MONITORING YEAR 3 ANNUAL REPORT
Final

LITTLE TROUBLESOME CREEK MITIGATION SITE
Rockingham County, NC
DENR Contract 003267
NCEEP Project Number 94640

Data Collection Period: May 2014-November 2014
Draft Submission Date: December 1, 2014
Final Submission Date: December 19, 2014

PREPARED FOR:

NC Department of Environment and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

PREPARED BY:

Wildlands Engineering, Inc.
1430 South Mint Street, Suite 104
Charlotte, NC 28203

Kirsten Y. Gimbert
kgimbert@wildlandseng.com
Phone: 704.332.7754
Fax: 704.332.3306

EXECUTIVE SUMMARY

Wildlands Engineering (Wildlands) completed a full-delivery project for the North Carolina Ecosystem Enhancement Program (NCEEP) to restore a total of 4,988 linear feet (LF) of stream and restore, enhance, and create 17.3 acres (ac) of wetlands in Rockingham County, North Carolina. The project streams consist of Little Troublesome Creek, Irvin Creek and one unnamed tributary (UT) to the Little Troublesome Creek. The largest of these streams, Little Troublesome Creek, ultimately drains to the Haw River. At the downstream limits of the project, the drainage area is 3,245 acres (5.1 square miles).

The Little Troublesome Creek Stream Mitigation Site, hereafter referred to as the Stream Site, is located in Rockingham County on the southeastern side of Reidsville along Irvin and Little Troublesome Creeks. The wetland area, hereafter referred to as the Wetland Site, is located approximately four (4) miles southeast of the Stream Site and is also adjacent to Little Troublesome Creek. The Stream Site is located south of Turner Road, east of the intersection of Turner Road and Way Street in the City of Reidsville, North Carolina (see Figure 1). The Wetland Site is located approximately 3,000 feet southwest of the intersection of NC Highway 150 and Mizpah Church Road, south of the City of Reidsville (see Figure 1). The Stream and Wetland Sites are located in the Inner Piedmont Belt of the Piedmont Physiographic Province (USGS, 1998). The Sites are located within the North Carolina Division of Water Resources (NCDWR) subbasin 03-06-01 of the Cape Fear River Basin (United States Geological Survey (USGS) Hydrologic Unit 03030002010030). Approximately 28% of the land in the project watershed has been developed and approximately 17% of the land surface is impervious. Land uses within the watershed include: forested land (55%), developed (28%), and cultivated land (17%). The Stream Site is a tract owned by Wildlands Little Troublesome Creek Holdings, LLC and the Wetland Site is owned by Jerry Apple.

Prior to construction activities, the most significant watershed stressors identified during the technical assessment were stream bank erosion and instability. Other stressors included declining aquatic habitat, loss of forest, degraded riparian buffers, loss of wetlands, lack of urban stormwater detention, and water quality problems related to increased sediment and nutrient loadings. As a result of the aforementioned stressors, the Stream Site and Wetland Site had poor water quality due to sediment pollution and poor habitat due to lack of riparian and wetland vegetation. In particular, the Stream Site lacked stable streambank vegetation despite being surrounded by mature vegetation. The Stream Site also lacked in-stream bed diversity and exhibited unstable geomorphic conditions. The primary objectives of the project were to stabilize highly eroding stream banks, reconnect streams to their historic floodplain, improve wetland hydrology and function, reduce nutrient levels, sediment input, and water temperature, increase dissolved oxygen concentrations, create appropriate in-stream and terrestrial habitat, and decrease channel velocities. These objectives were achieved by restoring 4,988 linear feet (LF) of perennial stream channel, and restoring, enhancing, and creating 17.3 acres of riparian wetland. The Stream Site and Wetland Site riparian areas were also planted to stabilize streambanks, improve habitat, and protect water quality. Figure 2 and Table 1 present design applications for the Sites.

The following project goals were established to address the effects listed above in the executive summary from watershed and project site stressors:

- Stabilize stream dimensions;
- Stabilize stream pattern and profile;
- Establish proper substrate distribution throughout stream;
- Establish wetland hydrology for restored wetlands; and
- Restore native vegetation throughout wetlands and buffer zones.

The following secondary project goals (unmeasured) were established in the project Mitigation Plan (2011) to address the effects from watershed and project site stressors:

- Decrease nutrient and urban runoff pollutant levels;
- Decrease sediment input;
- Decrease water temperature and increase dissolved oxygen levels;
- Create appropriate in-stream habitat;
- Create appropriate terrestrial habitat; and
- Decrease channel velocities.

Stream and wetland restoration, enhancement, and creation construction efforts were completed in May 2012. A conservation easement is in place on the 33.0 ac of the Stream Site and 19.0 ac of the Wetland Site to protect them in perpetuity.

Monitoring Year 3 (MY-3) monitoring and site visits were completed during May-November, 2014 to assess the conditions of the project. The Site has met the required hydrologic, vegetation, and stream success criteria for MY-3. The sites overall average stem density of 615 stems/ acre is greater than the 320 stem/ acre density required for MY-3. Overall, all restored and enhanced streams are stable and functioning as designed and the Site has met the Monitoring Year 5 (MY5) hydrology success criteria. All groundwater gages met the MY-3 success criteria.

TABLE OF CONTENTS

APPENDICES

Section 1: PROJECT OVERVIEW

The Little Troublesome Creek Mitigation Site, hereafter referred to as the Sites, is located in Rockingham County within the Cape Fear River Basin (USGS Hydrologic Unit 03030002) near the town of Reidsville, North Carolina. The Stream Site is located south of Turner Road, east of the intersection of Turner Road and Way Street in the City of Reidsville, North Carolina. The Wetland Site is located approximately 3,000 feet southwest of the intersection of NC Highway 150 and Mizpah Church Road, south of the City of Reidsville. The Sites are located in the Inner Piedmont Belt of the Piedmont Physiographic Province (USGS, 1998). The project watersheds consists of forested, developed, and cultivated lands. The drainage area for the Stream Site is 3,245 acres at the lower end of Little Troublesome Creek.

The project stream reaches consist of Little Troublesome Creek, Irvin Creek and one unnamed tributary (UT) to the Little Troublesome Creek (stream restoration approach). Mitigation work within the Site included restoring 4,988 linear feet (LF) of perennial and intermittent stream channel and restoring, enhancing, and creating 17.3 acres (ac) of riparian wetland. The stream and wetland areas were also planted with native vegetation to improve habitat and protect water quality. Construction activities were completed by Fluvial Solutions in May 2012. Planting and seeding activities were completed by Bruton Natural Systems, Inc. May 2012. A conservation easement has been recorded on the Sites and is in place along the stream and wetland riparian corridors to protect them in perpetuity; 33.0 ac (Deed Book 1411, Page Number 2458) owned by Wildlands Little Troublesome Creek Holdings, LLC and 19.0 ac (Deed Book 1412, Page Number 1685) owned by Jerry Apple. Directions and a map of the Site are provided in Figure 1 and project components are illustrated for the Site in Figures 2a and 2b.

1.1 Project Goals and Objectives

Prior to construction activities, the most significant watershed stressors identified during the technical assessment were stream bank erosion and instability. Other stressors included declining aquatic habitat, loss of forest, degraded riparian buffers, loss of wetlands, lack of urban stormwater detention, and water quality problems related to increased sediment and nutrient loadings. As a result of the aforementioned stressors, the Stream Site and Wetland Site had poor water quality due to sediment pollution and poor habitat due to lack of riparian and wetland vegetation. In particular, the Stream Site lacked stable streambank vegetation despite being surrounded by mature vegetation. The Stream Site also lacked in-stream bed diversity and exhibited unstable geomorphic conditions. Table 4 in Appendix 1 and Tables 10a, 10b, and 10c in Appendix 4 present the pre-restoration conditions in detail.

The Sites were designed to meet the over-arching goals as described in the mitigation plan (2011) to address the effects from watershed and project site stressors. The project is intended to provide numerous ecological benefits within the Cape Fear River Basin. While many of these benefits are limited to the Site project area, others, such as pollutant removal and improved aquatic and terrestrial habitat, have more far-reaching effects. The following project specific primary goals established in the mitigation plan include:

- Stabilize stream dimensions;
- Stabilize stream pattern and profile;
- Establish proper substrate distribution throughout stream;
- Establish wetland hydrology for restored wetlands; and
- Restore native vegetation throughout wetlands and buffer zones.

Secondary project goals (unmeasured) established in the mitigation plan were to address the effects from watershed and project site stressors include:

- Decrease nutrient and urban runoff pollutant levels;
- Decrease sediment input;
- Decrease water temperature and increase dissolved oxygen levels;
- Create appropriate in-stream habitat;
- Create appropriate terrestrial habitat; and
- Decrease channel velocities.

The primary and secondary project goals were addressed through the following project objectives:

- Riffle cross-sections of the restoration and enhancement reaches were constructed to remain stable and will show little change in bankfull area, maximum depth ratio, and width-to-depth ratio over time.
- The project was constructed so that the bedform features of the restoration reaches will remain stable overtime. This includes riffles that will remain steeper and shallower than the pools and pools that are deep with flat water surface slopes. The relative percentage of riffles and pools will not change significantly over time. Banks will be constructed so that bank height ratios will remain very near to 1.0 for nearly all of the restoration reaches.
- Stream substrate will remain coarse in the riffles and finer in the pools.
- A free groundwater surface will be present within 12 inches of the ground surface in the restored wetland areas for 7 percent of the growing season measured on consecutive days under typical precipitation conditions.
- Native vegetation appropriate for the wetland and riparian buffer zones were planted throughout both the Wetland and Stream Sites. The planted trees will become well established and survival criteria will be met.
- Off-site nutrient input will be absorbed on-site 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 input from eroding stream banks was reduced by installing bioengineering and in-stream structures while creating a stable channel form using geomorphic design principles. Sediment from off-site sources will be captured by deposition on restored floodplain areas where native vegetation will slow overland flow velocities.
- Restored riffle/step-pool sequences where distinct points of re-aeration can occur will allow for oxygen levels to be maintained in the perennial reaches. Creation of deep pool zones will lower temperature, helping to maintain dissolved oxygen concentrations. Establishment and maintenance of riparian buffers will create long-term shading of the channel flow to minimize thermal heating.
- A channel form that includes riffle/pool sequences and gravel and cobble zones creating habitat for macroinvertebrates and fish. Large woody debris, rock structures, root wads, and native stream bank vegetation were introduced to substantially increase habitat value.
- Adjacent buffer areas were restored by removing invasive vegetation and planting native vegetation. These areas will be allowed to receive more regular and inundating flows. Riparian wetland areas were restored and enhanced to provide wetland habitat.
- By allowing for more overbank flooding and by increasing channel roughness, local channel velocities can be reduced. This will allow for less bank shear stress, formation of refuge zones during large storm events and zonal sorting of depositional material.

The design streams and wetlands were restored to the appropriate type based on the surrounding landscape, climate, and natural vegetation communities but also with strong consideration to existing watershed conditions and trajectory. The mitigation project was developed to restore a high quality of riparian function to the streams, wetlands, and riparian corridors. The final mitigation plan was submitted and accepted by the NCEEP in June of 2011. Construction activities were completed by Fluvial Solutions and Land Mechanic Design, Inc in May of 2012. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in May 2012. Baseline monitoring (MY-0) was conducted between April and May 2012. Annual monitoring will be conducted for five years with the close-out anticipated to commence in 2019 given the success criteria are met. Appendix 1 provides more detailed project activity, history, contact information, and watershed/site background information for this project.

1.2 Monitoring Year 3 Data Assessment

Annual monitoring and quarterly site visits were conducted during monitoring year 3 (MY-3) to assess the condition of the project. The stream and wetland mitigation success criteria for the Site follow the approved success criteria presented in the Little Troublesome Creek Mitigation Plan (2011).

