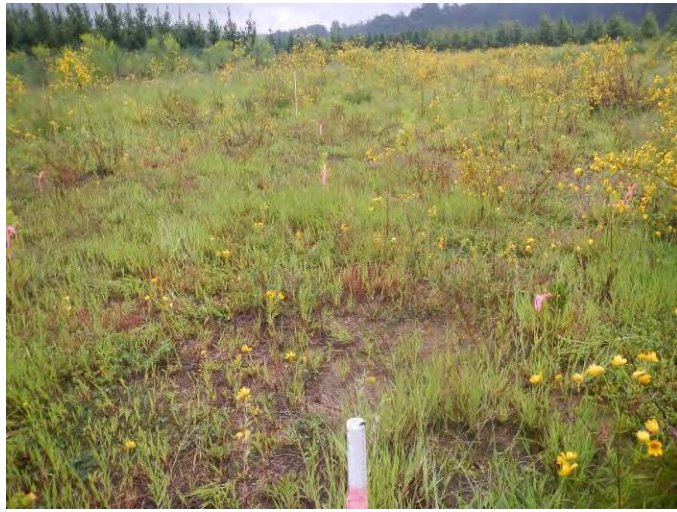


Photo Point 34 – looking upstream (10/16/2012)

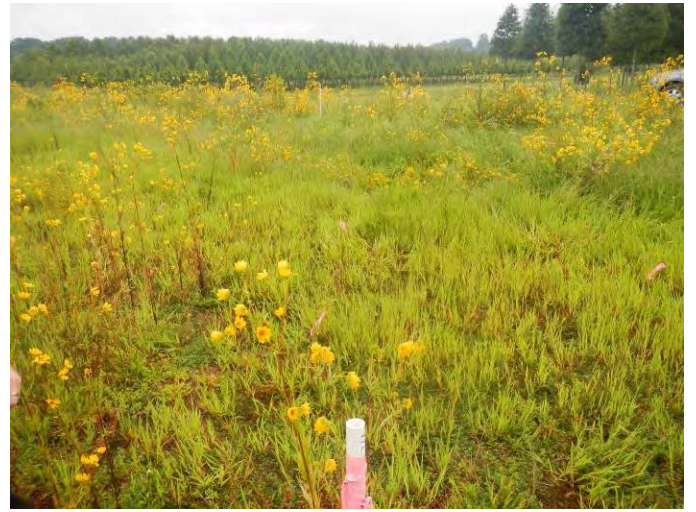


Photo Point 34 – looking downstream (10/16/2012)

## Vegetation Photographs



Vegetation Plot 1 (09/04/2012)



Vegetation Plot 2 (09/04/2012)



Vegetation Plot 3 (09/04/2012)



Vegetation Plot 4 (09/04/2012)



Vegetation Plot 5 (11/16/2012)



Vegetation Plot 6 (09/04/2012)



Vegetation Plot 7 (09/04/2012)



Vegetation Plot 8 (09/04/2012)



Vegetation Plot 9 (11/16/2012)



Vegetation Plot 10 (09/04/2012)



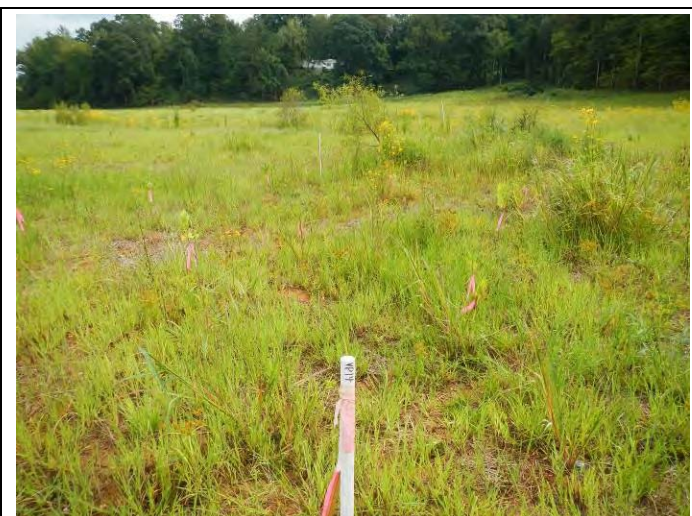
Vegetation Plot 11 (09/06/2012)



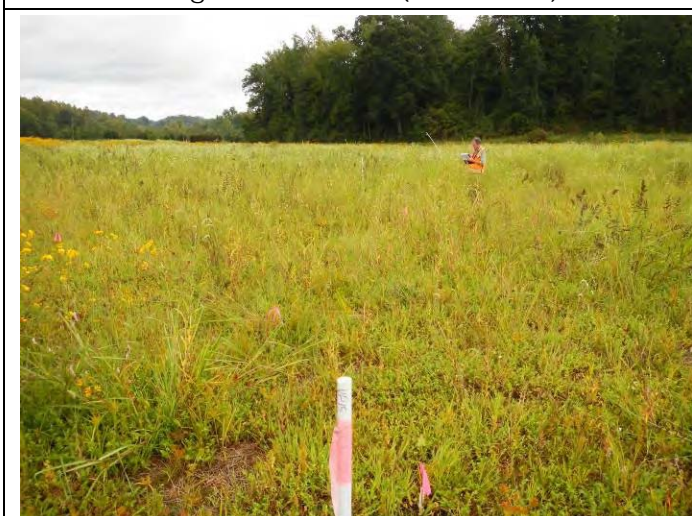
Vegetation Plot 12 (09/06/2012)



Vegetation Plot 13 (09/06/2012)



Vegetation Plot 14 (09/05/2012)



Vegetation Plot 15 (09/05/2012)



Vegetation Plot 16 (09/05/2012)



Vegetation Plot 17 (09/06/2012)



Vegetation Plot 18 (09/06/2012)



Vegetation Plot 19 (09/04/2012)



Vegetation Plot 20 (09/04/2012)



Vegetation Plot 21 (09/04/2012)



Vegetation Plot 22 (09/04/2012)



Vegetation Plot 23 (09/05/2012)



Vegetation Plot 24 (09/05/2012)

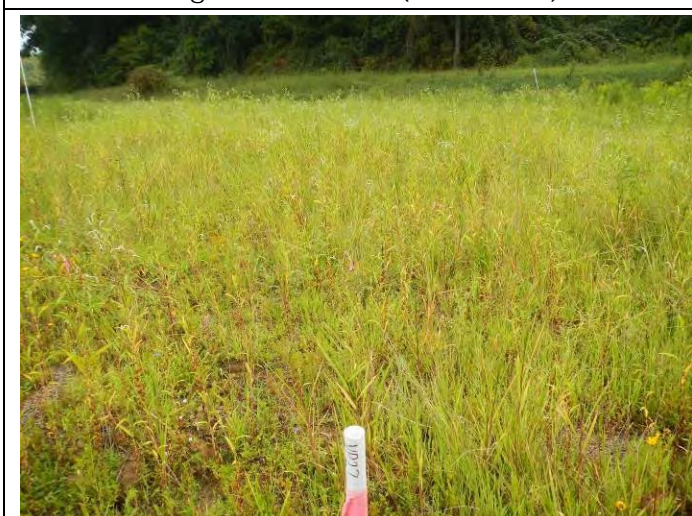




Vegetation Plot 25 (09/05/2012)



Vegetation Plot 26 (09/06/2012)



Vegetation Plot 27 (09/06/2012)



Vegetation Plot 28 (09/06/2012)



Vegetation Plot 29 (09/06/2012)



Vegetation Plot 30 (09/04/2012)



Vegetation Plot 31 (09/06/2012)



Vegetation Plot 32 (09/05/2012)



Vegetation Plot 33 (09/05/2012)



Vegetation Plot 34 (09/05/2012)



Vegetation Plot 35 (09/05/2012)

## APPENDIX 3. Vegetation Plot Data

**Appendix 3. Vegetation Plot Data**

**Table 7. Vegetation Plot Criteria Attainment**

**Lyle Creek Mitigation Site (NCEEP Project No. 94643)**

**Monitoring Year 1**

<b>Plot</b>	<b>MY1 Success Criteria Met (Y/N)</b>	<b>Tract Mean</b>
1	Y	74%
2	Y	
3	Y	
4	N	
5	N	
6	Y	
7	N	
8	Y	
9	Y	
10	N	
11	Y	
12	N	
13	Y	
14	Y	
15	Y	
16	Y	
17	Y	
18	Y	
19	N	
20	Y	
21	N	
22	Y	
23	Y	
24	Y	
25	Y	
26	Y	
27	Y	
28	Y	
29	N	
30	N	
31	Y	
32	Y	
33	Y	
34	Y	
35	Y	

**Appendix 3. Vegetation Plot Data**

**Table 8. CVS Vegetation Plot Metadata**

**Lyle Creek Mitigation Site (NCEEP Project No. 94643)**

**Monitoring Year 1**

<b>Report Prepared By</b>	<i>Ian Eckardt</i>
<b>Date Prepared</b>	<i>10/1/2012 13:42</i>
<b>database name</b>	<i>Lyle Creek-cvs-eep-entrytool-v2.2.7 (MY-1).mdb</i>
<b>database location</b>	<i>Q:\ActiveProjects\005-02123 Lyle Creek Mitigation FDP\Monitoring\Monitoring Year 1\Vegetation Assessment</i>
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----</b>	
<b>Metadata</b>	<i>Description of database file, the report worksheets, and a summary of project(s) and project data.</i>
<b>Plots</b>	<i>Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.</i>
<b>Stem Count by Plot and Spp</b>	<i>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.</i>
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	94643
<b>project Name</b>	Lyle Creek Mitigation Site
<b>Description</b>	Stream and Wetland Mitigation
<b>length (ft)</b>	
<b>stream-to-edge width (ft)</b>	
<b>area (sq m)</b>	
<b>Required Plots (calculated)</b>	35
<b>Sampled Plots</b>	35

**Appendix 3. Vegetation Plot Data**

**Table 9a. Planted and Total Stem Counts (Species by Plot with Annual Means)**

**Lyle Creek Mitigation Site (NCEEP Project No. 94643)**

**UT1**

**Monitoring Year 1**

		Current Data (MY1-9/2012)																		Annual Means								
		UT1 Reach 1 Upper		UT1 Reach 1 Upper		UT1 Reach 1 Lower		UT1 Reach 1 Lower		UT1 Reach 1 Lower		UT1 Reach 1 Lower		UT1 Reach 1 Lower		UT1 Reach 2		UT1 Reach 2		UT1 Reach 2		Current Mean		MY0-4/2012				
Species	Common Name	Type	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		P	T	P	T		
			P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T		
<i>Acer negundo</i>	boxelder	Tree	2	2					1	1			2	2	1	1			2	2			2	2	3	3		
<i>Alnus serrulata</i>	hazel alder	Tree/Shrub			1	1									1	1			1	1			1	1	2	2		
<i>Betula nigra</i>	river birch	Tree																	2	2			2	2	2	2		
<i>Carpinus caroliniana</i>	American hornbeam	Tree/Shrub						1	1								1	1					1	1	2	2		
<i>Celtis laevigata</i>	sugarberry	Tree/Shrub			5	5											1	1					3	3	4	4		
<i>Diospyros virginiana</i>	common persimmon	Tree					1	1			3	3			1	1					1	1	2	2	1	1		
<i>Fraxinus pennsylvanica</i>	green ash	Tree			1	1	1	1			1	1	2	2			4	4	1	1			2	2	2	2		
<i>Liriodendron tulipifera</i>	tuliptree	Tree								1	1	3	3	1	1	2	2	1	1			2	2	2	2	2		
<i>Nyssa sylvatica</i>	blackgum	Tree	3	3																			3	3	2	2		
<i>Platanus occidentalis</i>	American sycamore	Tree	5	5	1	1	5	5					2	2	3	3					6	6	4	4	3	3		
<i>Quercus michauxii</i>	swamp chestnut oak	Tree					4	4	1	1													3	3	2	2		
<i>Quercus phellos</i>	willow oak	Tree			1	1	1	1											3	3			2	2	1	1		
<b>Plot Area (acres)</b>		<b>0.0247</b>																										
<b>Species Count</b>		3	3	5	5	5	5	3	3	3	3	4	4	5	5	4	4	6	6	2	2	4	4	5	5			
<b>Stem Count</b>		10	10	9	9	12	12	3	3	5	5	9	9	7	7	8	8	10	10	7	7	8	8	13	13			
<b>Stems per Acre</b>		405	405	364	364	486	486	121	121	202	202	364	364	283	283	324	324	405	405	283	283	372	372	531	531			

Type=Shrub or Tree

P = Planted

T = Total

Appendix 3. Vegetation Plot Data

Table 9b. Planted and Total Stem Counts (Species by Plot with Annual Means)

Lyle Creek Mitigation Site (NCEEP Project No. 94643)

UT1A, B, C and D

Monitoring Year 1

			Current Data (MY1-9/2012)																								Annual Means				
Species	Common Name	Type	UT1a		UT1a/RW1		UT1a/RW1		UT1b		UT1b/RW1		UT1b/RW1		UT1c		UT1c		UT1c		UT1d		UT1d		UT1d		Current Mean		MY0-4/2012		
			Plot 11		Plot 12		Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22		P		T		
			P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P
<i>Acer negundo</i>	boxelder	Tree													4	4	1	1					1	1			2	2	3	3	
<i>Alnus serrulata</i>	hazel alder	Tree/Shrub															1	1					1	1			1	1	2	2	
<i>Betula nigra</i>	river birch	Tree	2	2	1	1	3	3			5	5	2	2	4	4					1	1	1	1	3	3	2	2	2	2	
<i>Carpinus caroliniana</i>	American hornbeam	Tree/Shrub																									0	0	2	2	
<i>Celtis laevigata</i>	sugarberry	Tree/Shrub							1	1							1	1									1	1	4	4	
<i>Diospyros virginiana</i>	common persimmon	Tree													1	1											1	1	1	1	
<i>Fraxinus pennsylvanica</i>	green ash	Tree	3	3	1	1	5	5	10	10	3	3	5	5								2	2	1	1	3	3	4	4	2	2
<i>Liriodendron tulipifera</i>	tuliptree	Tree			2	2					5	5			1	1									1	1	2	2	2	2	
<i>Nyssa sylvatica</i>	blackgum	Tree	1	1	2	2	4	4					5	5													3	3	2	2	
<i>Platanus occidentalis</i>	American sycamore	Tree	5	5	1	1	1	1									3	3	1	1	8	8	3	3	2	2	3	3	3	3	
<i>Quercus michauxii</i>	swamp chestnut oak	Tree					1	1									1	1									1	1	2	2	
<i>Quercus phellos</i>	willow oak	Tree															1	1							1	1	1	1	1	1	
Plot Area (acres)			0.0247																												
Species Count			4	4	5	5	5	5	2	2	3	3	3	3	4	4	6	6	1	1	4	4	4	4	5	5	4	4	5	5	
Stem Count			11	11	7	7	14	14	11	11	13	13	12	12	10	10	8	8	1	1	12	12	6	6	10	10	9	9	13	13	
Stems per Acre			445	445	283	283	567	567	445	445	526	526	486	486	405	405	324	324	40	40	486	486	243	243	405	405	372	372	531	531	

Type=Shrub or Tree

P = Planted

T = Total

Appendix 3. Vegetation Plot Data

Table 9c. Planted and Total Stem Counts (Species by Plot with Annual Means)

Lyle Creek Mitigation Site (NCEEP Project No. 94643)

RW 1 and 2

Monitoring Year 1

Species	Common Name	Type	Current Data (MY1-9/2012)																						Annual Means																			
			UT1b/RW1		UT1b/RW1		UT1b/RW1		UT1b/RW1		UT1a/RW1		UT1a/RW1		UT1a/RW1		UT1 Reach 1 Lower		UT1a/RW1		RW2		UT1 Reach 1 Lower / RW2		RW2		RW2		Current Mean		MY0-4/2012													
			Plot 23	Plot 24	Plot 25	Plot 26	Plot 27	Plot 28	Plot 29	Plot 30	Plot 31	Plot 32	Plot 33	Plot 34	Plot 35	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T									
<i>Acer negundo</i>	boxelder	Tree																											2	2	3	3												
<i>Alnus serrulata</i>	hazel alder	Tree/Shrub																											1	1	2	2												
<i>Betula nigra</i>	river birch	Tree	1	1	3	3	3	3																				2	2	5	5	4	4	3	3	2	2							
<i>Carpinus caroliniana</i>	American hornbeam	Tree/Shrub																																		1	1	2	2					
<i>Celtis laevigata</i>	sugarberry	Tree/Shrub																																			2	2	4	4				
<i>Diospyros virginiana</i>	common persimmon	Tree																																			1	1	1	1				
<i>Fraxinus pennsylvanica</i>	green ash	Tree	3	3	2	2	4	4	1	1	1	1	3	3			1	1	3	3							1	1	1	1	1	1	3	3	3	3	2	2						
<i>Liriodendron tulipifera</i>	tuliptree	Tree																																			2	2	2	2				
<i>Nyssa sylvatica</i>	blackgum	Tree	4	4	4	4																																4	4	3	3	2	2	
<i>Platanus occidentalis</i>	American sycamore	Tree																																				3	3	3	3			
<i>Quercus michauxii</i>	swamp chestnut oak	Tree			1	1																																2	2	2	2			
<i>Quercus phellos</i>	willow oak	Tree																																					6	6	3	3	1	1
Plot Area (acres)			0.0247																																									
Species Count			3	3	5	5	4	4	4	4	4	4	4	2	2	3	3	4	4	4	4	2	2	3	3	4	4	4	4															
Stem Count			8	8	11	11	11	11	11	13	13	13	13	7	7	3	3	10	10	10	10	8	8	9	9	13	13	9	9	13	13	9	9	13	13	9	9	13	13					
Stems per Acre			324	324	445	445	445	445	445	526	526	526	526	283	283	121	121	405	405	405	405	324	324	364	364	526	526	372	372	531	531													