1.2.1 Vegetative Assessment

Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-NCEEP Level 2 Protocol (Lee et al., 2008). A total of 35 (22 at the Wetland Site; 13 at the Stream Site) vegetation plots were established during the baseline monitoring within the project easement areas using standard 10 meter by 10 meter vegetation monitoring plots. Due to the narrow planted corridor along UT1, vegetation plots were not established. Instead, a visual assessment of the planted corridor is used to evaluate vegetation growth success. The final vegetative success criteria will be the survival of 260 planted stems per acre in the riparian corridor of the Stream Site at the end of MY-5, and 200 planted stems per acre within the Wetland Site at the end of year seven monitoring (MY-7). The interim measure of vegetative success for the Stream and Wetland Sites will be the survival of at least 320 planted stems per acre at the end of the third monitoring year (MY-3).

The MY-3 vegetative survey was completed in June 2014. The 2014 annual vegetation monitoring resulted in an average stem density of 498 stems per acre for the Wetland Site, which is greater than the interim requirement of 320 stems/acre and approximately 29% less than the baseline (MY-0) density recorded (701 stems/acre). At Wetland Site, three of the plots did not meet the interim success criteria and averaged 135 stems per acre; however with the inclusion of volunteer species the plots do meet the success criteria. There was an average of 12 stems per plot compared to 17 stems per plot during MY-0 for the Wetland Site. All plots at the Stream Site met the MY-3 target of 320 stems per acre. The average stem density on the Stream Site was 732 stems/acre, which is also greater than the interim requirement, but approximately 23% less than the baseline density recorded (953 stems/acre). There was an average of 18 stems per plot compared to 24 stems per plot in MY-0 for the Stream Site. Please refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

1.2.2 Vegetation Areas of Concern

Isolated areas of invasive species including kudzu (*Pueraria montana*), multiflora rose (*Rosa multiflora*), and Japanese stiltgrass (*Microstegium vimineum*) have been documented at the site. However, the presence of these species do not appear to be affecting the survivability of planted stems. These areas will be closely monitored during subsequent site visits and controlled if deemed necessary.

1.2.3 Stream Assessment

Morphological surveys for the MY-1 were conducted in May 2014. With the exception of some isolated areas of bank erosion and pool deposition, all streams within the Site are stable with little to no erosion and have met the success criteria for MY-3. Please refer to Appendix 2 for the visual assessment table, Integrated Current Condition Plan View, and reference photographs. Refer to Appendix 4 for the morphological data and plots.

In general, cross-sections show little to no change in the bankfull area, maximum depth ratio, or width-to-depth ratio. Surveyed riffle cross-sections fell within the parameters defined for channels of the appropriate Rosgen stream type. The surveyed longitudinal profile data for 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 riffles and maintaining flat water surface slopes. The longitudinal profiles show that the bank height ratios remain very near to 1.0 for all of the restoration reaches. Deposition within pools was documented in the longitudinal profile along UT1. The deposition is not affecting channel stability but will be monitored.

Overall in-stream structures, such as root wads used to enhance channel habitat and stability on the outside bank of meander bends are providing stability and habitat as designed. Bank scour was documented in one outside meander bend on Little Troublesome Creek (approximate STA 208+00-208+50). This area will be repaired in the winter of 2015. Details regarding the maintenance plan are discussed below in section 1.2.7.

Pattern data will only be completed in MY-5 if there are indicators from the profile or cross-sections that significant geomorphic adjustments have occurred. No changes were observed that indicated a change in the radius of curvature or channel belt width; therefore, pattern data is not included in the MY-3 report.

1.2.4 Stream Areas of Concern

An isolated area of bank erosion was documented on Little Troublesome Creek and is scheduled to be stabilized in the winter of 2015. A small beaver was noted on Irvin Creek Reach 1 (approximate STA 19+10) during a site walk with EEP on December 11, 2014. Details regarding the tentative maintenance plan are discussed below in section 1.2.7. Depositional areas observed on UT1 will be monitored for indications of long term instability and a maintenance plan will implemented if deemed necessary.

1.2.5 Hydrology Assessment

At the end of the five year monitoring period, two or more bankfull events must have occurred in separate years within the restoration reaches. Bankfull events were recorded on Irvin Creek, Little Troublesome Creek, and UT1 by crest gage or onsite observations (wrack lines) during the MY-1, MY-2 and M-3 data collection. The Site has met the hydrologic success criteria. Please refer to Appendix 5 for hydrologic data.

1.2.6 Wetland Assessment

Eight groundwater monitoring gages were established during the baseline monitoring within the wetland restoration, enhancement, and creation zones. The gages were installed at appropriate locations so that the data collected will provide an indication of groundwater levels throughout the site. To provide data for the determination of the growing season for the wetland areas, two soil temperature loggers were installed; one within each wetland, to collect additional growing season data. These probes can 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). The probes indicate a longer growing season than that defined for Rockingham County by the WETS station data. A barotroll logger and a rain gage were also installed onsite. All monitoring gages were downloaded on a quarterly basis and maintained on an as needed basis. The success criteria for wetland hydrology is to have a free groundwater surface within 12 inches of the ground surface for 7 percent of the growing season, which is measured on consecutive days under typical precipitation conditions. All groundwater gages met the annual wetland hydrology success criteria for MY-3. Please refer to Appendix 2 for the groundwater gage locations and Appendix 5 for groundwater hydrology data and plots.

1.2.7 Maintenance Plan

The isolated area of bank erosion documented on Little Troublesome Creek will be stabilized in the winter of 2015. Existing root wads will be lowered and geo lifts will be installed with willow whips and stakes. EEP has provided contacts for Wildlands to address beaver activity along Irvin Creek. Wildlands will provide results in the MY-4 report.

1.3 Monitoring Year 3 Summary

With the exception of an isolated area of bank erosion on Little Troublesome Creek and pool deposition on UT1, all streams within the Site are stable and functioning as designed. Deposition observed on UT1 will be monitored for indications of long term instability. The isolated area of bank erosion documented on Little Troublesome Creek will be stabilized in the winter of 2015. The average stem density for the Site is on track to meeting the MY-5 success criteria; however, a few individual vegetation plots did not meet the MY-3 success criteria as noted in the Integrated Current Condition Plan View. The MY-5 stream hydrology attainment requirement was met in MY-2. However, there have been two additional bankfull events documented with the crest gauges on the restoration reaches in MY-3. All groundwater gages met the MY-3 success criteria.

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

Section 2: METHODOLOGY

Geomorphic data was collected following 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). Cross-sectional data were collected using a total station and were georeferenced. All Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcView. Crest gages and pressure transducers 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). Reporting follows the NCEEP Monitoring Report Template and Guidance Version 1.2.1 (NCEEP, 2009).

Section 3: REFERENCES

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

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

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

North Carolina Ecosystem Enhancement Program (NCEEP). 2009. Monitoring Report Template and Guidance. Version 1.2.1. Raleigh, NC.

NC Interagency Review Team (IRT). 2009. DRAFT (For Public Review and Comment) Regulatory Guidance for the Calculation of Stream and Buffer Mitigation Credit for Buffer Widths Different From Standard Minimum Widths. Version 4.4.

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.

State Climate Office of North Carolina (SCONC). 2013. CRONOS Database ECONet weather station at Upper Piedmont Research Station (REID), in Reidsville, NC. http://nc-climate.ncsu.edu/cronos?station=REID&temporal=daily

United States Army Corps of Engineers (USACE). 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

United States Department of Agriculture (USDA). 2002. Natural Resources Conservation Service, Climate Information for Catawba County, NC (1971-2000). WETS Station: Reidsville NW, NC7202. http://www.wcc.nrcs.usda.gov/ftpref/support/climate/wetlands/nc/37157.txt

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

Wildlands Engineering, Inc (2011). Little Troublesome Mitigation Site Mitigation Plan. NCEEP, Raleigh, NC.

Wildlands Engineering, Inc. 2011. Little Troublesome Creek Mitigation Site Baseline Monitoring Document and As-Built Baseline Report. NCEEP, Raleigh, NC.

APPENDIX 1. General Tables and Figures

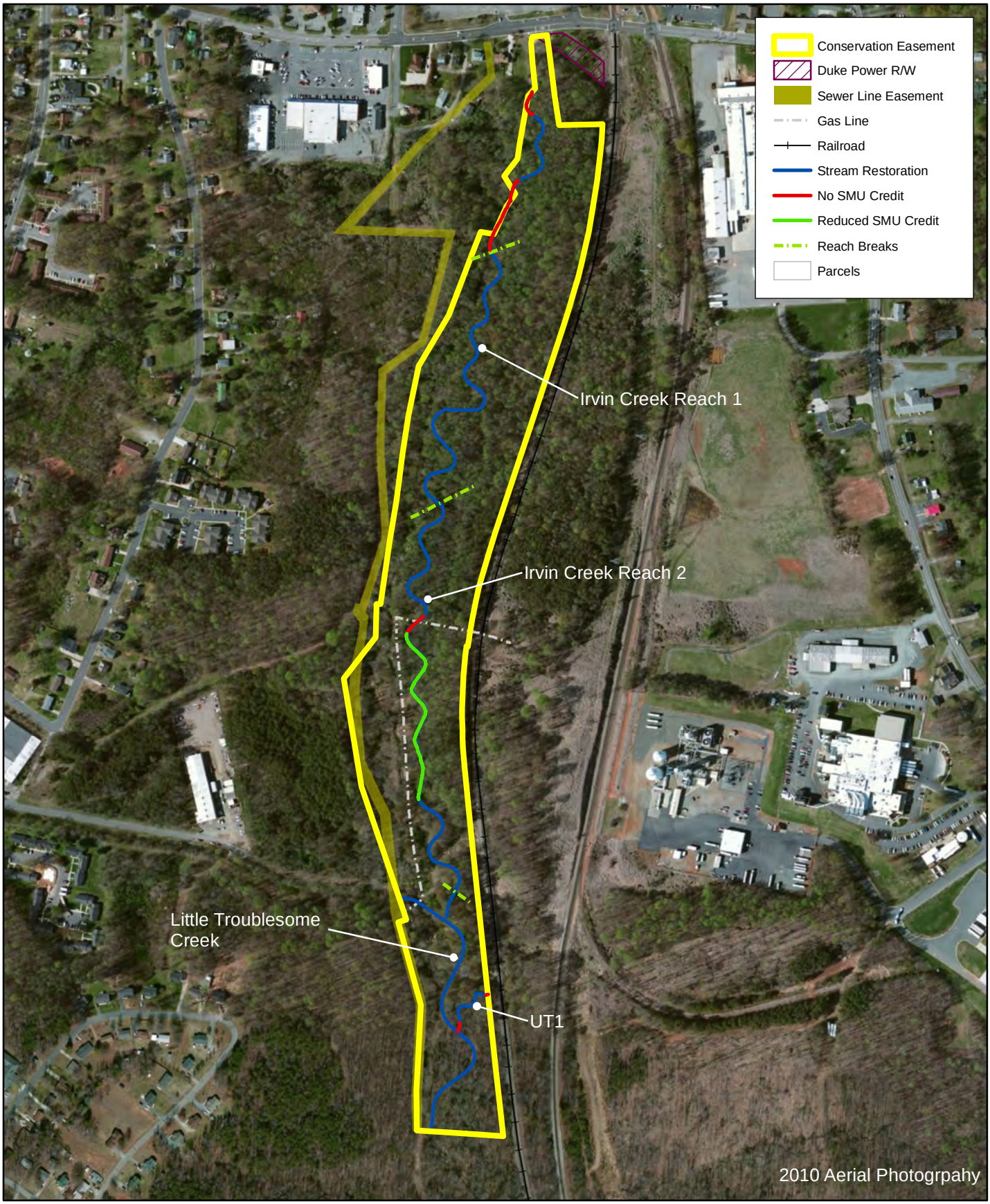
WILDLANDS ENGINEERING

Ecosystem Enhancement PROGRAM

0 0.75 1.5 Miles

N

Figure 1 Project Vicinity Map
Little Troublesome Creek Mitigation Site
NCEEP Project Number 94640
Monitoring Year 3
Rockingham County, NC



WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 250 500 Feet

N

Figure 2a Project Component/Asset Map
Little Troublesome Creek Mitigation Site
Stream Site
NCEEP Project Number 94640
Monitoring Year 3

Rockingham County, NC

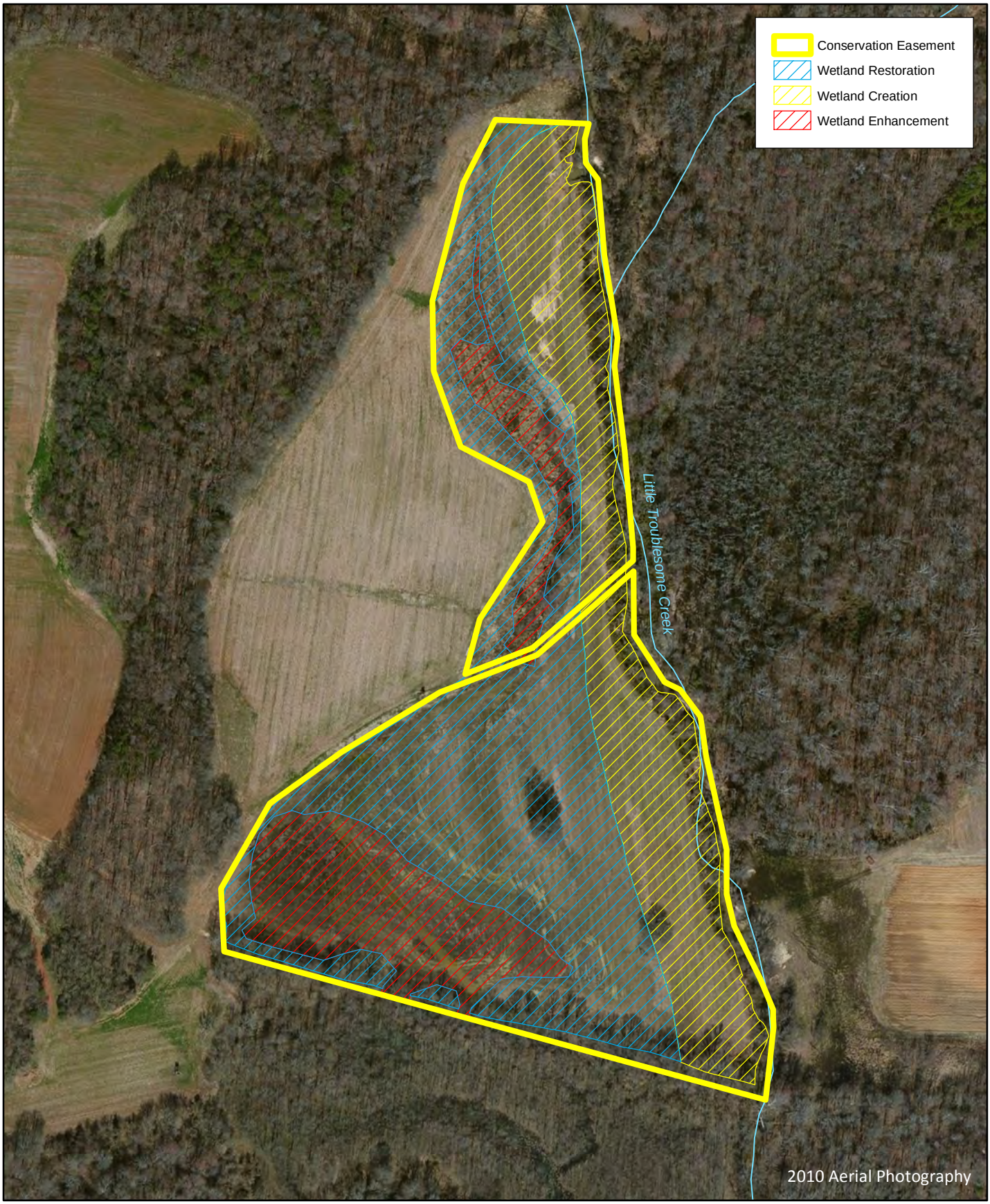


Figure 2b Project Component/Asset Map
Little Troublesome Creek Mitigation Site
Wetland Site
NCEEP Project Number 94640
Monitoring Year 3

Rockingham County, NC

WILDLANDS ENGINEERING

Ecosystem Enhancement PROGRAM

0 125 250 Feet

N

Table 1. Project Components and Mitigation Credits
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Mitigation Credits									
	Stream^		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offet	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	5,052	N/A	10.3	2.8	N/A	N/A	N/A	N/A	N/A

Project Components						
Reach ID	As-Built Stationing/ Location	Existing Footage (LF) / Acreage (Ac)	Approach	Restoration or Restoration Equivalent	Restoration Footage (LF) / Acreage (Ac)*	Mitigation Ratio
Irvin Creek - Reach 1	102+10 to 123+05	1,640	Priority 1	Restoration	1,793	1:1
Irvin Creek - Reach 2	123+05 to 142+37	1,505	Priority 1	Restoration	1,882	1:1
Little Troublesome Creek	200+00 to 211+71	1,080	Priority 1	Restoration	1,080	1:1
UT1	400+00 to 402+33	184	Priority 1/2	Restoration	233	1:1
RW1	N/A	N/A	Restoration	Restoration	8.7	1:1
RW1	N/A	N/A	Creation	Restoration Equivalent	4.9	3:1
RW1	N/A	3.7	Enhancement	Restoration Equivalent	3.7	1.3:1**

Component Summation							
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)		Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine				
Restoration	4,988	8.7	-	-	-	-	-
Enhancement		3.7	-	-	-	-	-
Enhancement I	-						
Enhancement II	-						
Creation		4.9	-	-			
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

^Stream Mitigation Units were calculated following the NC IRT Draft Regulatory Guidance for the Calculation of Stream and Buffer Mitigation Credit (March 11, 2009).

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

**The higher enhancement ratio was agreed to with Todd Tugwell, with the USACE, during a March 9, 2011 meeting for several reasons. The higher ratio is warranted because of the low quality of the existing wetland enhancement zone. Previously the enhancement zone, like the restoration and creation zones, was used for farming. The hydrology of the site has been altered by a drainage ditch and a berm along Little Troublesome Creek. There is no vegetation on the site except for some areas of grasses and cultivated crops. Enhancement activities performed on the site will include improving the hydrology of the enhancement zone (as well as the creation and restoration zones) and restoring the native vegetation. Therefore the functional uplift of the enhancement portion of the project will be nearly the same as that of the restoration zone and, thus, a high ratio for enhancement is appropriate.

Table 2. Project Activity and Reporting History
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Activity or Report	Date Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	June 2011	June 2011
Final Design - Construction Plans	August 2011	August 2011
Construction	April 2012	May 2012
Temporary S&E mix applied to entire project area[1]	April 2012	May 2012
Permanent seed mix applied to reach/segments	April 2012	May 2012
Bare root plantings for reach/segments	April 2012	May 2012
Baseline Monitoring Document (Year 0 Monitoring - baseline)	April/May 2012	June 2012
Year 1 Monitoring	Sept/Oct 2012	December 2012
Year 2 Monitoring	June/October 2013	December 2013
Year 3 Monitoring	May/November 2014	December 2014
Year 4 Monitoring	2015	December 2015
Year 5 Monitoring	2016	December 2016
Year 6 Monitoring[2]	2017	December 2017
Year 7 Monitoring[2]	2018	December 2018

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

[2]Monitoring Year 6 and 7 include monitoring the Wetland Site only.

Table 3. Project Contact Table
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Designer	**Wildlands Engineering, Inc.**
Jeff Keaton, PE	312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Fluvial Solutions**
Peter Jelenevsky	PO Box 28749 Raleigh, NC 28749
Planting Contractor - Stream Site	**Fluvial Solutions**
Peter Jelenevsky	PO Box 28749 Raleigh, NC 28749
Planting Contractor - Wetland Site	**Bruton Natural Systems, Inc.**
Charlie Bruton	PO Box 1197 Freemont, NC 27830 919.242.6555
Seeding Contractor - Stream and Wetland Site	**Fluvial Solutions**
Peter Jelenevsky	PO Box 28749 Raleigh, NC 28749
Seed Mix Sources	**Mellow Marsh Farm**
Nursery Stock Suppliers	**Arborgen** **Dykes and Son Nursery** **NC Forestry Service, Claridge Nursery**
Monitoring Performers	**Wildlands Engineering, Inc.**
Stream, Vegetation, and Wetland Monitoring POC	Kirsten Y. Gimbert 704.332.7754, ext. 110

Table 4. Project Baseline Information and Attributes
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Project Information					
Project Name	Little Troublesome Creek Mitigation Site				
County	Rockingham				
Project Area (acres)	Stream Site: 33 acres, Wetland Site: 19 acres				
Project Coordinates (latitude and longitude)	36° 20' 96"N, 79° 39' 31"W				
Project Watershed Summary Information					
Physiographic Province	Inner Piedmont Belt of the Piedmont				
River Basin	Cape Fear				
USGS Hydrologic Unit 8-digit	03030002				
USGS Hydrologic Unit 14-digit	03030002010030				
DWQ Sub-basin	03-06-01				
Project Drainiage Area (acres)	3,245				
Project Drainage Area Percentage of Impervious Area	17%				
CGIA Land Use Classification	55% Forest Land,17% Cultivated Land, 28% Developed				
Reach Summary Information					
Parameters	**Irvin Creek Reach 1**	**Irvin Creek Reach 2**	**Little Troublesome Creek**	**UT1**	**RW1**
Length of reach (linear feet) - Post-Restoration	2,095	1,932	1,171	233	N/A
Drainage area (acres)	525	584	3,245	62	N/A
NCDWQ stream identification score	44.5	44.5	45.5	26.5	N/A
NCDWQ Water Quality Classification	C	C	C; NSW	C	C; NSW
Morphological Desription (stream type)	Perennial	Perennial	Perennial	Intermittent	N/A
Evolutionary trend (Simon's Model) - Pre-Restoration	Stage IV	Stage IV	Stage IV	Stage IV	N/A
Underlying mapped soils	CsA	CsA	CsA	CsA	CsA / HcA
Drainage class	Somewhat Poorly-Drained	Somewhat Poorly-Drained	Somewhat Poorly-Drained	Somewhat Poorly-Drained	Somewhat Poorly-Drained / Poorly Drained
Soil Hydric status	No	No	No	No	No / Yes
Slope	0-2%	0-2%	0-2%	0-2%	0-2%
FEMA classification	Zone AE				
Native vegetation community	Bottom-land forest				
Percent composition of exotic invasive vegetation - Post-Restoration	0%				
Regulatory Considerations					
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**		
Waters of the United States - Section 404	X	X	Little Troublesome Creek Mitigation Plan; 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	Little Troublesome Creek Mitigation Plan; studies found "no effect" (letter from USFWS)		
Historic Preservation Act	X	X	Little Troublesome Creek Mitigation Plan; No historic resources were found to be impacted (letter from SHPO)		
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A		
FEMA Floodplain Compliance	X	X	Approved CLOMR		
Essential Fisheries Habitat	N/A	N/A	N/A		

*LF provided includes portions of the stream that will be monitored and has been reconstructed, but for which mitigation credit will not be claimed. Please refer to Table 1 for the credit summary lengths.