Type=Shrub or Tree

P = Planted

T = Total



## **APPENDIX 4. Morphological Summary Data and Plots**



**Appendix 4. Morphological Summary Data and Plots**  
**Table 10b. Baseline Stream Data Summary**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1A and UT1B**  
**Monitoring Year 1**

Parameter	Gauge	As-Built/Baseline											
		UT1A Upper		UT1A Lower		UT1B 200+00 to 203+20		UT1B 203+21 to 207+18		UT1B 207+18 to 209+97			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
<b>Dimension and Substrate - Riffle</b>													
Bankfull Width (ft)	n/a	5.8				4.5							
Floodprone Width (ft)		30.5				67.3							
Bankfull Mean Depth		0.4				0.5							
Bankfull Max Depth		0.8				1.0							
Bankfull Cross-sectional Area (ft <sup>2</sup> )		2.1				2.2							
Width/Depth Ratio		16.0				9.0							
Entrenchment Ratio		2.2+				2.2+							
Bank Height Ratio		1.0				1.0							
D50 (mm)													
<b>Profile</b>													
Riffle Length (ft)	n/a	8	19	10	23	19	31	15	22	10	20		
Riffle Slope (ft/ft)		0.0353	0.0477	0.0086	0.0290	0.0224	0.0593	0.0072	0.0323	0.0032	0.0217		
Pool Length (ft)		5	12	12	34	23	40	17	41	28	42		
Pool Max Depth (ft)		1.0	1.9	1.2	1.9	1.2	2.1	1.3	2.4	1.9	2.2		
Pool Spacing (ft)		4	33	29	90	43	71	34	61	46	66		
Pool Volume (ft <sup>3</sup> )													
<b>Pattern</b>													
Channel Beltwidth (ft)	n/a	N/A	N/A	25	35	35	39	23	39	29	41		
Radius of Curvature (ft)		N/A	N/A	14	20	19	27	16	26	19	26		
Rc:Bankfull Width (ft/ft)		N/A	N/A	2	3	2	3	2	3	2	3		
Meander Wave Length (ft)		N/A	N/A	53	82	83	106	78	86	79	90		
Meander Width Ratio		N/A	N/A	4	5	4	5	3	5	4	5		
<b>Substrate, Bed and Transport Parameters</b>													
Ri%/Ru%/P%/G%/S%	n/a												
SC%/Sa%/G%/C%/B%/Be%													
d16/d35/d50/d84/d95/d100		N/A											
Reach Shear Stress (Competency) lb/ft <sup>2</sup>		-											
Max part size (mm) mobilized at bankfull		-											
Stream Power (Capacity) W/m <sup>2</sup>													
<b>Additional Reach Parameters</b>													
Drainage Area (SM)	n/a												
Impervious Cover Estimate (%)													
Rosgen Classification		C				E							
Bankfull Velocity (fps)		-				-							
Bankfull Discharge (cfs)													
Q-NFF regression													
Q-USGS extrapolation													
Q-Mannings													
Valley Length (ft)													
Channel Thalweg Length (ft)		201		414		320		398		279			
Sinuosity (ft)		1.1		1.2		1.1		1.2		1.2			
Water Surface Slope (ft/ft)		0.0296		0.0089		0.0187		0.0080		0.0039			
Bankfull Slope (ft/ft)		0.0294		0.0091		0.0190		0.0079		0.0039			

(-): Data was not provided

N/A: Not Applicable

<sup>1</sup>Pre-Restoration Reaches differ from the as-built/baseline reaches.

<sup>2</sup>Channel was straightened, moved, and/or maintained to prevent pattern formation prior to restoration.

<sup>3</sup>The Rosgen classification system is for natural streams. These channels have been heavily manipulated by man and therefore the Rosgen classification system is not applicable.

<sup>4</sup>UT1 Reach 3 drops down to meet the Lyle Creek water surface elevation, which accounts for a channel slope steeper than the valley slope.

<sup>5</sup>Data not provided in reference reach report (Lowther, 2008).

<sup>6</sup>Data not provided in Neu-Con Umbrella Wetland and Stream Mitigation Bank Westbrook Lowgrounds Site Specific Mitigation Plan (Environmental Bank and Exchange).

<sup>7</sup>Lowther reported a range of possible discharges from 46.8 to 108.9 cfs based on different Manning's 'n' estimation techniques (Lowther, 2008).

**Appendix 4. Morphological Summary Data and Plots**

**Table 11. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross-Section)**

**Lyle Creek Mitigation Site (EEP Project No. 94643)**

**UT1 Reaches 1 and 2, UT1A and UT1B**

**Monitoring Year 1**

	UT1 Reach 1 Upper												UT1 Reach 1 Lower											
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Riffle)						Cross-Section 4 (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
<i>based on fixed bankfull elevation</i>																								
Bankfull Width (ft)	11.2	6.1					13.6	9.8					22.4	17.1					20.7	17.3				
Floodprone Width (ft)	65.0	63.8					N/A	N/A					62.6	63.4					N/A	N/A				
Bankfull Mean Depth (ft)	0.3	0.4					1.0	0.9					0.6	0.6					1.1	1.0				
Bankfull Max Depth (ft)	0.8	0.8					2.4	1.9					1.7	1.3					2.4	2.2				
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	3.3	2.2					14.2	9.8					14.3	9.7					22.5	16.8				
Bankfull Width/Depth Ratio	37.5	17.2					13.0	12.0					35.0	30.1					19.0	17.9				
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				
	UT1 Reach 1 Lower												UT1 Reach 2											
	Cross-Section 5 (Pool)						Cross-Section 6 (Riffle)						Cross-Section 7 (Riffle)						Cross-Section 8 (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
<i>based on fixed bankfull elevation</i>																								
Bankfull Width (ft)	16.6	16.9					12.3	13.3					14.7	11.5					22.1	21.0				
Floodprone Width (ft)	N/A	N/A					79.6	80.3					69.7	70.8					N/A	N/A				
Bankfull Mean Depth (ft)	1.0	0.9					0.7	0.7					0.8	0.9					1.2	1.0				
Bankfull Max Depth (ft)	2.1	1.9					1.5	1.3					1.8	1.7					2.9	2.1				
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	16.5	13.4					9.0	9.5					12.3	10.6					27.0	21.4				
Bankfull Width/Depth Ratio	16.7	16.6					16.8	18.5					17.6	12.5					18.1	20.5				
Bankfull Entrenchment Ratio	N/A	N/A					2.2+	2.2+					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				
	UT1A												UT1B											
	Cross-Section 9 (Riffle)						Cross-Section 10 (Pool)						Cross-Section 11 (Riffle)						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
<i>based on fixed bankfull elevation</i>																								
Bankfull Width (ft)	5.8	2.5					6.3	0.0					4.5	6.1					7.8	7.4				
Floodprone Width (ft)	30.5	31.4					N/A	N/A					67.3	66.5					N/A	N/A				
Bankfull Mean Depth (ft)	0.4	0.3					0.5	0.0					0.5	0.5					0.6	0.5				
Bankfull Max Depth (ft)	0.8	0.4					1.0	0.1					1.0	1.1					1.2	1.0				
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	2.1	0.7					2.9	0.0					2.2	2.8					4.6	4.0				
Bankfull Width/Depth Ratio	16.0	9.4					13.6	0.0					9.0	13.3					13.1	13.9				
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	0.0					1.0	1.0					1.0	1.0				





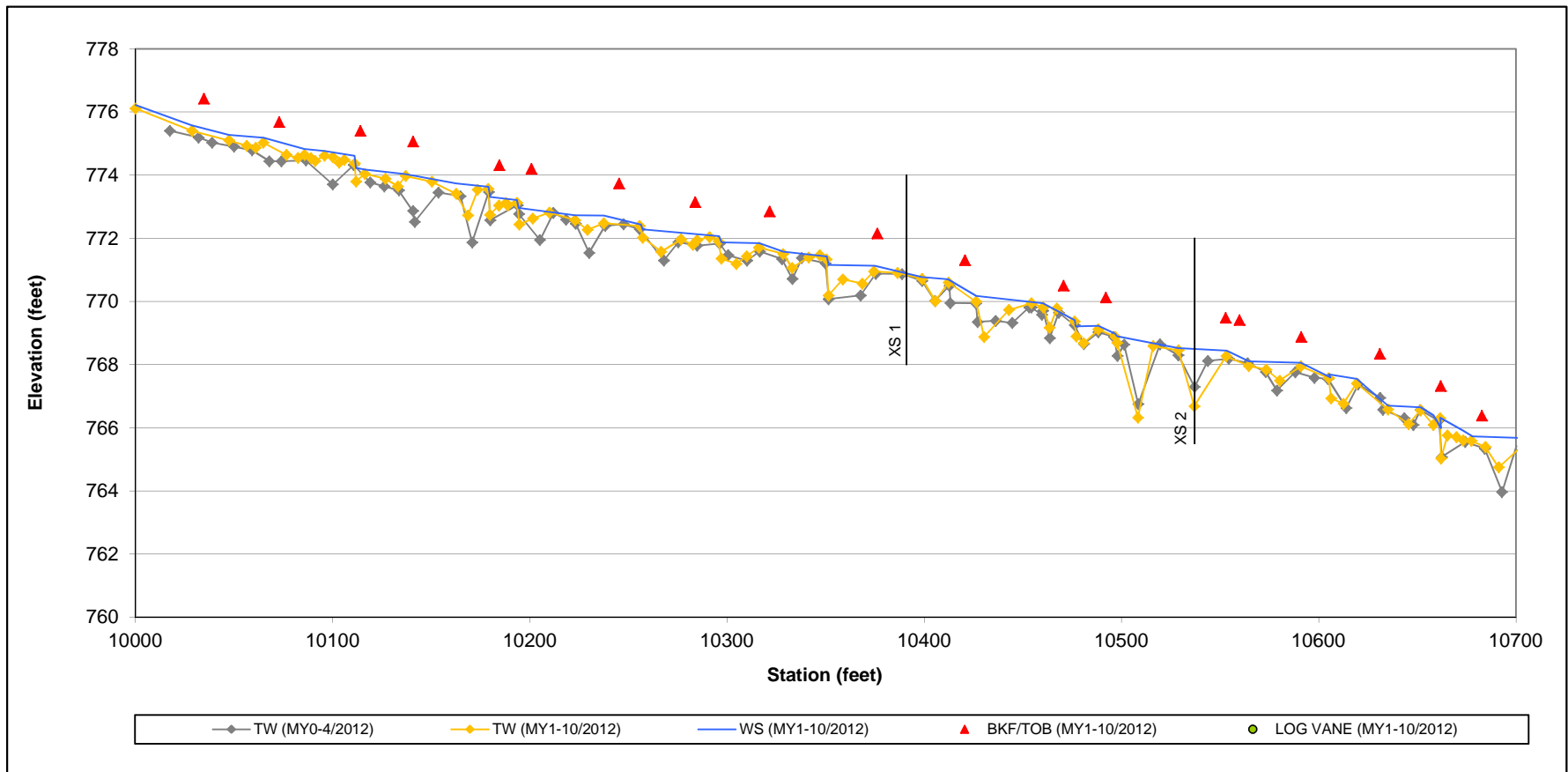




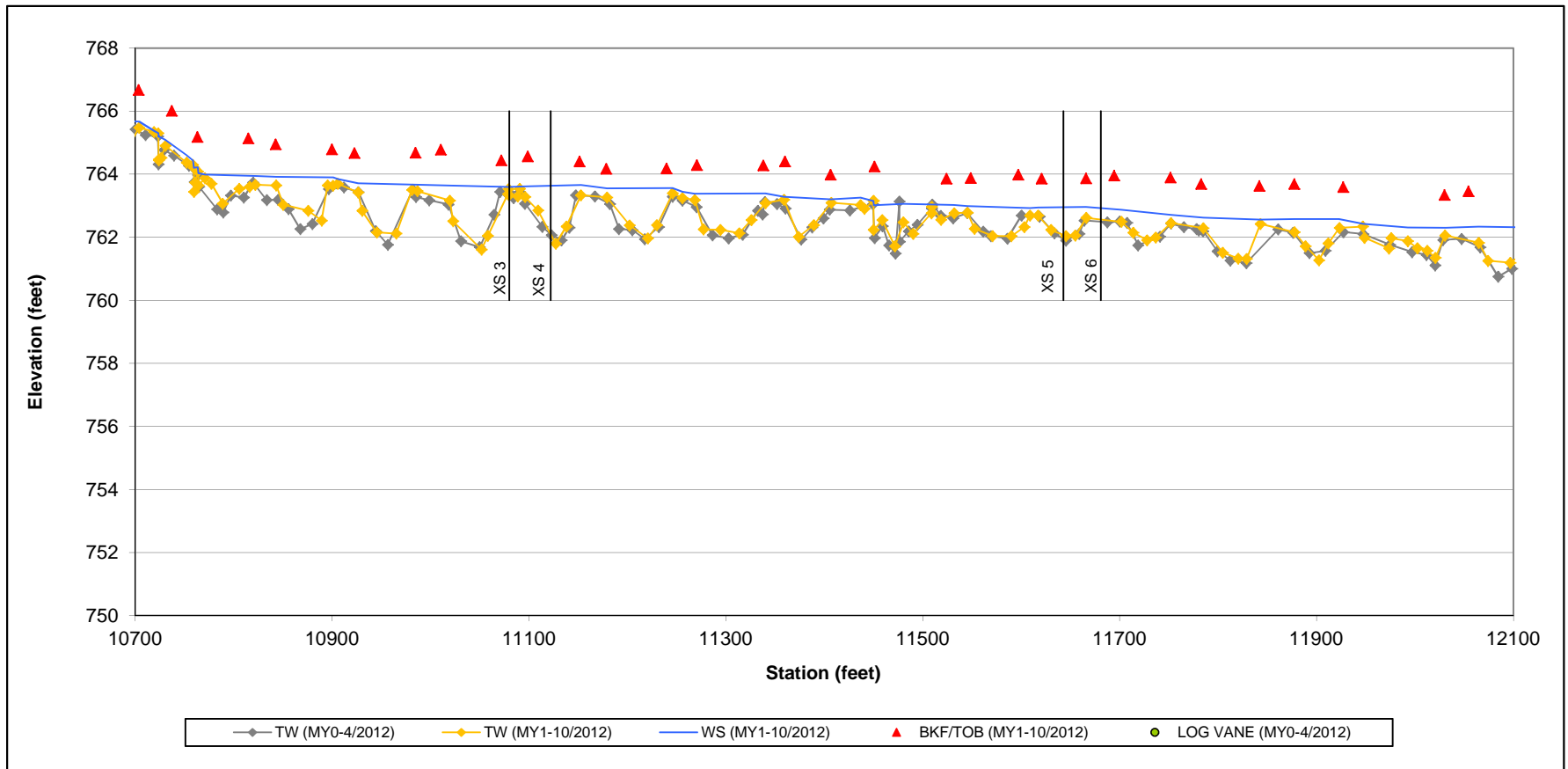




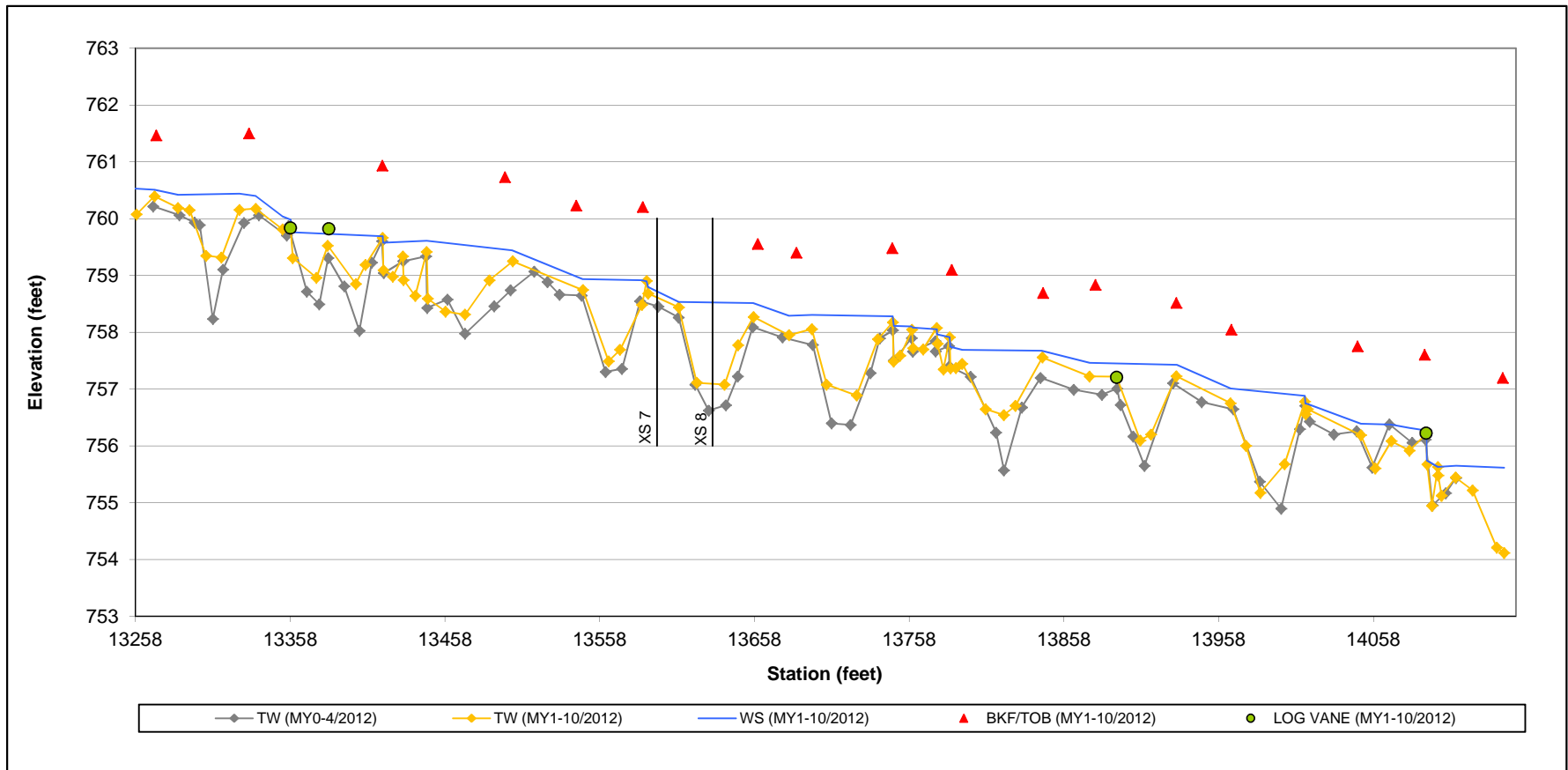
**Appendix 4. Morphological Summary Data and Plots**  
**Figure 4a. Longitudinal Profile Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 1 Upper**  
**Monitoring Year 1**