APPENDIX 2. Visual Assessment Data

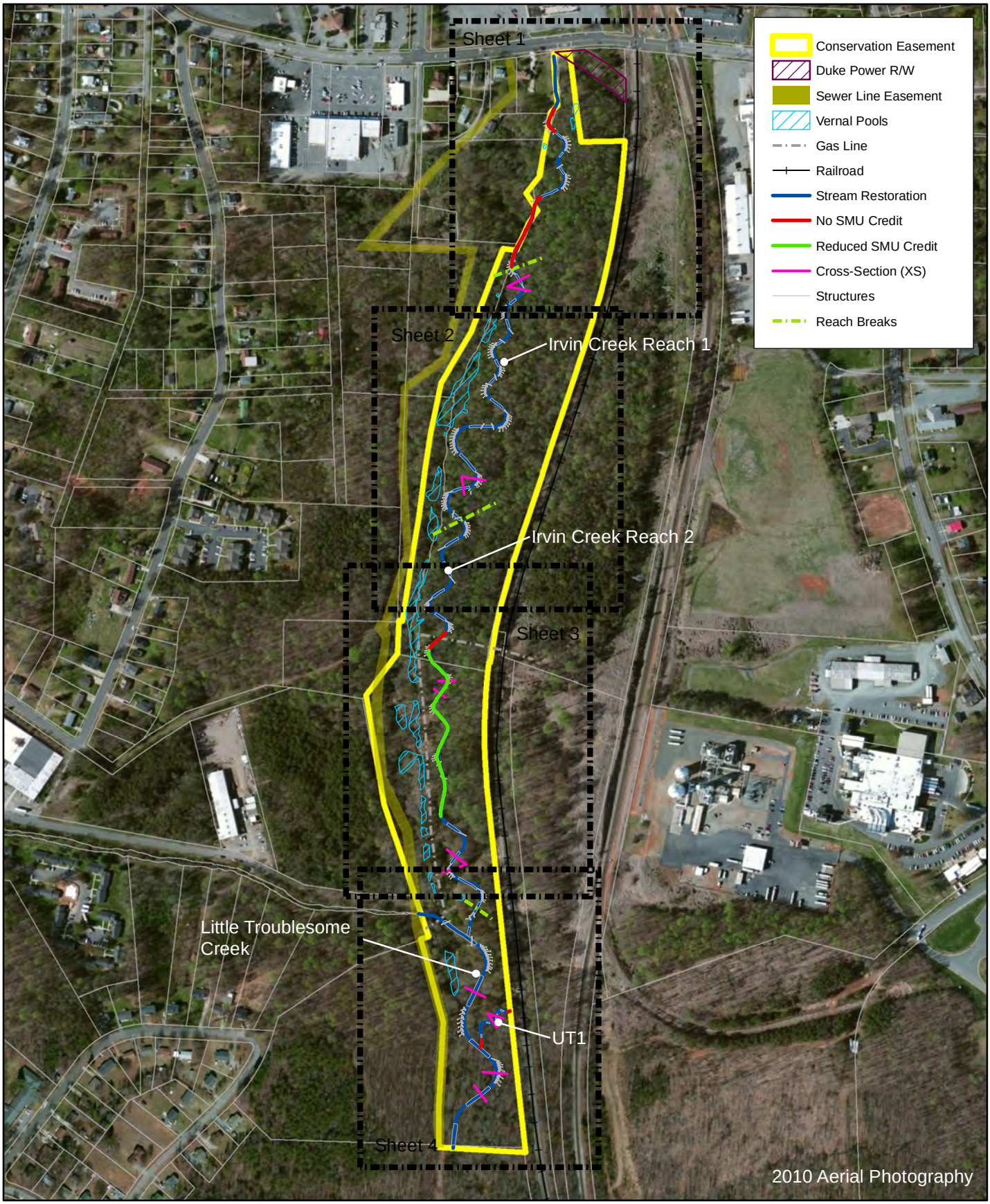


Figure 3.0 Integrated Current Condition Plan View
(Key)
Little Troublesome Creek Mitigation Site
Stream Site
NCEEP Project Number 94640
Monitoring Year 3

Rockingham County, NC

WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 250 500 Feet

N

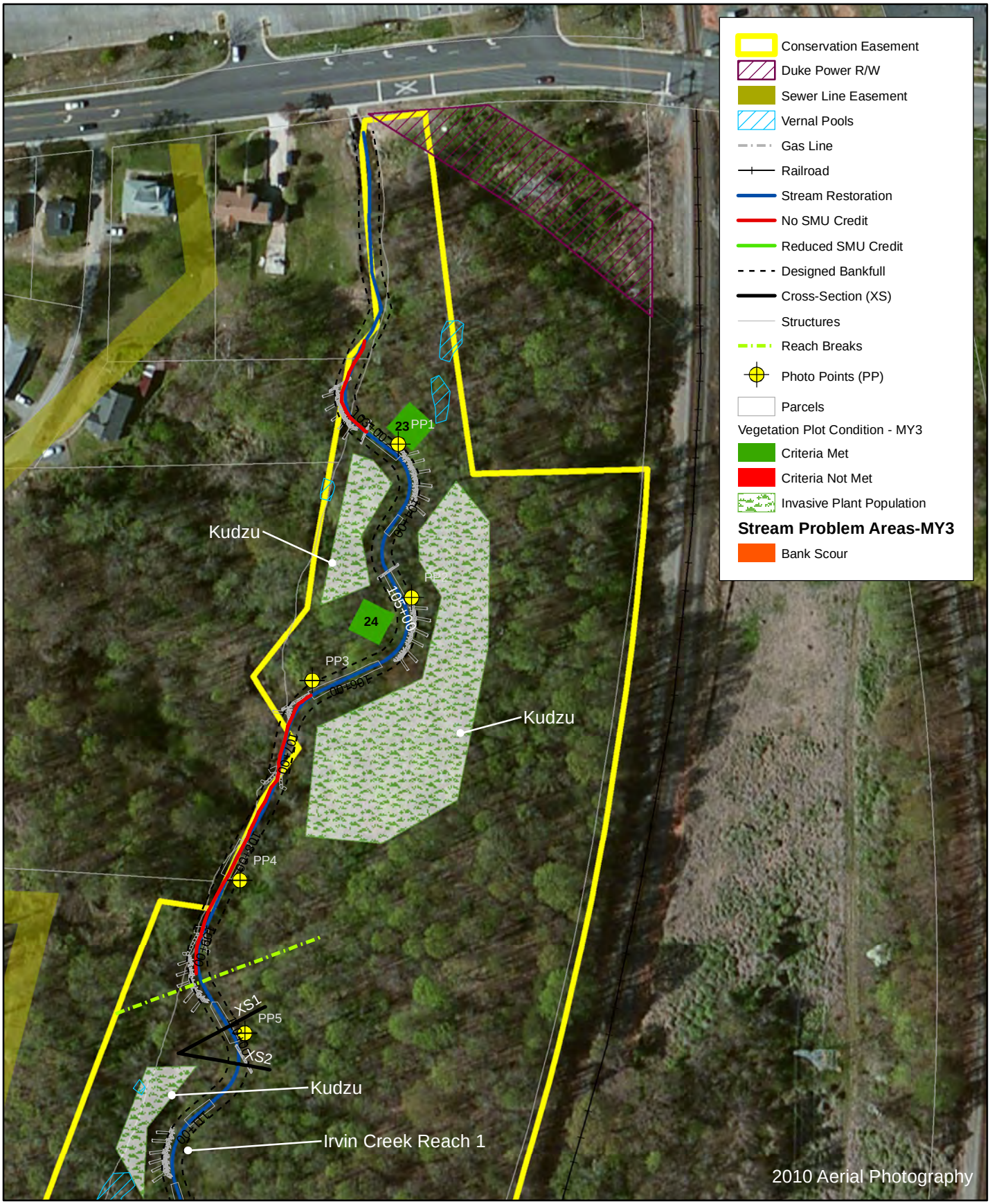


Figure 3.1 Integrated Current Condition Plan View
(Sheet 1 of 4)
Little Troublesome Creek Mitigation Site
Stream Site
NCEEP Project Number 94640
Monitoring Year 3

Rockingham County, NC

WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 75 150 Feet

N

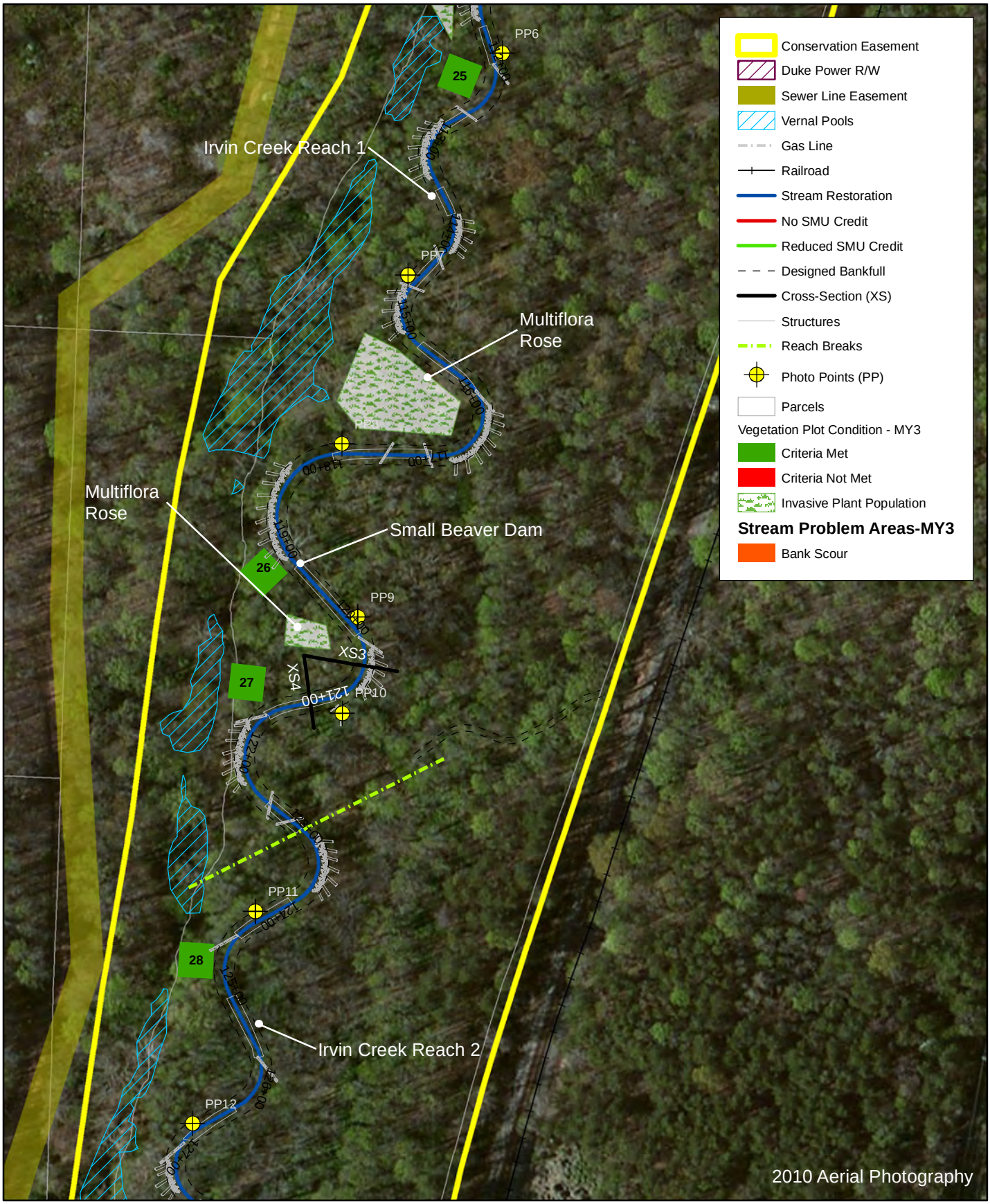


Figure 3.2 Integrated Current Condition Plan View
(Sheet 2 of 4)
Little Troublesome Creek Mitigation Site
Stream Site
NCEEP Project Number 94640
Monitoring Year 3