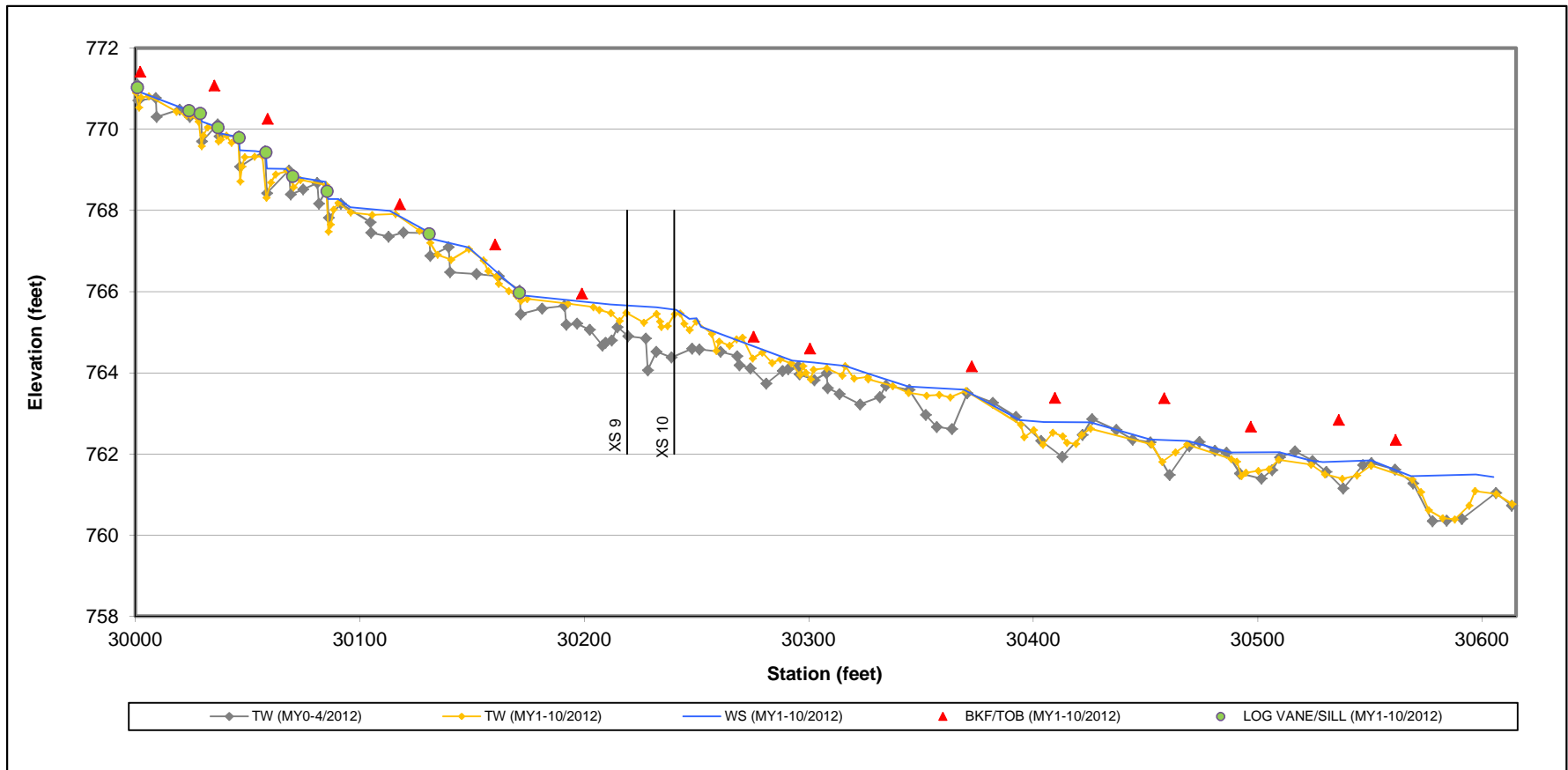
**Appendix 4. Morphological Summary Data and Plots**  
**Figure 4b. Longitudinal Profile Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 1 Lower**  
**Monitoring Year 1**



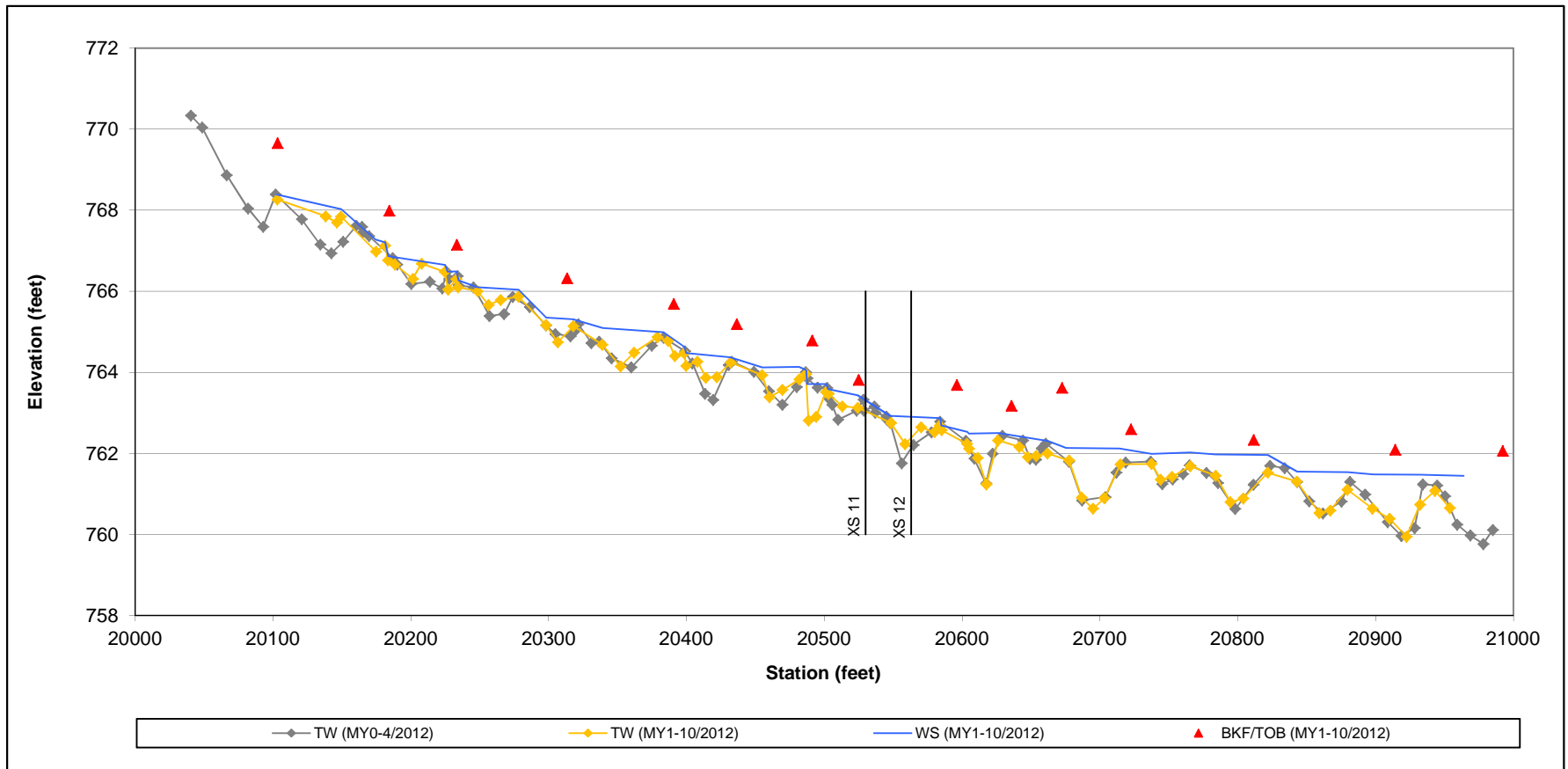
**Appendix 4. Morphological Summary Data and Plots**  
**Figure 4c. Longitudinal Profile Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 2**  
**Monitoring Year 1**



Appendix 4. Morphological Summary Data and Plots  
Figure 4d. Longitudinal Profile Plots  
Lyle Creek Mitigation Site (EEP Project No. 94643)  
UT1A  
Monitoring Year 1



**Appendix 4. Morphological Summary Data and Plots**  
**Figure 4e. Longitudinal Profile Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1B**  
**Monitoring Year 1**



**Appendix 4. Morphological Summary Data and Plots**  
**Figure 5a. Cross-Section Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 1 Upper, Cross-Section 1 (Riffle)**  
**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	1
<b>Drainage Area</b>	315 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering

Summary Data	
<b>Bankfull Elevation (ft)</b>	771.6
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	2.2
<b>Bankfull Width (ft)</b>	6.1
<b>Flood Prone Area Elevation (ft)</b>	772.4
<b>Flood Prone Width (ft)</b>	63.8
<b>Max Depth at Bankfull (ft)</b>	0.8
<b>Mean Depth at Bankfull (ft)</b>	0.4
<b>W/D Ratio</b>	17.2
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	C

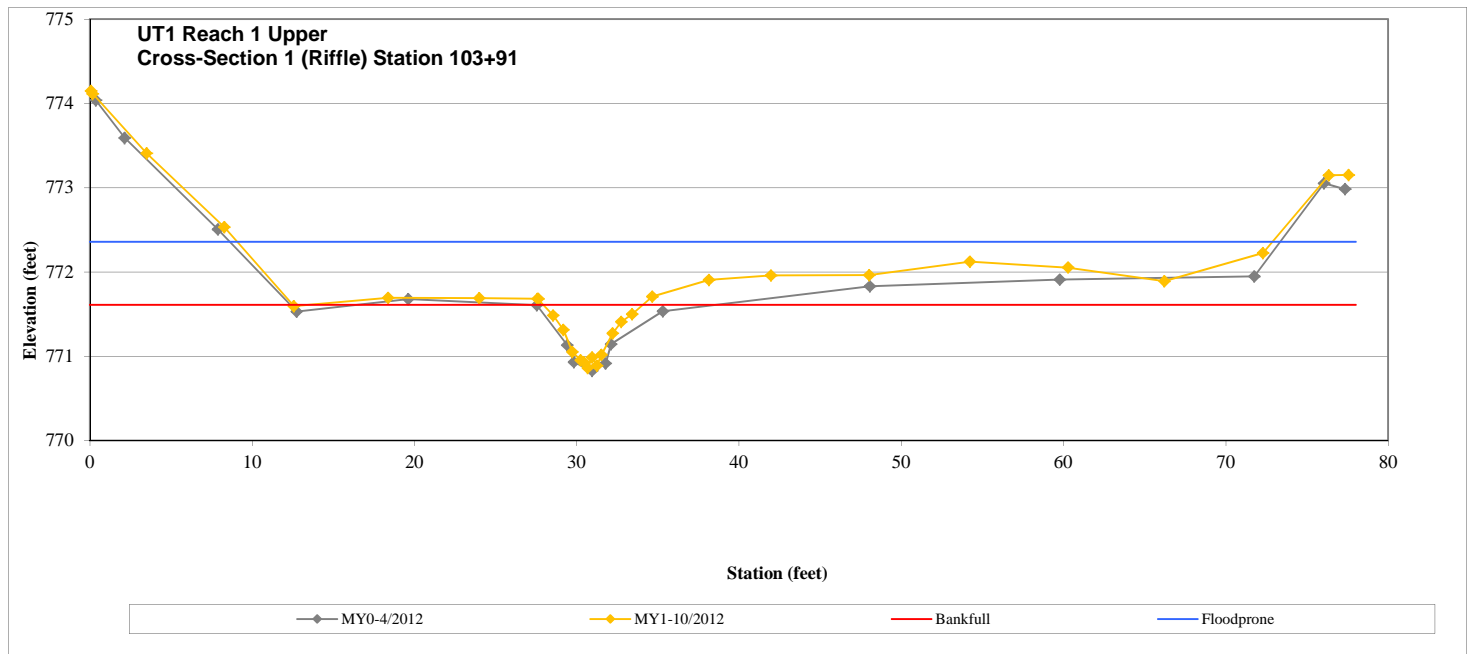


**Cross-Section 1: View Upstream (10/2012)**



**Cross-Section 1: View Downstream (10/2012)**

Station	Elevation	Station	Elevation
0.07	774.15	48.03	771.97
0.18	774.12	54.24	772.12
3.50	773.41	60.28	772.05
8.30	772.53	66.22	771.89
12.57	771.60	72.28	772.23
18.38	771.69	76.34	773.15
24.00	771.69	77.58	773.15
27.64	771.68		
27.59	771.68		
28.55	771.49		
29.19	771.31		
29.74	771.05		
30.24	770.95		
30.44	770.93		
30.68	770.86		
30.95	770.99		
31.26	770.89		
31.52	771.02		
32.21	771.27		
32.76	771.41		
33.42	771.50		
34.67	771.71		
38.15	771.91		
41.98	771.96		



**Appendix 4. Morphological Summary Data and Plots**  
**Figure 5b. Cross-Section Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 1 Upper, Cross-Section 2 (Pool)**  
**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	2
<b>Drainage Area</b>	315 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering



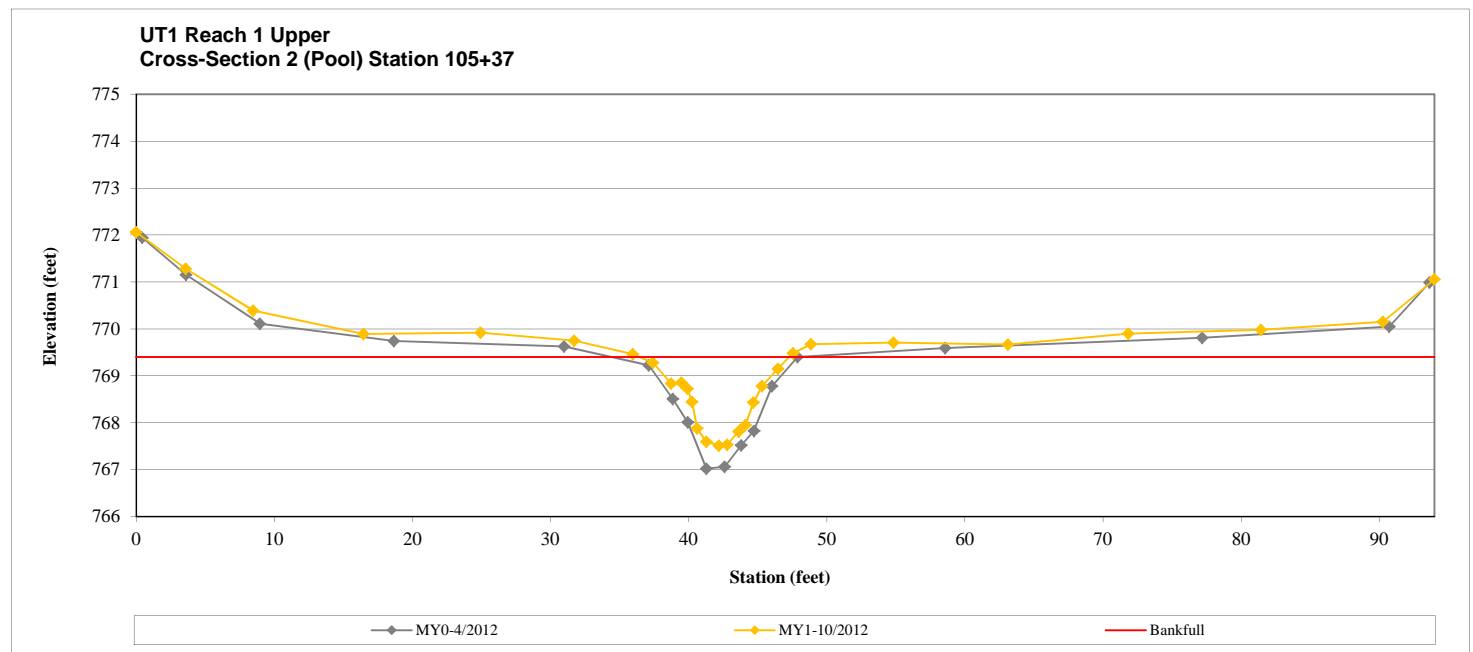
**Cross-Section 2: View Upstream (10/2012)**



**Cross-Section 2: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	769.4
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	9.8
<b>Bankfull Width (ft)</b>	10.8
<b>Flood Prone Area Elevation (ft)</b>	N/A
<b>Flood Prone Width (ft)</b>	N/A
<b>Max Depth at Bankfull (ft)</b>	1.9
<b>Mean Depth at Bankfull (ft)</b>	0.9
<b>W/D Ratio</b>	12.0
<b>Entrenchment Ratio</b>	N/A
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	N/A

Station	Elevation	Station	Elevation
0.00	772.06	63.12	769.67
3.59	771.29	71.82	769.90
8.47	770.39	81.43	769.98
16.45	769.89	90.27	770.15
24.94	769.92	94.00	771.05
31.71	769.75		
35.95	769.46		
37.41	769.28		
38.73	768.84		
39.47	768.86		
39.91	768.72		
40.24	768.45		
40.61	767.88		
41.29	767.60		
42.18	767.52		
42.79	767.54		
43.61	767.81		
44.10	767.95		
44.68	768.43		
45.31	768.78		
46.46	769.15		
47.56	769.48		
48.86	769.67		
54.83	769.71		





**Appendix 4. Morphological Summary Data and Plots**  
**Figure 5c. Cross-Section Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 1 Lower, Cross-Section 3 (Riffle)**  
**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	3
<b>Drainage Area</b>	315 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering



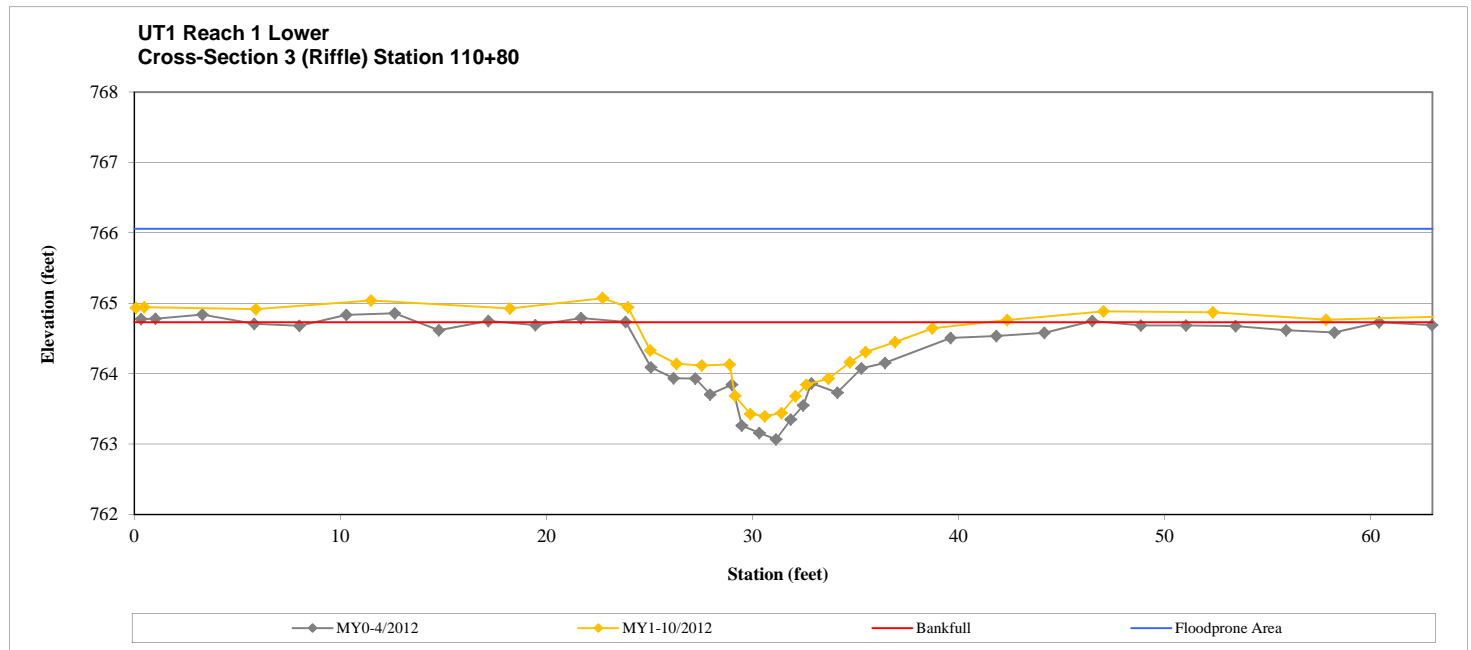
**Cross-Section 3: View Upstream (10/2012)**



**Cross-Section 3: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	764.7
<b>Bankfull Cross-Sectional Area (ft2)</b>	9.7
<b>Bankfull Width (ft)</b>	17.1
<b>Flood Prone Area Elevation (ft)</b>	766.1
<b>Flood Prone Width (ft)</b>	63.4
<b>Max Depth at Bankfull (ft)</b>	1.3
<b>Mean Depth at Bankfull (ft)</b>	0.6
<b>W/D Ratio</b>	30.1
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	C

Station	Elevation	Station	Elevation
0.09	764.94	52.35	764.87
0.49	764.94	57.84	764.77
5.91	764.92	63.09	764.81
11.49	765.04	63.48	764.87
18.23	764.93		
22.73	765.07		
23.96	764.94		
25.04	764.33		
26.32	764.14		
27.55	764.12		
28.89	764.13		
29.15	763.69		
29.90	763.43		
30.60	763.40		
31.40	763.44		
32.09	763.68		
32.62	763.85		
33.69	763.93		
34.73	764.16		
35.49	764.31		
36.92	764.45		
38.74	764.64		
42.36	764.76		
47.04	764.89		



**Appendix 4. Morphological Summary Data and Plots**

**Figure 5d. Cross-Section Plots**

**Lyle Creek Mitigation Site (EEP Project No. 94643)**

**UT1 Reach 1 Lower, Cross-Section 4 (Pool)**

**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	4
<b>Drainage Area</b>	315 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering



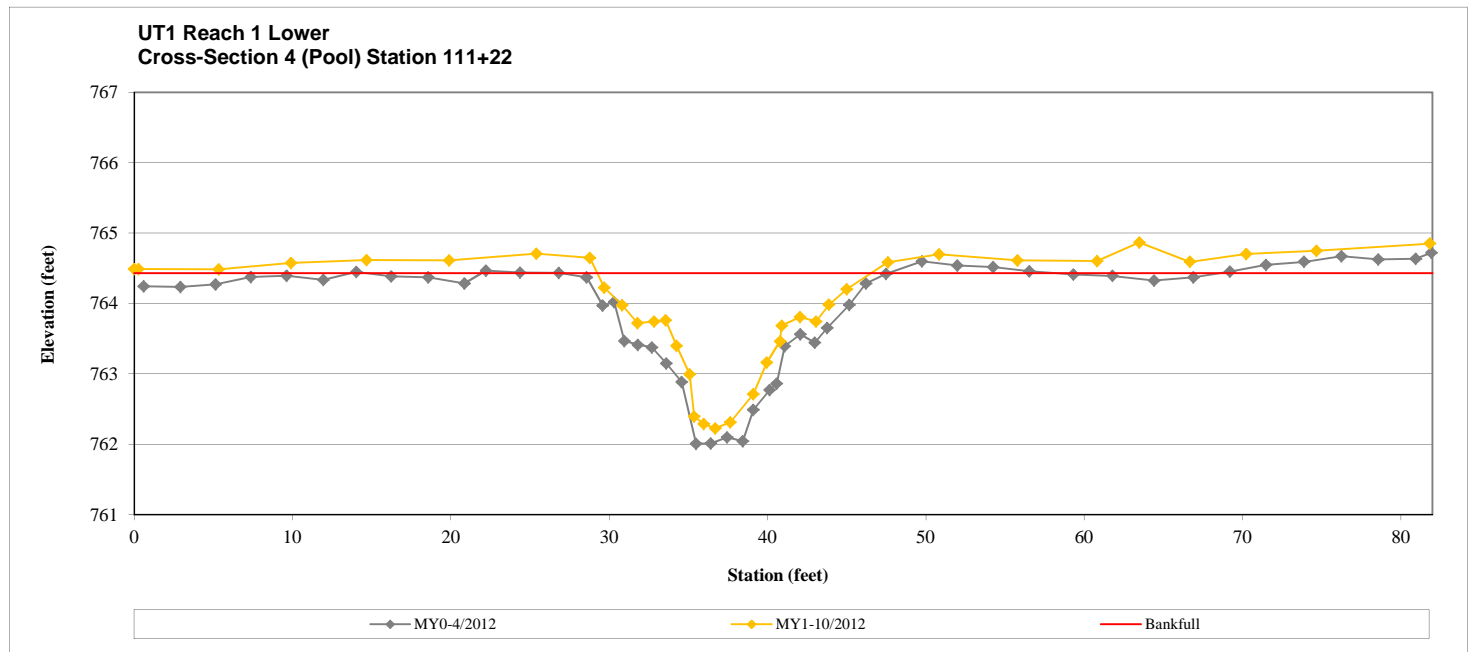
**Cross-Section 4: View Upstream (10/2012)**



**Cross-Section 4: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	764.4
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	16.8
<b>Bankfull Width (ft)</b>	17.3
<b>Flood Prone Area Elevation (ft)</b>	N/A
<b>Flood Prone Width (ft)</b>	N/A
<b>Max Depth at Bankfull (ft)</b>	2.2
<b>Mean Depth at Bankfull (ft)</b>	1.0
<b>W/D Ratio</b>	17.9
<b>Entrenchment Ratio</b>	N/A
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	N/A

Station	Elevation	Station	Elevation
0.00	764.49	43.87	763.98
0.28	764.49	45.00	764.21
5.35	764.49	47.60	764.59
9.90	764.58	50.83	764.70
14.67	764.62	55.79	764.61
19.89	764.61	60.82	764.61
25.41	764.71	63.48	764.87
28.77	764.65	66.68	764.59
29.68	764.23	70.23	764.70
30.81	763.98	74.67	764.75
31.78	763.72	81.82	764.85
32.84	763.75	0.00	0.00
33.56	763.76	0.00	0.00
34.26	763.40	0.00	0.00
35.08	762.99	0.00	0.00
35.37	762.40	0.00	0.00
35.97	762.29	0.00	0.00
36.69	762.23	0.00	0.00
37.65	762.31	0.00	0.00
39.10	762.71	0.00	0.00
39.96	763.16	0.00	0.00
40.79	763.46	0.00	0.00
40.89	763.68	0.00	0.00
42.05	763.81	0.00	0.00
43.07	763.75	0.00	0.00



## Appendix 4. Morphological Summary Data and Plots

### Figure 5e. Cross-Section Plots

Lyle Creek Mitigation Site (EEP Project No. 94643)

UT1 Reach 1 Lower, Cross-Section 5 (Pool)

Monitoring Year 1

River Basin	Catawba 03050101
Watershed	NCDWQ Subbasin 03-08-32
XS ID	5
Drainage Area	315 Acres
Date	10/2012
Field Crew	Wildlands Engineering



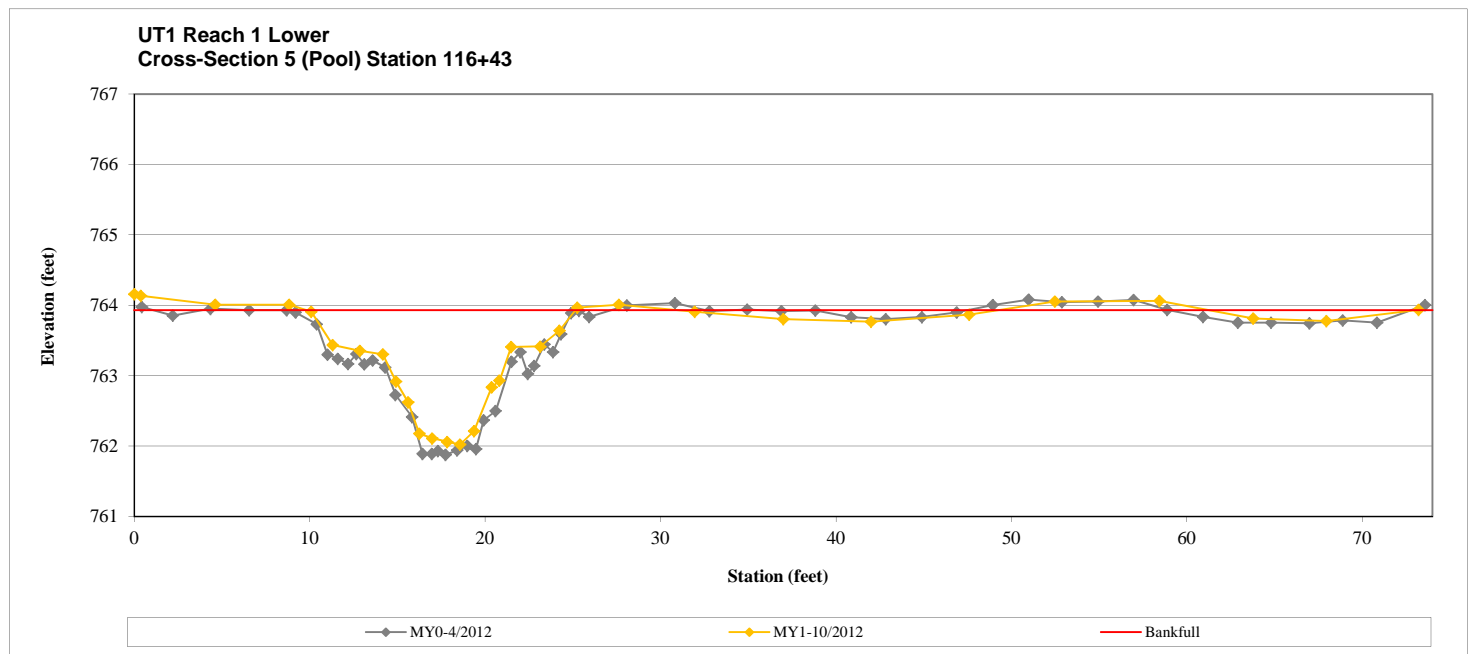
Cross-Section 5: View Upstream (10/2012)



Cross-Section 5: View Downstream (10/2012)

Summary Data	
Bankfull Elevation (ft)	763.9
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	13.4
Bankfull Width (ft)	16.9
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	1.9
Mean Depth at Bankfull (ft)	0.9
W/D Ratio	16.6
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A

Station	Elevation	Station	Elevation
0.01	764.16	67.95	763.78
0.37	764.13	73.21	763.94
4.63	764.01	0.00	0.00
8.84	764.01	0.00	0.00
10.10	763.91	0.00	0.00
11.32	763.44	0.00	0.00
12.86	763.35	0.00	0.00
14.17	763.30	0.00	0.00
14.92	762.92	0.00	0.00
15.61	762.62	0.00	0.00
16.25	762.18	0.00	0.00
16.99	762.11	0.00	0.00
17.84	762.06	0.00	0.00
18.57	762.02	0.00	0.00
19.37	762.21	0.00	0.00
20.37	762.84	0.00	0.00
20.82	762.93	0.00	0.00
21.48	763.41	0.00	0.00
23.15	763.42	0.00	0.00
24.23	763.64	0.00	0.00
25.26	763.97	0.00	0.00
27.63	764.01	0.00	0.00
31.95	763.91	0.00	0.00
37.00	763.80	0.00	0.00
42.00	763.77	0.00	0.00
47.59	763.87	0.00	0.00
52.48	764.05	0.00	0.00
58.44	764.06	0.00	0.00
63.78	763.81	0.00	0.00



**Appendix 4. Morphological Summary Data and Plots**

**Figure 5f. Cross-Section Plots**

**Lyle Creek Mitigation Site (EEP Project No. 94643)**

**UT1 Reach 1 Lower, Cross-Section 6 (Riffle)**

**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	6
<b>Drainage Area</b>	315 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering

Summary Data	
<b>Bankfull Elevation (ft)</b>	763.9
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	9.5
<b>Bankfull Width (ft)</b>	13.3
<b>Flood Prone Area Elevation (ft)</b>	765.2
<b>Flood Prone Width (ft)</b>	80.3
<b>Max Depth at Bankfull (ft)</b>	1.3
<b>Mean Depth at Bankfull (ft)</b>	0.7
<b>W/D Ratio</b>	18.5
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	C