Rockingham County, NC

WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 75 150 Feet

N

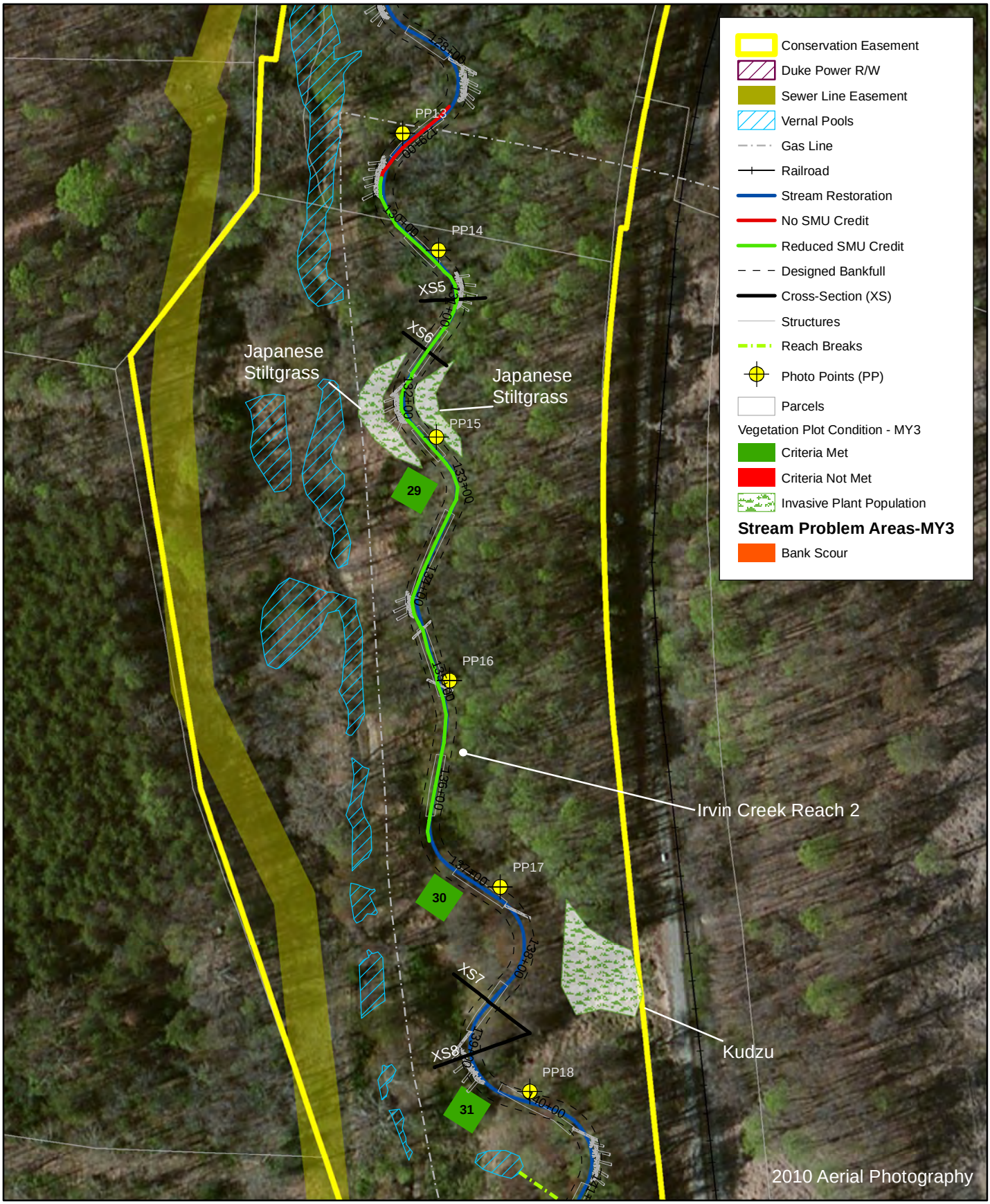


Figure 3.3 Integrated Current Condition Plan View
(Sheet 3 of 4)
Little Troublesome Creek Mitigation Site
Stream Site
NCEEP Project Number 94640
Monitoring Year 3

Rockingham County, NC

WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 75 150 Feet

N

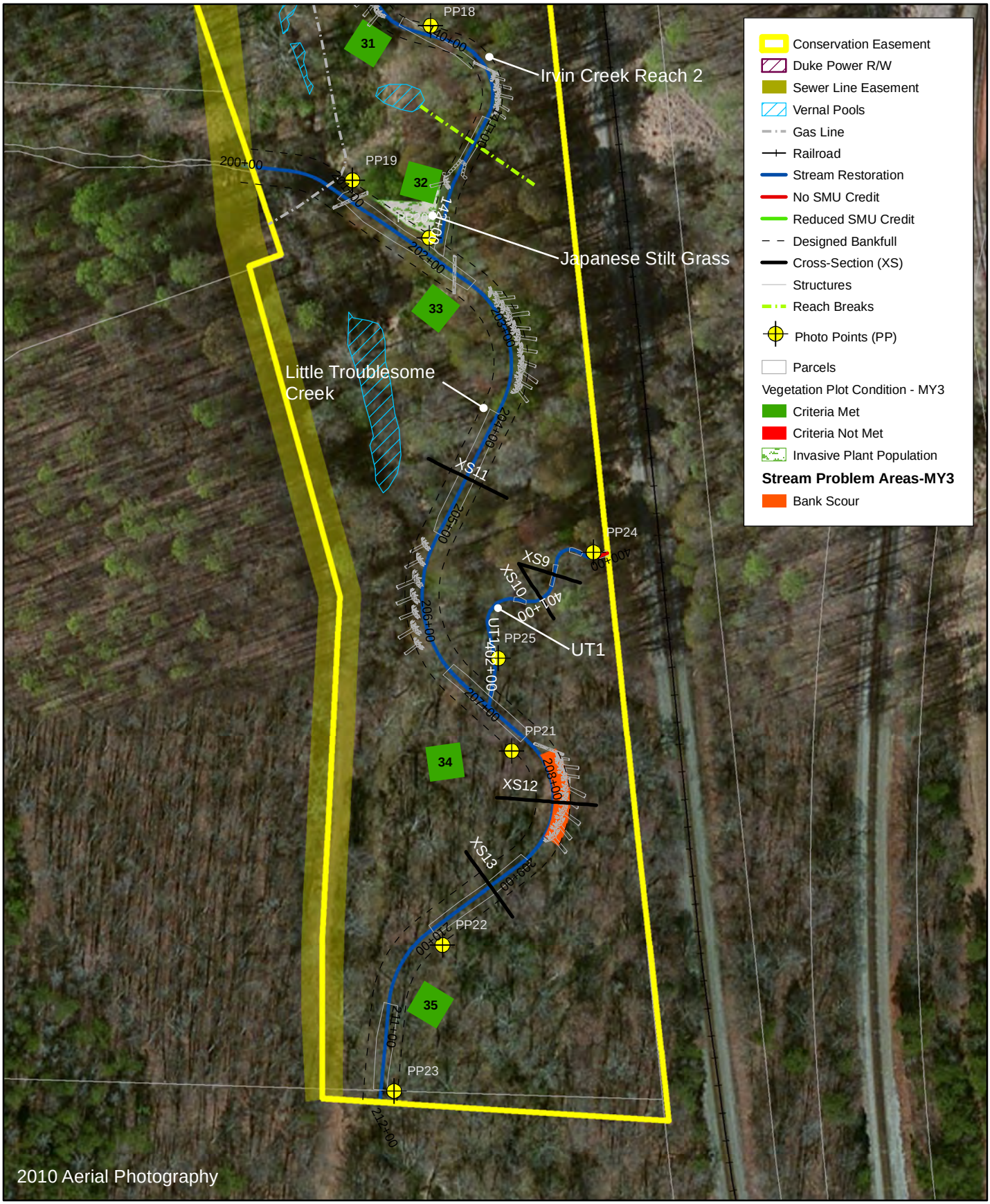


Figure 3.4 Integrated Current Condition Plan View
(Sheet 4 of 4)
Little Troublesome Creek Mitigation Site
Stream Site
NCEEP Project Number 94640
Monitoring Year 3

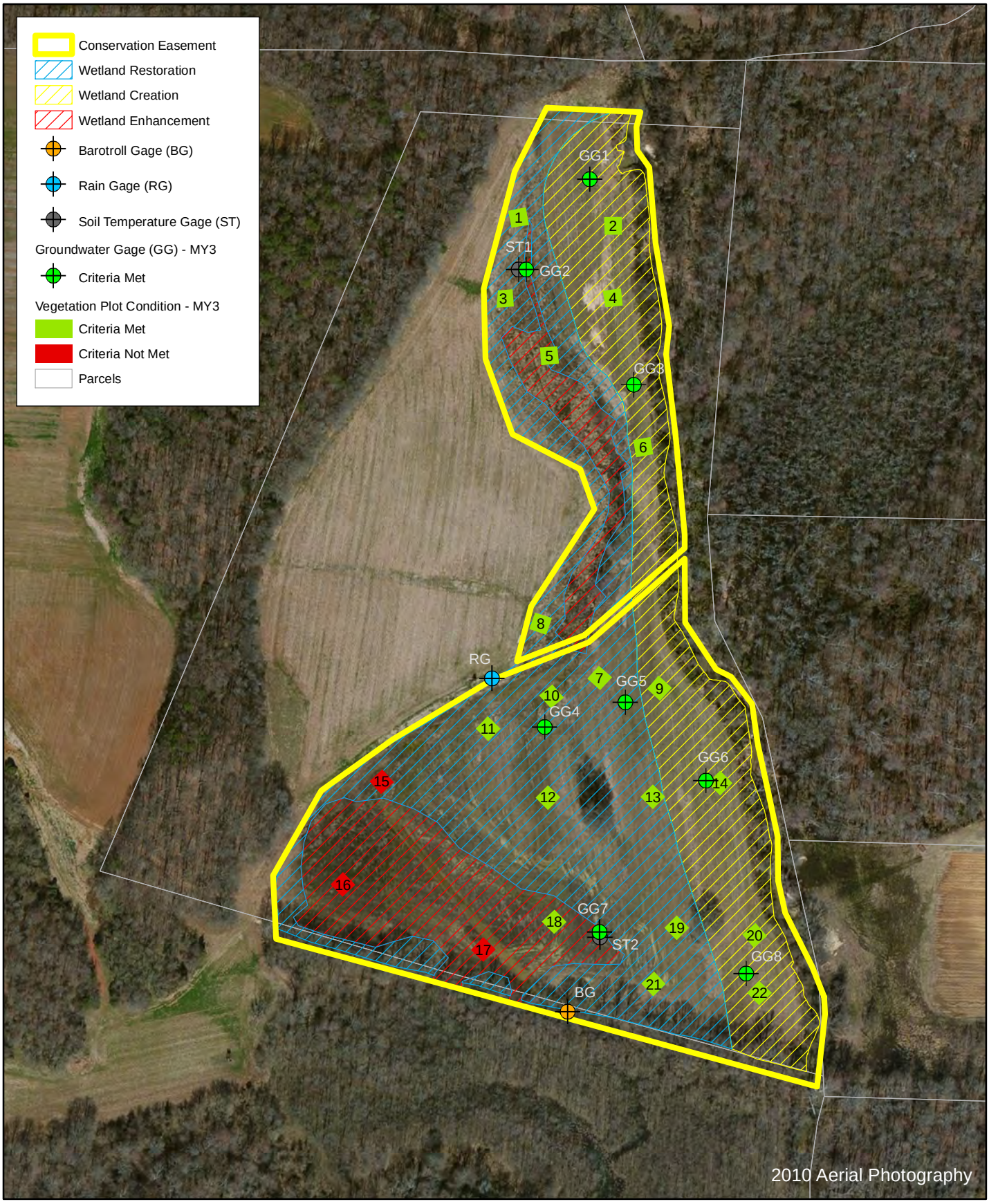
Rockingham County, NC

WILDLANDS ENGINEERING

Ecosystem Enhancement Program

0 75 150 Feet

N



WILDLANDS ENGINEERING

Ecosystem Enhancement PROGRAM

0 125 250 Feet

N

Figure 3.5 Integrated Current Condition Plan View
Little Troublesome Creek Mitigation Site
Wetland Site
NCEEP Project Number 94640
Monitoring Year 3