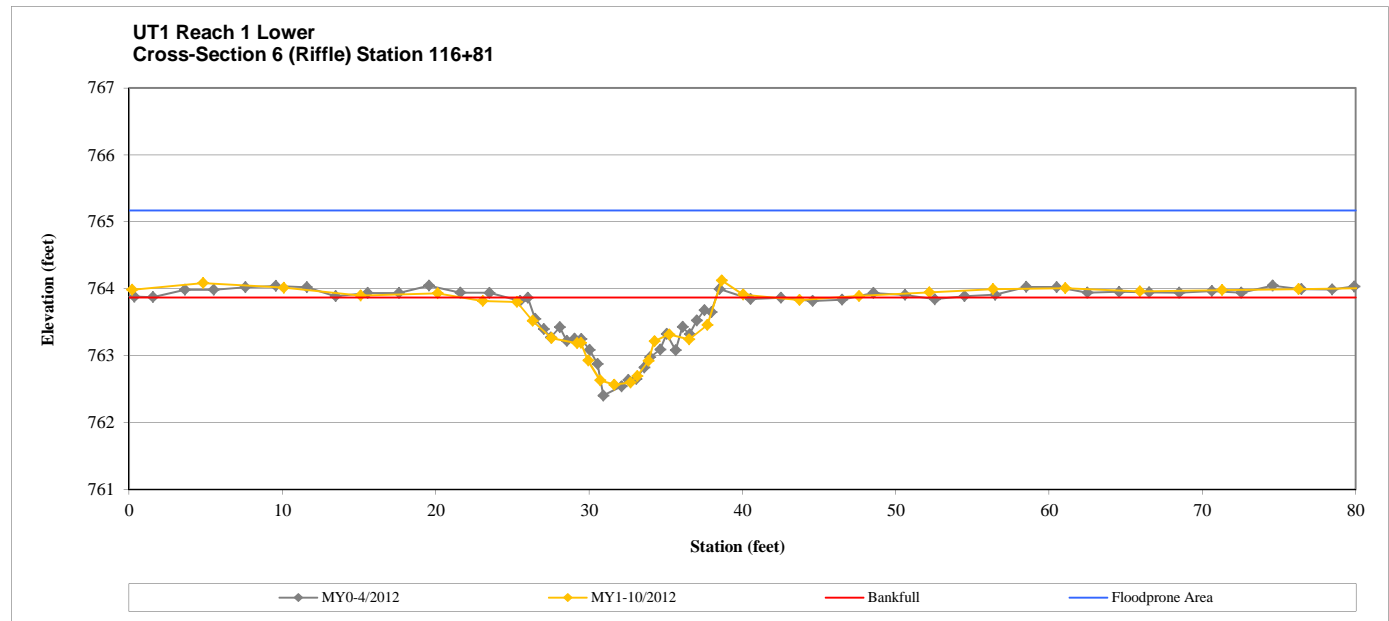


**Cross-Section 6: View Upstream (10/2012)**



**Cross-Section 6: View Downstream (10/2012)**

Station	Elevation	Station	Elevation
0.19	763.99	76.27	763.99
4.83	764.09	80.16	764.01
10.09	764.02	80.52	764.00
15.10	763.90	0.00	0.00
20.12	763.93	0.00	0.00
23.07	763.82	0.00	0.00
25.30	763.80	0.00	0.00
26.32	763.52	0.00	0.00
27.56	763.26	0.00	0.00
29.22	763.19	0.00	0.00
29.48	763.19	0.00	0.00
29.94	762.93	0.00	0.00
30.72	762.63	0.00	0.00
31.64	762.57	0.00	0.00
32.70	762.60	0.00	0.00
33.15	762.70	0.00	0.00
33.87	762.92	0.00	0.00
34.26	763.22	0.00	0.00
35.22	763.32	0.00	0.00
36.53	763.24	0.00	0.00
37.71	763.46	0.00	0.00
38.66	764.12	0.00	0.00
40.04	763.91	0.00	0.00
43.73	763.83	0.00	0.00
47.60	763.89	0.00	0.00
52.20	763.95	0.00	0.00
56.35	763.99	0.00	0.00
61.06	764.01	0.00	0.00
65.93	763.96	0.00	0.00
71.29	763.98	0.00	0.00
76.27	763.99		



**Appendix 4. Morphological Summary Data and Plots**  
**Figure 5g. Cross-Section Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 2, Cross-Section 7 (Riffle)**  
**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	7
<b>Drainage Area</b>	315 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering



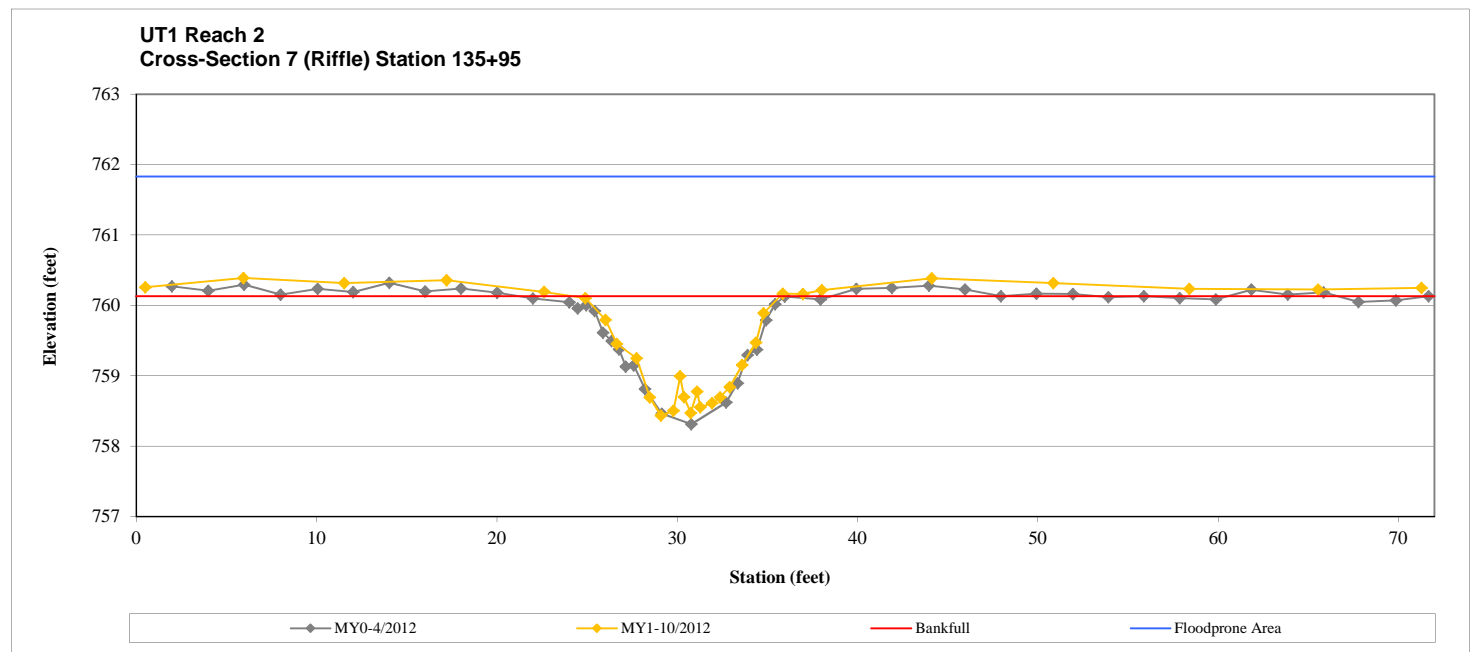
**Cross-Section 7: View Upstream (10/2012)**



**Cross-Section 7: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	760.1
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	10.6
<b>Bankfull Width (ft)</b>	11.5
<b>Flood Prone Area Elevation (ft)</b>	761.8
<b>Flood Prone Width (ft)</b>	70.8
<b>Max Depth at Bankfull (ft)</b>	1.7
<b>Mean Depth at Bankfull (ft)</b>	0.9
<b>W/D Ratio</b>	12.5
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	C

Station	Elevation	Station	Elevation
0.50	760.26	36.97	760.16
5.96	760.39	38.02	760.22
11.54	760.32	44.13	760.39
17.22	760.36	50.86	760.32
22.62	760.19	58.41	760.24
24.91	760.10	65.55	760.23
26.04	759.80	71.29	760.25
26.66	759.45	0.00	0.00
27.76	759.25	0.00	0.00
28.48	758.69	0.00	0.00
29.10	758.43	0.00	0.00
29.79	758.51	0.00	0.00
30.17	759.00	0.00	0.00
30.38	758.70	0.00	0.00
30.75	758.47	0.00	0.00
31.10	758.78	0.00	0.00
31.29	758.55	0.00	0.00
31.94	758.61	0.00	0.00
32.39	758.70	0.00	0.00
32.91	758.84	0.00	0.00
33.61	759.15	0.00	0.00
34.37	759.47	0.00	0.00
34.80	759.89	0.00	0.00
35.85	760.17	0.00	0.00



**Appendix 4. Morphological Summary Data and Plots**  
**Figure 5h. Cross-Section Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1 Reach 2, Cross-Section 8 (Pool)**  
**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	8
<b>Drainage Area</b>	315 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering



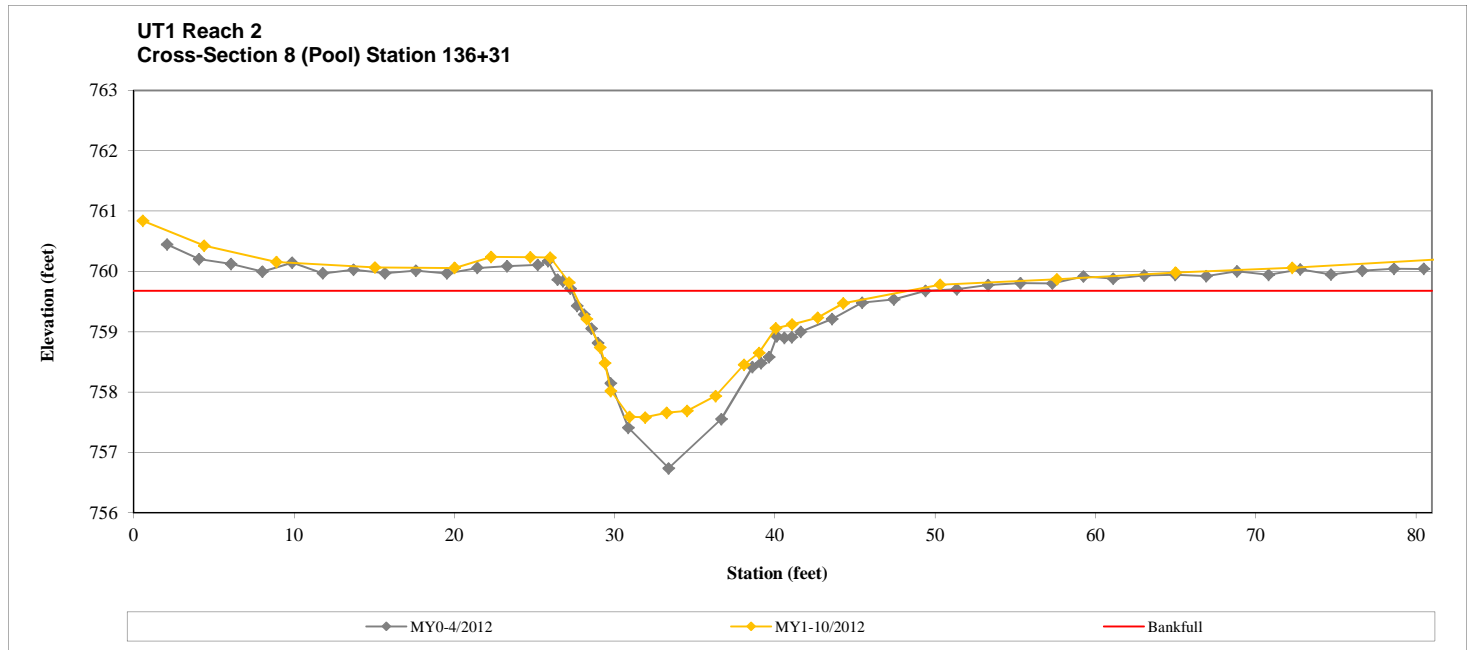
**Cross-Section 8: View Upstream (10/2012)**



**Cross-Section 8: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	759.7
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	21.4
<b>Bankfull Width (ft)</b>	21.0
<b>Flood Prone Area Elevation (ft)</b>	N/A
<b>Flood Prone Width (ft)</b>	N/A
<b>Max Depth at Bankfull (ft)</b>	2.1
<b>Mean Depth at Bankfull (ft)</b>	1.0
<b>W/D Ratio</b>	20.5
<b>Entrenchment Ratio</b>	N/A
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	N/A

Station	Elevation	Station	Elevation
0.56	760.84	65.00	759.98
4.41	760.43	72.29	760.06
8.91	760.15	81.72	760.21
15.06	760.07	0.00	0.00
20.02	760.06	0.00	0.00
22.31	760.24	0.00	0.00
24.76	760.24	0.00	0.00
26.00	760.23	0.00	0.00
27.17	759.82	0.00	0.00
28.26	759.21	0.00	0.00
29.10	758.74	0.00	0.00
29.41	758.48	0.00	0.00
29.76	758.02	0.00	0.00
30.94	757.59	0.00	0.00
31.91	757.58	0.00	0.00
33.26	757.66	0.00	0.00
34.54	757.69	0.00	0.00
36.31	757.94	0.00	0.00
38.08	758.46	0.00	0.00
39.03	758.65	0.00	0.00
40.07	759.06	0.00	0.00
41.08	759.12	0.00	0.00
42.68	759.23	0.00	0.00
44.27	759.47	0.00	0.00
50.31	759.78	0.00	0.00
57.60	759.87	0.00	0.00



**Appendix 4. Morphological Summary Data and Plots**

**Figure 5i. Cross-Section Plots**

**Lyle Creek Mitigation Site (EEP Project No. 94643)**

**UT1A, Cross-Section 9 (Riffle)**

**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	9
<b>Drainage Area</b>	56 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering



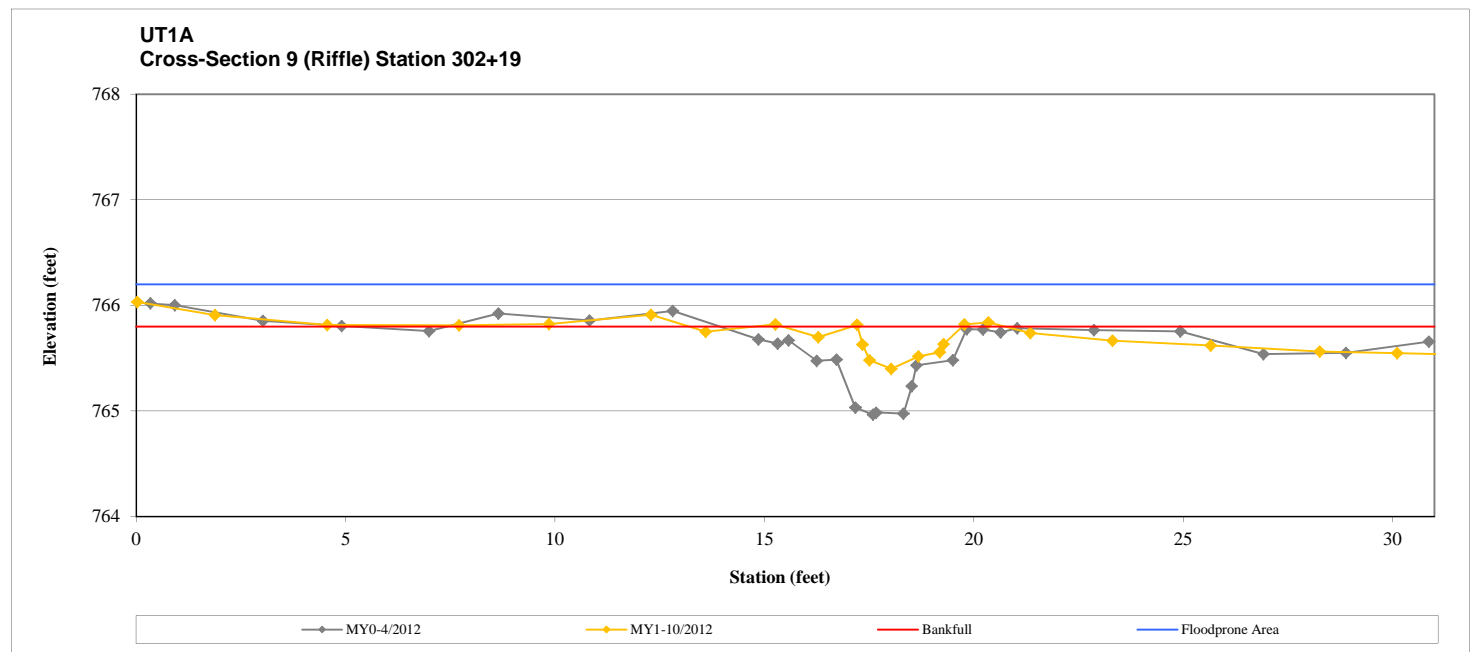
**Cross-Section 9: View Upstream (10/2012)**



**Cross-Section 9: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	765.8
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	0.7
<b>Bankfull Width (ft)</b>	2.5
<b>Flood Prone Area Elevation (ft)</b>	766.2
<b>Flood Prone Width (ft)</b>	31.4
<b>Max Depth at Bankfull (ft)</b>	0.4
<b>Mean Depth at Bankfull (ft)</b>	0.3
<b>W/D Ratio</b>	9.4
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	E

Station	Elevation	Station	Elevation
0.03	766.03	0.00	0.00
1.88	765.91	0.00	0.00
4.56	765.82	0.00	0.00
7.71	765.81	0.00	0.00
9.86	765.82	0.00	0.00
12.29	765.91	0.00	0.00
13.60	765.75	0.00	0.00
15.26	765.82	0.00	0.00
16.29	765.70	0.00	0.00
17.21	765.82	0.00	0.00
17.34	765.63	0.00	0.00
17.51	765.48	0.00	0.00
18.03	765.40	0.00	0.00
18.68	765.52	0.00	0.00
19.19	765.56	0.00	0.00
19.28	765.63	0.00	0.00
19.78	765.82	0.00	0.00
20.35	765.84	0.00	0.00
21.35	765.74	0.00	0.00
23.31	765.67	0.00	0.00
25.66	765.62	0.00	0.00
28.26	765.56	0.00	0.00
30.11	765.55	0.00	0.00
31.41	765.54	0.00	0.00



**Appendix 4. Morphological Summary Data and Plots**  
**Figure 5j. Cross-Section Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1A, Cross-Section 10 (Pool)**  
**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	10
<b>Drainage Area</b>	56 Acres
<b>Date</b>	Oct-12
<b>Field Crew</b>	Wildlands Engineering



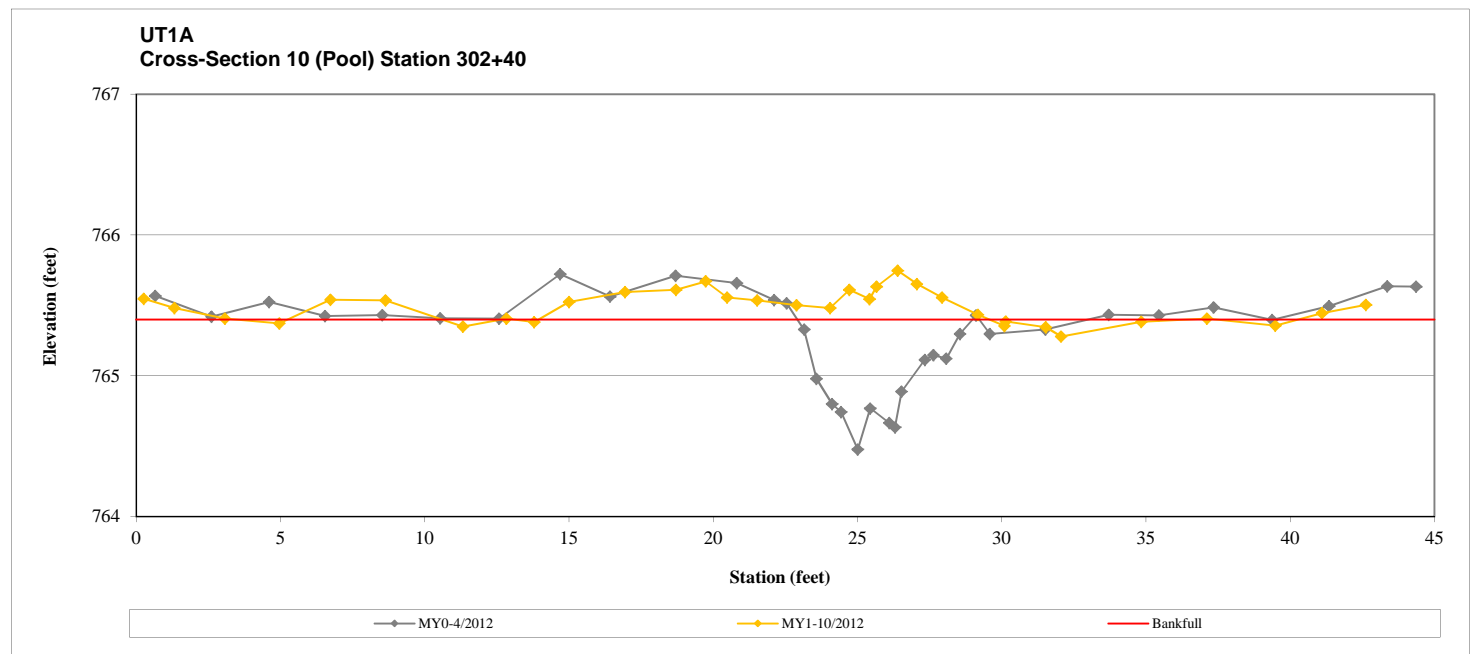
**Cross-Section 10: View Upstream (10/2012)**



**Cross-Section 10: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	765.4
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	0.0
<b>Bankfull Width (ft)</b>	0.0
<b>Flood Prone Area Elevation (ft)</b>	N/A
<b>Flood Prone Width (ft)</b>	N/A
<b>Max Depth at Bankfull (ft)</b>	0.1
<b>Mean Depth at Bankfull (ft)</b>	0.0
<b>W/D Ratio</b>	0.0
<b>Entrenchment Ratio</b>	N/A
<b>Bank Height Ratio</b>	0.0
<b>Stream Type</b>	N/A

Station	Elevation	Station	Elevation
0.26	765.55	30.10	765.35
1.33	765.48	30.14	765.39
3.08	765.41	31.53	765.35
4.96	765.37	32.06	765.28
6.73	765.54	34.84	765.38
8.64	765.54	37.11	765.41
11.32	765.35	39.48	765.36
12.83	765.41	41.10	765.45
13.80	765.38	42.62	765.50
15.01	765.52	0.00	0.00
16.95	765.59	0.00	0.00
18.71	765.61	0.00	0.00
19.74	765.67	0.00	0.00
20.48	765.56	0.00	0.00
21.52	765.54	0.00	0.00
22.89	765.50	0.00	0.00
24.05	765.48	0.00	0.00
24.72	765.61	0.00	0.00
25.42	765.55	0.00	0.00
25.66	765.63	0.00	0.00
26.39	765.75	0.00	0.00
27.06	765.65	0.00	0.00
27.93	765.56	0.00	0.00
29.18	765.43	0.00	0.00





**Appendix 4. Morphological Summary Data and Plots**  
**Figure 5k. Cross-Section Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1B, Cross-Section 11 (Riffle)**  
**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	11
<b>Drainage Area</b>	78 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering



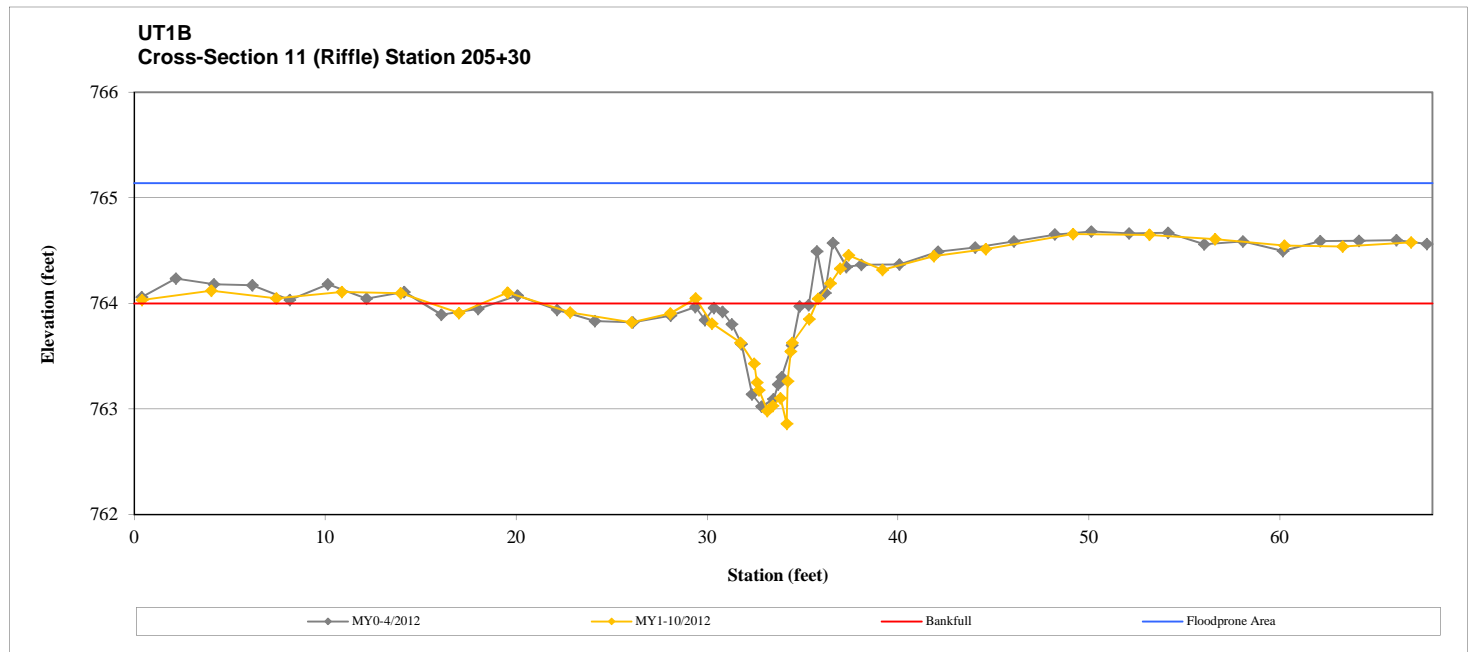
**Cross-Section 11: View Upstream (10/2012)**



**Cross-Section 11: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	764.0
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	2.8
<b>Bankfull Width (ft)</b>	6.1
<b>Flood Prone Area Elevation (ft)</b>	765.1
<b>Flood Prone Width (ft)</b>	66.5
<b>Max Depth at Bankfull (ft)</b>	1.1
<b>Mean Depth at Bankfull (ft)</b>	0.5
<b>W/D Ratio</b>	13.3
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	C

Station	Elevation	Station	Elevation
0.41	764.03	36.47	764.19
4.04	764.12	36.98	764.33
7.44	764.05	37.41	764.46
10.88	764.11	39.19	764.32
13.97	764.10	41.89	764.45
17.02	763.91	44.61	764.51
19.56	764.10	49.18	764.66
22.85	763.91	53.19	764.65
26.06	763.82	56.61	764.61
28.09	763.91	60.25	764.55
29.41	764.05	63.30	764.54
30.27	763.81	66.88	764.58
31.76	763.63		
32.48	763.43		
32.62	763.25		
32.73	763.18		
33.17	762.98		
33.44	763.03		
33.85	763.10		
34.18	762.86		
34.23	763.26		
34.39	763.55		
34.47	763.63		
35.36	763.85		
35.83	764.05		



**Appendix 4. Morphological Summary Data and Plots**

**Figure 5I. Cross-Section Plots**

**Lyle Creek Mitigation Site (EEP Project No. 94643)**

**UT1B, Cross-Section 12 (Pool)**

**Monitoring Year 1**

<b>River Basin</b>	Catawba 03050101
<b>Watershed</b>	NCDWQ Subbasin 03-08-32
<b>XS ID</b>	12
<b>Drainage Area</b>	78 Acres
<b>Date</b>	10/2012
<b>Field Crew</b>	Wildlands Engineering



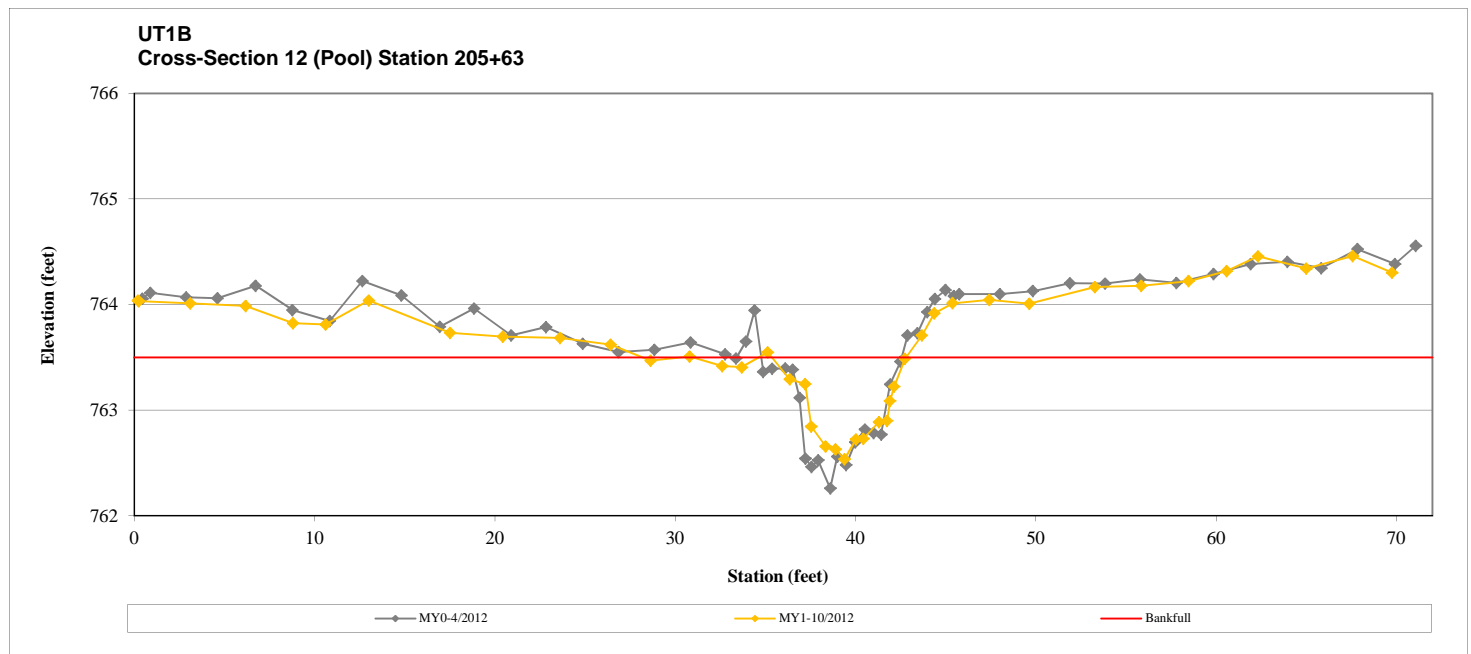
**Cross-Section 12: View Upstream (10/2012)**



**Cross-Section 12: View Downstream (10/2012)**

Summary Data	
<b>Bankfull Elevation (ft)</b>	763.5
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	4.0
<b>Bankfull Width (ft)</b>	7.4
<b>Flood Prone Area Elevation (ft)</b>	N/A
<b>Flood Prone Width (ft)</b>	N/A
<b>Max Depth at Bankfull (ft)</b>	1.0
<b>Mean Depth at Bankfull (ft)</b>	0.5
<b>W/D Ratio</b>	13.9
<b>Entrenchment Ratio</b>	N/A
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	N/A

Station	Elevation	Station	Elevation
0.20	764.04	43.68	763.71
0.25	764.03	44.38	763.92
3.12	764.01	45.39	764.01
6.18	763.99	47.42	764.04
8.81	763.82	49.64	764.01
10.61	763.81	53.27	764.17
13.01	764.04	55.85	764.18
17.52	763.73	58.48	764.22
20.44	763.70	60.58	764.32
23.62	763.68	62.33	764.46
26.42	763.62	65.00	764.34
28.64	763.47	67.57	764.46
30.80	763.51	69.76	764.30
32.62	763.42		
33.69	763.41		
35.14	763.55		
36.35	763.29		
37.21	763.25		
37.54	762.84		
38.34	762.66		
38.89	762.63		
39.39	762.54		
40.03	762.72		
40.44	762.73		
41.30	762.89		
41.75	762.90		
41.91	763.09		
42.14	763.23		
42.75	763.49		



## **APPENDIX 5. Hydrology Summary Data and Plots**

**Appendix 5. Hydrology Summary Data and Plots**  
**Table 13. Verification of Bankfull Events**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**UT1, UT1a, and UT1b**  
**Monitoring Year 1**