Rockingham County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 1 (2,095 LF)
Monitoring Year 3

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	16	16			100%			
	3. Meander Pool Condition	Depth Sufficient	16	16			100%			
		Lenth Appropriate	16	16			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	16	16			100%			
		Thalweg centering at downstream of meander bend (Glide)	16	16			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%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	36	36			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	24	24			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%.	31	31			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	12	12			100%			

Table 5b. Visual Stream Morphology Stability Assessment Table
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 2 (1,932 LF)
Monitoring Year 3

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	16	16			100%			
	3. Meander Pool Condition	Depth Sufficient	15	15			100%			
		Lenth Appropriate	15	15			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	15	15			100%			
		Thalweg centering at downstream of meander bend (Glide)	15	15			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	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%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	35	35			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	19	19			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	9	9			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	19	19			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	19	19			100%			

Table 5c. Visual Stream Morphology Stability Assessment Table
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
UT1 (233 LF)
Monitoring Year 3

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	6	6			100%			
	3. Meander Pool Condition	Depth Sufficient	4	4			100%			
		Lenth Appropriate	4	4			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		Thalweg centering at downstream of meander bend (Glide)	4	4			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%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	6	6			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	6	6			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	0	0			100%			

Table 5d. Visual Stream Morphology Stability Assessment Table
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Little Troublesome Creek (1,171 LF)
Monitoring Year 3

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability (Riffle and Run units)**	Aggradation			0	0	100%			
		Degredation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	5	5			100%			
	3. Meander Pool Condition	Depth Sufficient	4	4			100%			
		Lenth Appropriate	4	4			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		Thalweg centering at downstream of meander bend (Glide)	4	4			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			1	80	96%	0	0	96%
				Totals	1	80	96%	0	0	96%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dilodged boulders or logs.	9	9			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	6	6			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	1	1			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	4	4			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			

Table 6. Vegetation Condition Assessment Table
Little Troublesome Creek Mitigation Site (EEP Project No. 94640)
Monitoring Year 3

Planted Acreage **33.7**

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	0	0.00	0.0%
		Total	**0**	**0.00**	**0.0%**
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	0	0	0%
		Cumulative Total	**0**	**0.0**	**0%**

Easement Acreage **52**

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	8	1.23	4%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

Stream Photographs

	
Photo Point 1 – looking upstream (5/13/2014)	Photo Point 1 – looking downstream (5/13/2014)
	
Photo Point 2 – looking upstream (5/13/2014)	Photo Point 2 – looking downstream (5/13/2014)
	
Photo Point 3 – looking upstream (5/13/2014)	Photo Point 3 – looking downstream (5/13/2014)

	
Photo Point 4 – looking upstream (5/13/2014)	Photo Point 4 – looking downstream (5/13/2014)
	
Photo Point 5 – looking upstream (5/13/2014)	Photo Point 5 – looking downstream (5/13/2014)
	
Photo Point 6 – looking upstream (5/13/2014)	Photo Point 6 – looking downstream (5/13/2014)

	
Photo Point 7 – looking upstream (5/13/2014)	Photo Point 7 – looking downstream (5/13/2014)
	
Photo Point 8 – looking upstream (5/13/2014)	Photo Point 8 – looking downstream (5/13/2014)
	
Photo Point 9 – looking upstream (5/13/2014)	Photo Point 9 – looking downstream (5/13/2014)

	
Photo Point 10 – looking upstream (5/13/2014)	Photo Point 10 – looking downstream (5/13/2014)
	
Photo Point 11 – looking upstream (5/13/2014)	Photo Point 11 – looking downstream (5/13/2014)
	
Photo Point 12 – looking upstream (5/13/2014)	Photo Point 12 – looking downstream (5/13/2014)

	
Photo Point 13 – looking upstream (5/13/2014)	Photo Point 13 – looking downstream (5/13/2014)
	
Photo Point 14 – looking upstream (5/13/2014)	Photo Point 14 – looking downstream (5/13/2014)
	
Photo Point 15 – looking upstream (5/13/2014)	Photo Point 15 – looking downstream (5/13/2014)

	
Photo Point 16 – looking upstream (5/13/2014)	Photo Point 16 – looking downstream (5/13/2014)
	
Photo Point 17 – looking upstream (5/13/2014)	Photo Point 17 – looking downstream (5/13/2014)
	
Photo Point 18 – looking upstream (5/13/2014)	Photo Point 18 – looking downstream (5/13/2014)

Photo Point 19 – looking upstream (5/13/2014)

Photo Point 19 – looking downstream (5/13/2014)

Photo Point 20 – looking upstream - Irvin (5/13/2014)

Photo Point 20 – looking upstream – LTC (5/13/2014)

Photo Point 20 – looking downstream - LTC (5/13/2014)

	
Photo Point 21 – looking upstream (5/13/2014)	Photo Point 21 – looking downstream (5/13/2014)
	
Photo Point 22 – looking upstream (5/13/2014)	Photo Point 22 – looking downstream (5/13/2014)
	
Photo Point 23 – looking upstream (5/13/2014)	Photo Point 23 – looking downstream (5/13/2014)

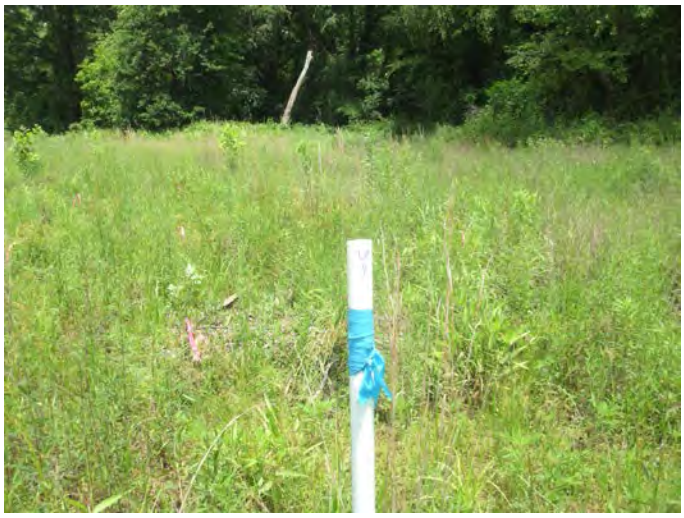
	
Photo Point 24 – looking upstream (5/13/2014)	Photo Point 24 – looking downstream (5/13/2014)
	
Photo Point 25 – looking upstream (5/13/2014)	Photo Point 25 – looking downstream (5/13/2014)

Wetland Site Vegetation Photographs

Vegetation Plot 1 (06/12/2014)

Vegetation Plot 2 (06/12/2014)

Vegetation Plot 3 (06/12/2014)



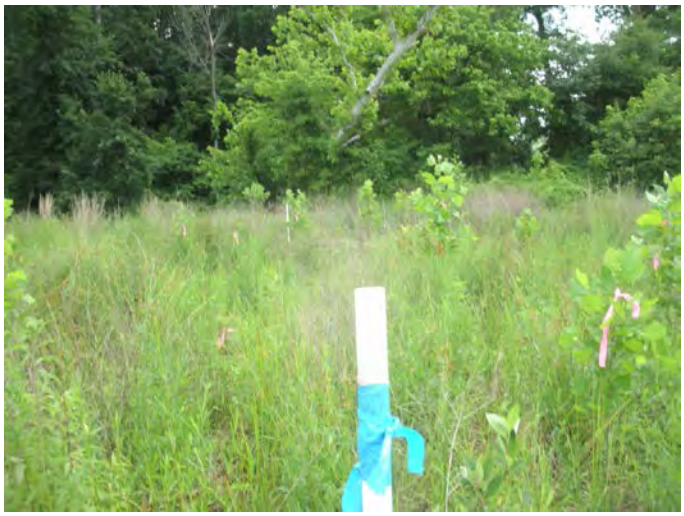
Vegetation Plot 4 (06/12/2014)

Vegetation Plot 5 (06/12/2014)

Vegetation Plot 6 (06/12/2014)

	
Vegetation Plot 7 (06/12/2014)	Vegetation Plot 8 (06/12/2014)
	
Vegetation Plot 9 (06/12/2014)	Vegetation Plot 10 (06/12/2014)
	
Vegetation Plot 11 (06/12/2014)	Vegetation Plot 12 (06/12/2014)

Vegetation Plot 13 (06/12/2014)



Vegetation Plot 14 (06/12/2014)

Vegetation Plot 15 (06/12/2014)

Vegetation Plot 16 (06/12/2014)

Vegetation Plot 17 (06/12/2014)

Vegetation Plot 18 (06/12/2014)

	
Vegetation Plot 19 (06/12/2014)	Vegetation Plot 20 (06/12/2014)
	
Vegetation Plot 21 (06/12/2014)	Vegetation Plot 22 (06/12/2014)

Stream Site Vegetation Photographs

	
Vegetation Plot 23 (6/4/2014)	Vegetation Plot 24 (6/4/2014)
	
Vegetation Plot 25 (6/4/2014)	Vegetation Plot 26 (6/4/2014)
	
Vegetation Plot 27 (6/4/2014)	Vegetation Plot 28 (6/4/2014)

	
Vegetation Plot 29 (6/4/2014)	Vegetation Plot 30 (6/4/2014)
	
Vegetation Plot 31 (6/4/2014)	Vegetation Plot 32 (6/4/2014)
	
Vegetation Plot 33 (6/4/2014)	Vegetation Plot 34 (6/4/2014)

Vegetation Plot 35 (6/4/2014)

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Plot	MY3 Success Criteria Met (Y/N)	Tract Mean
1	Y	
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	
7	Y	
8	Y	
9	Y	
10	Y	
11	Y	
12	Y	
13	Y	
14	Y	
15	N	
16	N	
17	N	
18	Y	91%
19	Y	
20	Y	
21	Y	
22	Y	
23	Y	
24	Y	
25	Y	
26	Y	
27	Y	
28	Y	
29	Y	
30	Y	
31	Y	
32	Y	
33	Y	
34	Y	
35	Y	

Table 8a. CVS Vegetation Tables - Metadata
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Wetland Site
Monitoring Year 3

Report Prepared By	Coy McKenzie
Date Prepared	9/9/2014 8:59
database name	LTC - Wetland Site MY3 cvs-eep-entrytool-v2.3.1.mdb
database location	F:\Projects\005-12700 Little Troublesome Creek\Monitoring\Monitoring Year 3\Vegetation Assessment
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	94640
project Name	Little Troublesome Creek-Cotton Rd Site
Description	Wetland Mitigation Site
Required Plots (calculated)	16
Sampled Plots	22

Table 8b. CVS Vegetation Tables - Metadata
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Stream Site
Monitoring Year 3

Report Prepared By	Coy McKenzie
Date Prepared	9/9/2014 9:03
database name	LTC - Stream Site MY3 cvs-eep-entrytool-v2.3.1.mdb
database location	F:\Projects\005-12700 Little Troublesome Creek\Monitoring\Monitoring Year 3\Vegetation Assessment
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	94640
project Name	Little Troublesome Mitigation Site
Description	Stream Mitigation Site
Required Plots (calculated)	13
Sampled Plots	13

Table 9. Planted and Total Stem Counts
Little Troublesome Creek (EEP Project No. 94640)
Wetland Site
Monitoring Year 3

			Current Plot Data (MY3 2014)														
			94640-WEI-0001			94640-WEI-0002			94640-WEI-0003			94640-WEI-0004			94640-WEI-0005		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree						5									
Alnus serrulata	hazel alder	Shrub	2	2	2	1	1	1	1	1	1	2	2	2	1	1	1
Betula nigra	river birch	Tree	1	1	1	1	1	1	3	3	3	3	3	3			
Cephalanthus occidentalis	common buttonbush	Shrub									20						12
Cornus amomum	silky dogwood	Shrub										4	4	4			
Fraxinus americana	white ash	Tree															
Fraxinus pennsylvanica	green ash	Tree				3	3	15	7	7	7	3	3	14	11	11	11
Liquidambar styraciflua	sweetgum	Tree			14												
Liriodendron tulipifera	tuliptree	Tree			2												
Nyssa sylvatica	blackgum	Tree							1	1	1	1	1	1	5	5	5
Platanus occidentalis	American sycamore	Tree	7	7	7	2	2	2	5	5	5				3	3	3
Quercus michauxii	swamp chestnut oak	Tree	2	2	2	3	3	3				1	1	1	1	1	1
Quercus phellos	willow oak	Tree	1	1	1			1	1	1	1	4	4	4			
Quercus rubra	northern red oak	Tree															
Sambucus canadensis	Common Elderberry	Shrub			5						20						
	unknown	Shrub/Tree															
		Stem count	13	13	34	10	10	28	18	18	58	18	18	29	21	21	33
		size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	5	5	8	5	5	7	6	6	8	7	7	7	5	5	6
		Stems per ACRE	526	526	1376	405	405	1133	728	728	2347	728	728	1174	850	850	1335

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts
Little Troublesome Creek (EEP Project No. 94640)
Wetland Site
Monitoring Year 3

			Current Plot Data (MY3 2014)														
			94640-WEI-0006			94640-WEI-0007			94640-WEI-0008			94640-WEI-0009			94640-WEI-0010		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree									3						3
Alnus serrulata	hazel alder	Shrub							1	1	1						
Betula nigra	river birch	Tree	3	3	3	3	3	3	2	2	2	6	6	6	2	2	2
Cephalanthus occidentalis	common buttonbush	Shrub															
Cornus amomum	silky dogwood	Shrub	5	5	5				2	2	2				2	2	2
Fraxinus americana	white ash	Tree															
Fraxinus pennsylvanica	green ash	Tree	2	2	8	8	8	8				3	3	11	2	2	2
Liquidambar styraciflua	sweetgum	Tree															
Liriodendron tulipifera	tuliptree	Tree															
Nyssa sylvatica	blackgum	Tree							3	3	3	2	2	2			
Platanus occidentalis	American sycamore	Tree	1	1	3	3	3	3	5	5	5				4	4	4
Quercus michauxii	swamp chestnut oak	Tree													2	2	2
Quercus phellos	willow oak	Tree	1	1	1	1	1	1				5	5	5			
Quercus rubra	northern red oak	Tree															
Sambucus canadensis	Common Elderberry	Shrub															
	unknown	Shrub/Tree															
		Stem count	12	12	20	15	15	15	13	13	16	16	16	24	12	12	15
		size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	5	5	5	4	4	4	5	5	6	4	4	4	5	5	6
		Stems per ACRE	486	486	809	607	607	607	526	526	647	647	647	971	486	486	607

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts
Little Troublesome Creek (EEP Project No. 94640)
Wetland Site
Monitoring Year 3

			Current Plot Data (MY3 2014)														
			94640-WEI-0011			94640-WEI-0012			94640-WEI-0013			94640-WEI-0014			94640-WEI-0015		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree						8									
Alnus serrulata	hazel alder	Shrub	1	1	1							2	2	2			
Betula nigra	river birch	Tree	4	4	4	1	1	1	2	2	2	3	3	3	2	2	3
Cephalanthus occidentalis	common buttonbush	Shrub			9			2									5
Cornus amomum	silky dogwood	Shrub				2	2	2				1	1	1			
Fraxinus americana	white ash	Tree															
Fraxinus pennsylvanica	green ash	Tree	5	5	5	1	1	6	5	5	11	2	2	14	2	2	5
Liquidambar styraciflua	sweetgum	Tree															
Liriodendron tulipifera	tuliptree	Tree															
Nyssa sylvatica	blackgum	Tree				2	2	2	2	2	2						
Platanus occidentalis	American sycamore	Tree	3	3	3	1	1	3				6	6	6			
Quercus michauxii	swamp chestnut oak	Tree				5	5	5	1	1	1						
Quercus phellos	willow oak	Tree							4	4	4	2	2	2			
Quercus rubra	northern red oak	Tree															
Sambucus canadensis	Common Elderberry	Shrub															
	unknown	Shrub/Tree															
	Stem count		13	13	22	12	12	29	14	14	20	16	16	28	4	4	13
	size (ACRES)			0.02			0.02			0.02			0.02			0.02	
	Species count		4	4	5	6	6	8	5	5	5	6	6	6	2	2	3
	Stems per ACRE		526	526	890	486	486	1174	567	567	809	647	647	1133	162	162	526

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts
Little Troublesome Creek (EEP Project No. 94640)
Wetland Site
Monitoring Year 3

			Current Plot Data (MY3 2014)														
			94640-WEI-0016			94640-WEI-0017			94640-WEI-0018			94640-WEI-0019			94640-WEI-0020		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree									5			5			
Alnus serrulata	hazel alder	Shrub															
Betula nigra	river birch	Tree	2	2	2				1	1	1				2	2	2
Cephalanthus occidentalis	common buttonbush	Shrub			10			6			2			2			
Cornus amomum	silky dogwood	Shrub	1	1	1				1	1	1	1	1	1			
Fraxinus americana	white ash	Tree															
Fraxinus pennsylvanica	green ash	Tree	1	1	3	1	1	3	3	3	5	2	2	2	5	5	11
Liquidambar styraciflua	sweetgum	Tree												3			
Liriodendron tulipifera	tuliptree	Tree															
Nyssa sylvatica	blackgum	Tree										1	1	1			
Platanus occidentalis	American sycamore	Tree	1	1	1				4	4	4	1	1	12	1	1	1
Quercus michauxii	swamp chestnut oak	Tree															
Quercus phellos	willow oak	Tree										5	5	5	1	1	1
Quercus rubra	northern red oak	Tree															1
Sambucus canadensis	Common Elderberry	Shrub															
	unknown	Shrub/Tree															
		Stem count	5	5	17	1	1	9	9	9	18	10	10	31	9	9	16
		size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	5	1	1	2	4	4	6	5	5	8	4	4	5
		Stems per ACRE	202	202	688	40	40	364	364	364	728	405	405	1255	364	364	647

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts
Little Troublesome Creek (EEP Project No. 94640)
Wetland Site
Monitoring Year 3

			Current Plot Data (MY3 2014)						Annual Summary											
			94640-WEI-0021			94640-WEI-0022			MY3 (2014)			MY2 (2013)			MY1 (2012)			MY0 (2012)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree			4						33									
Alnus serrulata	hazel alder	Shrub	4	4	4	2	2	2	17	17	17	20	20	20	31	31	31	62	62	62
Betula nigra	river birch	Tree							41	41	42	43	43	43	55	55	55	75	75	75
Cephalanthus occidentalis	common buttonbush	Shrub			5						73									
Cornus amomum	silky dogwood	Shrub				1	1	1	20	20	20	20	20	20	30	30	30	38	38	38
Fraxinus americana	white ash	Tree													1	1	1			
Fraxinus pennsylvanica	green ash	Tree	2	2	7	2	2	22	70	70	170	64	64	64	68	68	68	71	71	71
Liquidambar styraciflua	sweetgum	Tree			3						20									
Liriodendron tulipifera	tuliptree	Tree									2									
Nyssa sylvatica	blackgum	Tree	3	3	3	1	1	1	21	21	21	25	25	25	27	27	27	17	17	17
Platanus occidentalis	American sycamore	Tree	5	5	13	8	8	11	60	60	86	67	67	67	75	75	75	82	82	82
Quercus michauxii	swamp chestnut oak	Tree	1	1	1				16	16	16	20	20	20	24	24	24	18	18	18
Quercus phellos	willow oak	Tree	1	1	1				26	26	27	30	30	30	35	35	35	11	11	11
Quercus rubra	northern red oak	Tree									1									
Sambucus canadensis	Common Elderberry	Shrub									25									
	unknown	Shrub/Tree																7	7	7
	Stem count		16	16	41	14	14	37	271	271	553	289	289	289	346	346	346	381	381	381
	size (ACRES)			0.02			0.02			0.54			0.54			0.54			0.54	
	Species count		6	6	9	5	5	5	8	8	14	8	8	8	9	9	9	9	9	9
	Stems per ACRE		647	647	1659	567	567	1497	498	498	1017	532	532	532	636	636	636	701	701	701

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts- Stream
Little Troublesome Creek (EEP Project No. 94640)
Stream Site
Monitoring Year 3

			Current Plot Data (MY3 2014)											
			94640-WEI-0023			94640-WEI-0024			94640-WEI-0025			94640-WEI-0026		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	4	4	4	2	2	2	2	2	2	2	2	2
Carpinus caroliniana	American hornbeam	Tree				9	9	9	2	2	2	2	2	2
Cornus amomum	silky dogwood	Shrub				2	2	2						
Fraxinus pennsylvanica	green ash	Tree	1	1	1	2	2	2	12	12	12	6	6	6
Liriodendron tulipifera	tuliptree	Tree	3	3	3	2	2	2						
Platanus occidentalis	American sycamore	Tree	5	5	5	2	2	2	2	2	2	5	5	5
Quercus phellos	willow oak	Tree				4	4	4						
Quercus rubra	northern red oak	Tree				2	2	2						
	unknown	Shrub/Tree												
		Stem count	13	13	13	25	25	25	18	18	18	15	15	15
		size (ACRES)		0.02			0.02			0.02			0.02	
		Species count		4			8			4			4	
		Stems per ACRE	526	526	526	1012	1012	1012	728	728	728	607	607	607

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts- Stream
Little Troublesome Creek (EEP Project No. 94640)
Stream Site
Monitoring Year 3

			Current Plot Data (MY3 2014)											
			94640-WEI-0027			94640-WEI-0028			94640-WEI-0029			94640-WEI-0030		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree										1	1	1
Carpinus caroliniana	American hornbeam	Tree	2	2	2	2	2	2	3	3	3	7	7	7
Cornus amomum	silky dogwood	Shrub												
Fraxinus pennsylvanica	green ash	Tree	7	7	7	3	3	3	6	6	6	2	2	2
Liriodendron tulipifera	tuliptree	Tree										4	4	4
Platanus occidentalis	American sycamore	Tree	12	12	12	10	10	10	10	10	10	2	2	2
Quercus phellos	willow oak	Tree												
Quercus rubra	northern red oak	Tree												
	unknown	Shrub/Tree												
		Stem count	21	21	21	15	15	15	19	19	19	16	16	16
		size (ACRES)		0.02			0.02			0.02			0.02	
		Species count		3			3			3			5	
		Stems per ACRE	850	850	850	607	607	607	769	769	769	647	647	647

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts- Stream
Little Troublesome Creek (EEP Project No. 94640)
Stream Site
Monitoring Year 3

			Current Plot Data (MY3 2014)											
			94640-WEI-0031			94640-WEI-0032			94640-WEI-0033			94640-WEI-0034		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Betula nigra	river birch	Tree	9	9	9	7	7	7	6	6	6	1	1	1
Carpinus caroliniana	American hornbeam	Tree							2	2	2	8	8	8
Cornus amomum	silky dogwood	Shrub										2	2	2
Fraxinus pennsylvanica	green ash	Tree	7	7	7	2	2	2				2	2	2
Liriodendron tulipifera	tuliptree	Tree	4	4	4	1	1	1				5	5	5
Platanus occidentalis	American sycamore	Tree	2	2	2	10	10	10	1	1	1			
Quercus phellos	willow oak	Tree							1	1	1	6	6	6
Quercus rubra	northern red oak	Tree												
	unknown	Shrub/Tree												
		Stem count	22	22	22	20	20	20	10	10	10	24	24	24
		size (ACRES)		0.02			0.02			0.02			0.02	
		Species count		4			4			4			6	
		Stems per ACRE	890	890	890	809	809	809	405	405	405	971	971	971