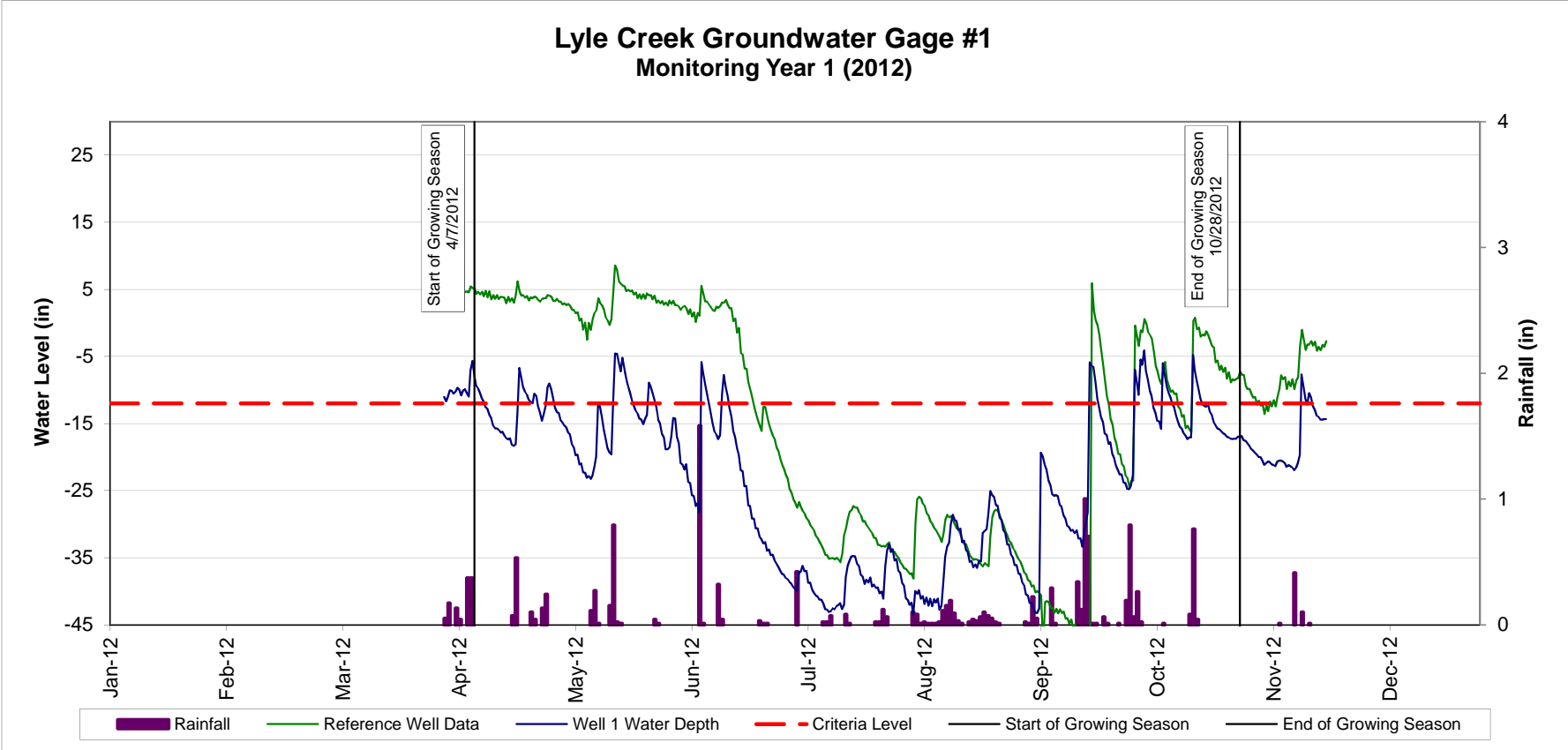
<b>Reach</b>	<b>Date of Data Collection</b>	<b>Date of Occurrence</b>	<b>Method</b>	<b>Photo (if available)</b>
UT1	5/11/2012	U	Crest Gage	N
UT1A	7/10/2012	U	Crest Gage	N
UT1B	7/10/2012	U	Crest Gage	N

u: unknown

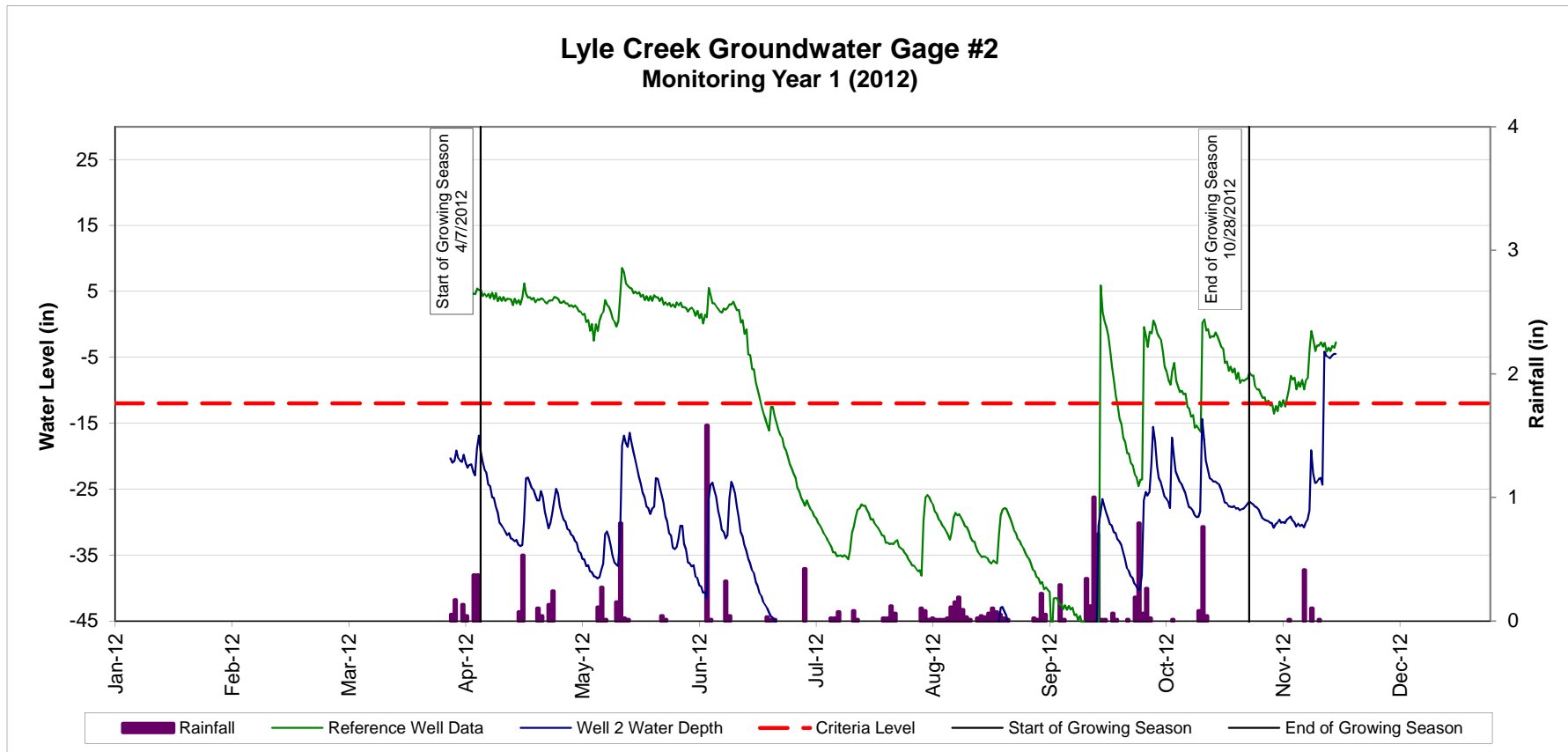
**Appendix 5. Hydrology Summary Data and Plots**  
**Table 14. Wetland Gage Attainment Summary**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetlands RW1 and RW2**  
**Monitoring Year 1**

Summary of Groundwater Gage Results for Years 1 through 7							
Gage	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2012)	Year 2 (2013)	Year 3 (2014)	Year 4 (2015)	Year 5 (2016)	Year 6 (2017)	Year 7 (2018)
1	No/5 Days (2.5 %)						
2	No/0 Days (0 %)						
3	Yes/29 Days (14 %)						
4	Yes/27 Days (13 %)						
5	No/11 Days (5 %)						
6	No/5 Days (2.5 %)						
7	Yes/22 Days (11 %)						
8	No/12 Days (6 %)						

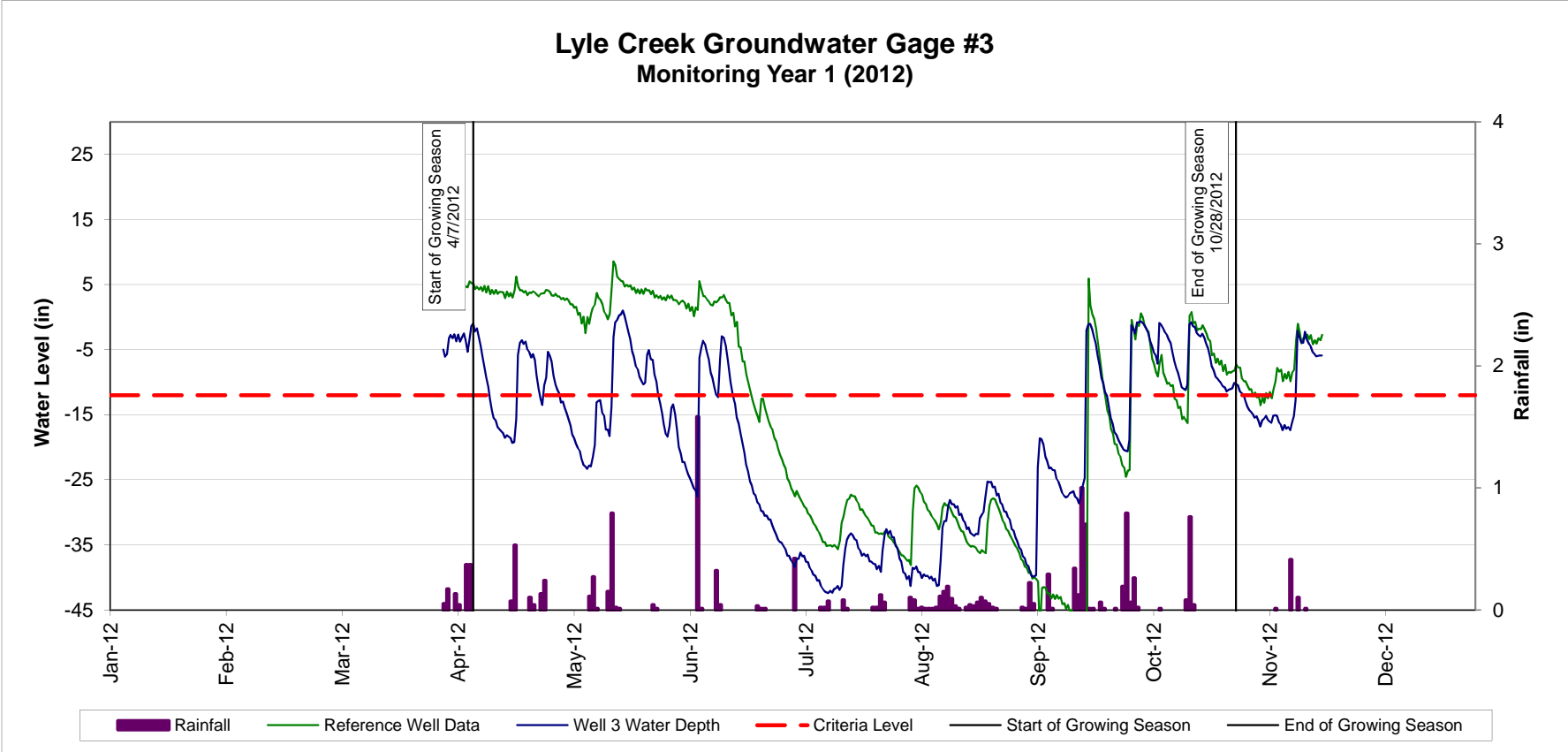
**Appendix 5. Hydrology Summary Data and Plots**  
**Figure 6a. Groundwater Gage Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetland RW1**  
**Monitoring Year 1**



**Appendix 5. Hydrology Summary Data and Plots**  
**Figure 6b. Groundwater Gage Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetland RW1**  
**Monitoring Year 1**

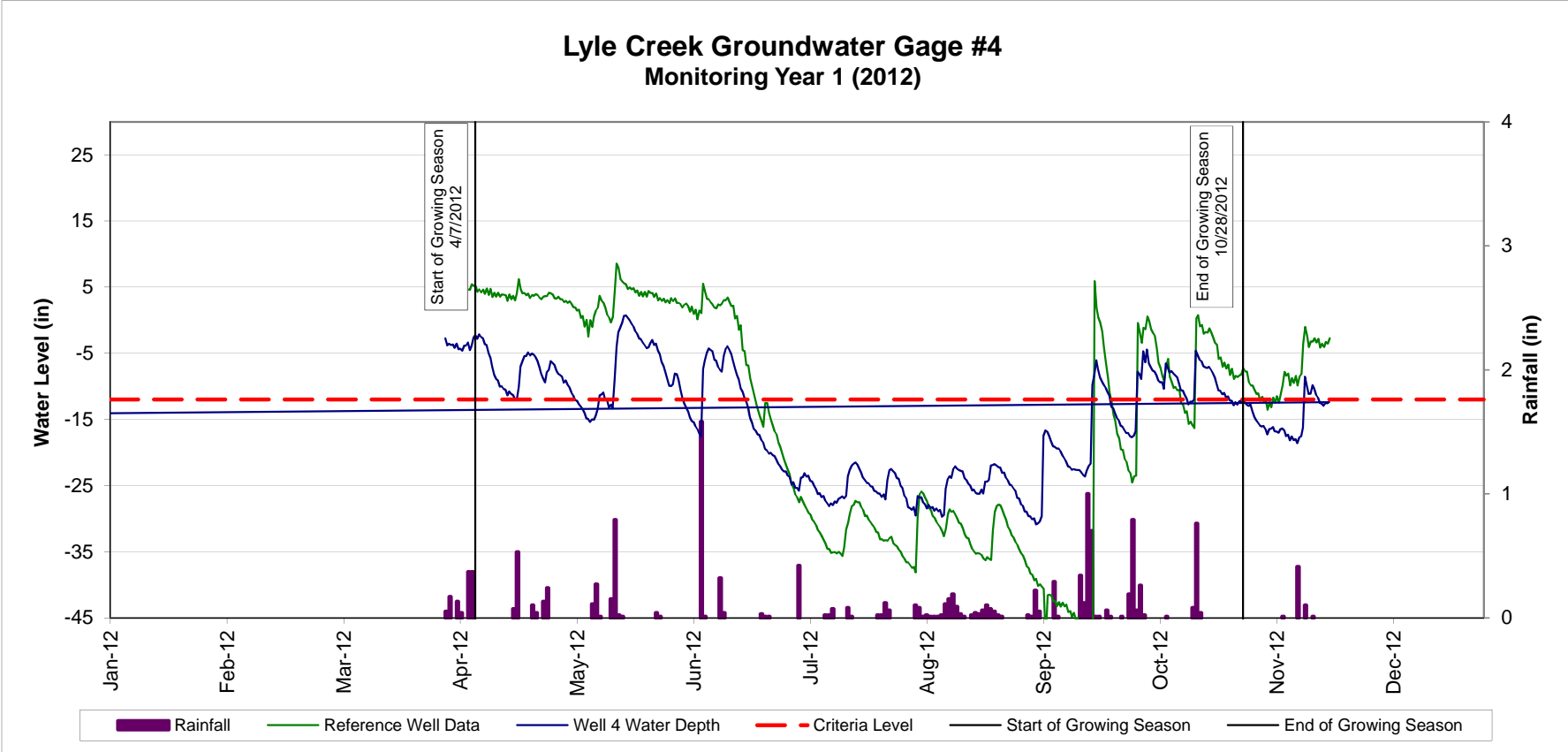


**Appendix 5. Hydrology Summary Data and Plots**  
**Figure 6c. Groundwater Gage Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetland RW1**  
**Monitoring Year 1**

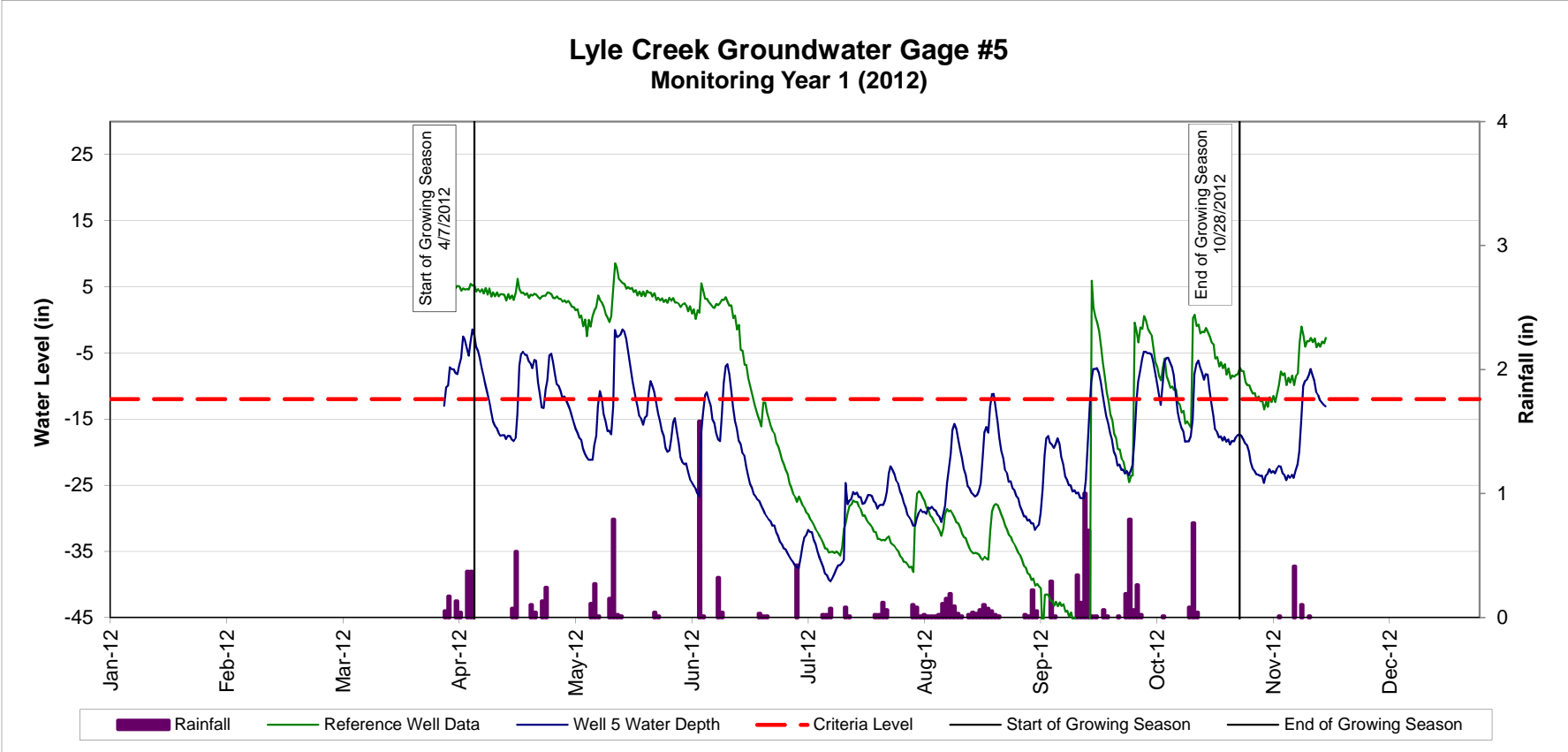




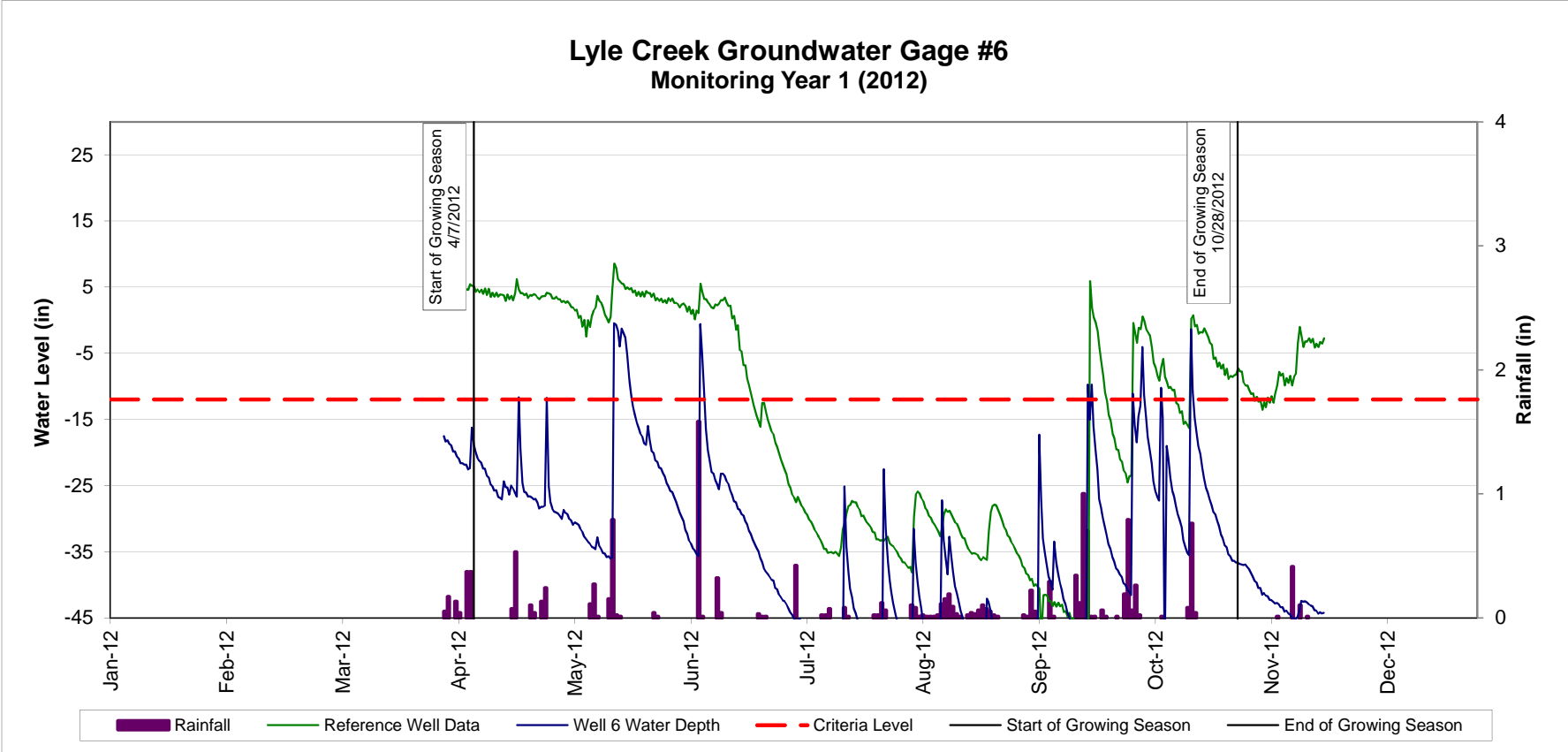
**Appendix 5. Hydrology Summary Data and Plots**  
**Figure 6d. Groundwater Gage Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetland RW1**  
**Monitoring Year 1**



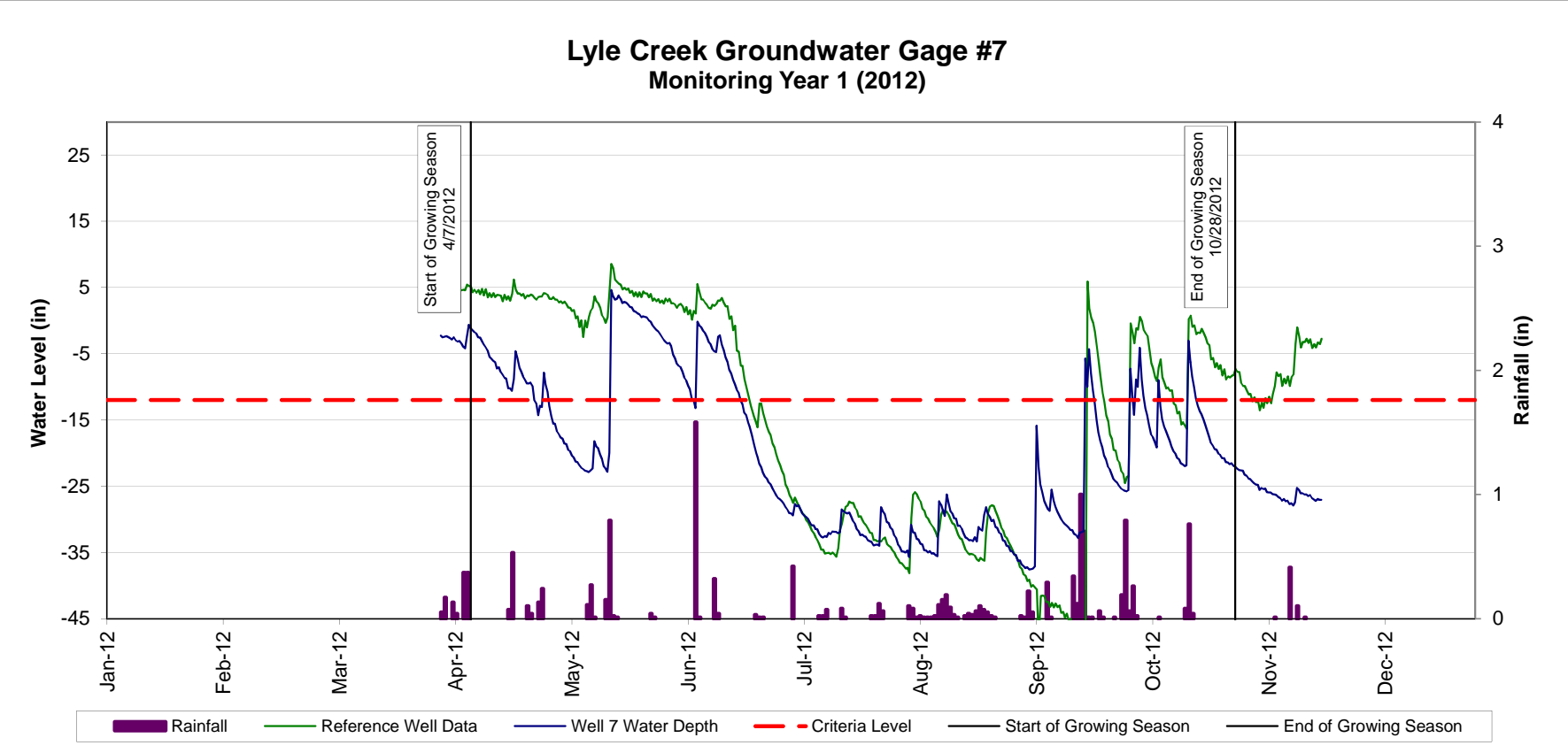
**Appendix 5. Hydrology Summary Data and Plots**  
**Figure 6e. Groundwater Gage Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetland RW1**  
**Monitoring Year 1**



**Appendix 5. Hydrology Summary Data and Plots**  
**Figure 6f. Groundwater Gage Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetland RW2**  
**Monitoring Year 1**



**Appendix 5. Hydrology Summary Data and Plots**  
**Figure 6g. Groundwater Gage Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetland RW2**  
**Monitoring Year 1**



**Appendix 5. Hydrology Summary Data and Plots**  
**Figure 6h. Groundwater Gage Plots**  
**Lyle Creek Mitigation Site (EEP Project No. 94643)**  
**Wetland RW2**  
**Monitoring Year 1**

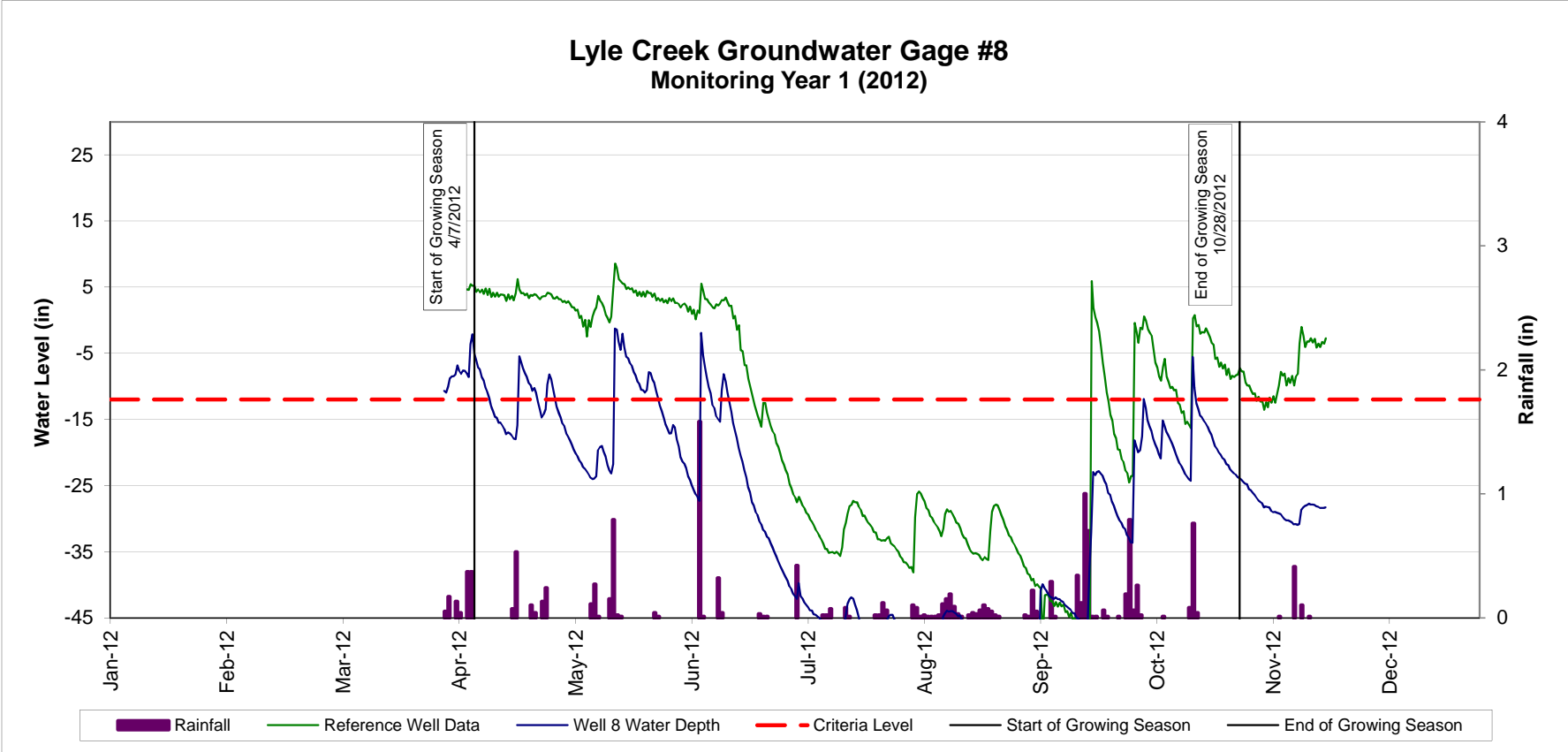
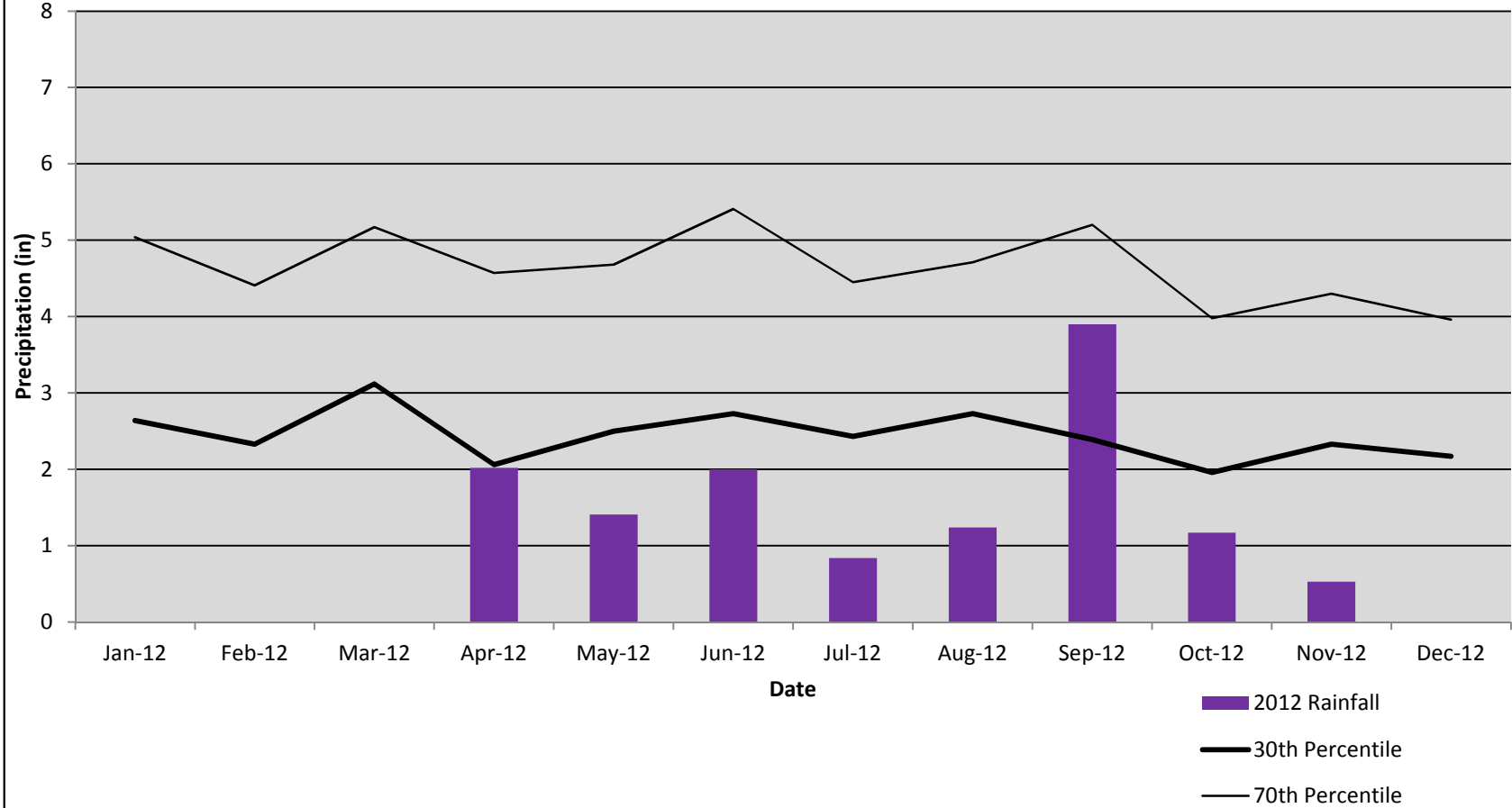


Figure 7. Lyle Creek 30-70 Percentile Graph for Rainfal in 2012 Catawba, NC



<sup>1</sup> 2012 rainfall collected by onsite rainfall gage.

<sup>2</sup> 30th and 70th percentile rainfall data collected from weather station Catawba 3 NNW, NC1579 (USDA, 2002)