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts- Stream
Little Troublesome Creek (EEP Project No. 94640)
Stream Site
Monitoring Year 3

			Current Plot Data (MY3 2014)			Annual Summary											
			94640-WEI-0035			MY3 (2014)			MY2 (2013)			MY1 (2012)			MY0 (2012)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	2	2	2	36	36	36	33	33	33	36	36	36	36	36	36
Carpinus caroliniana	American hornbeam	Tree	2	2	2	39	39	39	44	44	44	50	50	50	56	56	56
Cornus amomum	silky dogwood	Shrub				4	4	4	5	5	5	6	6	6	8	8	8
Fraxinus pennsylvanica	green ash	Tree	2	2	2	52	52	52	55	55	55	63	63	63	67	67	67
Liriodendron tulipifera	tuliptree	Tree				19	19	19	21	21	21	31	31	31	37	37	37
Platanus occidentalis	American sycamore	Tree	3	3	3	64	64	64	65	65	65	67	67	67	68	68	68
Quercus phellos	willow oak	Tree	5	5	5	16	16	16	17	17	17	20	20	20	22	22	22
Quercus rubra	northern red oak	Tree	3	3	3	5	5	5	11	11	11	13	13	13	11	11	11
	unknown	Shrub/Tree													1	1	1
		Stem count	17	17	17	235	235	235	251	251	251	286	286	286	306	306	306
		size (ACRES)		0.02			0.321			0.321			0.321			0.321	
		Species count		6			8			8			8			9	
		Stems per ACRE	688	688	688	732	732	732	781	781	781	890	890	890	953	953	953

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reaches 1 and 2
Monitoring Year 3

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data								Design[1]				As-Built/Baseline			
		Irvin Creek Reach 1		Irvin Creek Reach 2		Collins Creek		UT to Belews Creed		UT to Rocky Creek		Spencer Creek		Irvin Creek Reach 1		Irvin Creek Reach 2		Irvin Creek Reach 1		Irvin Creek Reach 2	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																					
Bankfull Width (ft)	N/A	17.7		15.2	17.2	11.9	20.1	14.4		12.2		8.7		19.0		19.0		18.6	19.7	18.1	20.9
Floodprone Width (ft)		21.0		18.0	21.0	60		200		72		229		80+		200+		200+	200+	200+	200+
Bankfull Mean Depth		1.5		1.9	2.0	1.6	2.7	2.0		1.3		1.2		1.6		1.6		1.6	1.7	1.6	1.6
Bankfull Max Depth		1.8		2.4	2.6	3.3	4.2	2.7		1.8		1.9		2.2		2.2		2.4	2.6	2.4	2.4
Bankfull Cross-sectional Area (ft^2)		27.3		30.6	32.8	32.9		27.4		16.3		10.6		29.7		29.7		29.3	33.7	29.0	32.7
Width/Depth Ratio		11.5		8.0	8.6	4.4	12.1	7.6		9.1		7.3		12.0		12.0		11.5	11.8	11.3	13.3
Entrenchment Ratio		1.2		1.2	1.2	2.0	3.0	34.7		6.0		26.3		2.2+		2.2+		2.2+	2.2+	2.2+	2.2+
Bank Height Ratio		1.9	3.3	2.3	2.5	1.0	1.1	1.0		1.0		1.0		1.0		1.0		1.0	1.0	1.0	1.0
d50 (mm)		32.8		24.2														22.6		18.6	
Profile																					
Riffle Length (ft)	N/A					-		-		-		-		-	-	-	-	18	92	17	73
Riffle Slope (ft/ft)		0.0010	0.0250	0.0019	0.0170	0.0030	0.0080	-		0.0606	0.0892	0.0100	0.0670	0.0060	0.0080	0.0070	0.0147	0.0039	0.0215	0.0021	0.0280
Pool Length (ft)						-		-		-		-		-		-		32	141	46	85
Pool Max Depth (ft)		2.1	3.7	2.3	3.3	2.4		4.6		2.2		2.5		2.8	4.0	2.9	4.0	3.7	4.2	3.6	4.0
Pool Spacing (ft)^		39	60	27	76	32	80	75		26	81	13	47	76	133	77	135	57	236	91	142
Pool Volume (ft^3)																					
Pattern																					
Channel Beltwidth (ft)	N/A	39	81	46	94	-		31	32	-		24	52	57	152	58	154	52	151	49	86
Radius of Curvature (ft)		57	114	100	251	-		16	27	-		5	22	38	57	38	58	38	59	38	62
Rc:Bankfull Width (ft/ft)		3.2	6.4	6.6	14.6	-		2.2	4.1	-		1.5	2.8	1.8	3.1	1.8	3.1	2.0	3.1	2.0	3.2
Meander Wave Length (ft)		86	175	175	348	-		71	101	-		54	196	152	228	154	231	150	235	166	229
Meander Width Ratio		2.2	4.6	3.0	5.5	-		2.15	2.22	-		2.8	6.0	3.0	8.0	3.0	8.0	2.7	7.9	2.6	4.5
Substrate, Bed and Transport Parameters																					
Ri%/Ru%/P%/G%/S%	N/A																				
SC%/Sa%/G%/C%/B%/Be%																					
d16/d35/d50/d84/d95/d100		0.1/0.6/15/56/98/>2048		0.1/0.3/5/25/31/45		N/A		N/A		N/A		N/A						SC/SC/23/49/64/128		SC/SC/19/49/79/180	
Reach Shear Stress (Competency) lb/ft^2		0.88		0.42										0.38		0.43		0.38	0.41	0.40	
Max part size (mm) mobilized at bankfull																					
Stream Power (Capacity) W/m^2																					
Additional Reach Parameters																					
Drainage Area (SM)	N/A	0.67	0.82	0.82	0.91	1.68		3.40		1.10		0.50		0.82		0.91		0.82		0.91	
Watershed Impervious Cover Estimate (%)		17		17		-		-		-		-		17		17		17		17	
Rosgen Classification		G4c		G4c		E4		E5		E4b		E4/C4		C4		C4		C		C	
Bankfull Velocity (fps)		3.3		3.0	3.3									3.0		3.3		2.7	3.1	3.1	3.4
Bankfull Discharge (cfs)		90		100		115	150	125		85		N/A		90		100		90		100	
Q-NFF regression		110		126																	
Q-USGS extrapolation		-		-																	
Q-Mannings		122		99	102	-															
Valley Length (ft)		1,491		1,505		-		-		-		-		-		-					
Channel Thalweg Length (ft)		1,640		1,505		-		-		-		-		2,057*		1,919*		2,095*		1,932*	
Sinuosity (ft)		1.1		1.0		-		1.2		1.1		1.1		1.3		1.2		1.3		1.2	
Water Surface Slope (ft/ft)		-		-		0.0030		0.0070		0.0235		0.0132		-		-		N/A[1]		N/A[1]	
Bankfull Slope (ft/ft)		0.0107		0.0043		-		-		-		-		0.0045		0.0049		0.0045		0.0047	

(-): Data was not provided
[1]Design parameters were expanded during the final design phase.
*LF provided includes portions of the stream that will be monitored and has been reconstructed, but for which mitigation credit will not be claimed. Please refer to Table 1 in Appendix 1 for the credit summary lengths.
^Pool to pool spacing calculations were measured using the most downstream pool in the meander for the as-built compared to the design pool to pool spacing, which included pools and plunge pools in the min and max values.

Table 10b. Baseline Stream Data Summary
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Little Troublesome Creek and UT1
Monitoring Year 3

Parameter	Gage	Pre-Restoration Condition[1]				Reference Reach Data		Design[1]				As-Built/Baseline			
		UT1		Little Troublesome Creek				UT1[2]		Little Troublesome Creek		UT1[2]		Little Troublesome Creek	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle															
Bankfull Width (ft)	N/A	5.2		28.7		refer to table 5a		7.8		32.3		10.9		32.6	41.0
Floodprone Width (ft)		8.0		93.0				100+		285+		36.7		200+	
Bankfull Mean Depth		1.2		2.6				0.6		2.7		0.5		2.2	2.7
Bankfull Max Depth		1.9		3.3				0.9		3.8		1.0		4.1	4.17
Bankfull Cross-sectional Area (ft^2)		6.4		73.6				5.0		86.6		5.1		77.4	87.1
Width/Depth Ratio		4.3		11.2				12.0		12.0		23.0		12.2	15.47
Entrenchment Ratio		1.5		3.2				2.2+		2.2+		2.2+		2.2+	
Bank Height Ratio		1.2	2.5	1.6	2.8			1.0		1.0		1.0		1.0	
d50 (mm)		0.8		9.7								0.4		20.7	
Profile															
Riffle Length (ft)	N/A					refer to table 5a		-		-		11	26	79	142
Riffle Slope (ft/ft)[1]		0.0072	0.0500	0.0007	0.0110			0.0185	0.0369	0.0066	0.0088	0.0231	0.0600	0.0063	0.0126
Pool Length (ft)								-		-		18	48	88	159
Pool Max Depth (ft)		2.2	3.3	3.2	5.3			1.2	1.6	4.8	6.7	1.2		5.9	
Pool Spacing (ft)^		29	42	46	127			24	43	129	226	35	59	206	267
Pool Volume (ft^3)															
Pattern															
Channel Beltwidth (ft)	N/A	-		119		refer to table 5a		27	62	113	258	27	62	113	258
Radius of Curvature (ft)		-		103	313			16	23	65	97	16	23	65	97
Rc:Bankfull Width (ft/ft)		-		3.6	10.9			2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Meander Wave Length (ft)		-		179	315			62	94	258	388	62	94	258	388
Meander Width Ratio		-		4.1				3.5	8.0	3.5	8.0	3.5	8.0	3.5	8.0
Substrate, Bed and Transport Parameters															
Ri%/Ru%/P%/G%/S%	N/A					refer to table 5a									
SC%/Sa%/G%/C%/B%/Be%															
d16/d35/d50/d84/d95/d100		SC/SC/SC/4/13/>2048		0.2/0.5/1/22/30/>2048								SC/SC/0.4/44/64/128		SC/C/21/62/110/180	
Reach Shear Stress (Competency) lb/ft^2		0.96		0.41				N/A[3]		N/A[3]		0.34		0.38	0.53
Max part size (mm) mobilized at bankfull															
Stream Power (Capacity) W/m^2															
Additional Reach Parameters															
Drainage Area (SM)	N/A	0.10		4.95	5.07	refer to table 5a		0.10		5.07		0.10		5.07	
Watershed Impervious Cover Estimate (%)		17		17				17		17		17		17	
Rosgen Classification		G5		C5				C5		C5		C5		C4	
Bankfull Velocity (fps)		4.4		5.0				2.7		4.3		2.7		4.2	4.8
Bankfull Discharge (cfs)		14		370				14		370		14		370	
Q-NFF regression		-		422											
Q-USGS extrapolation		-		-											
Q-Mannings		-		237											
Valley Length (ft)		184		982				-		-					
Channel Thalweg Length (ft)		184		1,080				240		1,158*		233		1,171*	
Sinuosity (ft)		1.0		1.1				1.3		1.3		1.2		1.3	
Water Surface Slope (ft/ft)		-		-				-		-		N/A[1]		N/A[1]	
Bankfull Slope (ft/ft)		0.0183		0.0033				0.0123		0.0044		0.0126		0.0038	

(-): Data was not provided
[1]Design parameters were expanded during the final design phase.
[2]Restoration approach was adjusted from a priority 1 to a priority 2 during the final design phase.
[3]The critical shear stress analysis was not perfomed on the sand bed channels.
*LF provided includes portions of the stream that will be monitored and has been reconstructed, but for which mitigation credit will not be claimed. Please refer to Table 1 in Appendix 1 for the credit summary lengths.
^Pool to pool spacing calculations were measured using the most downstream pool in the meander for the as-built compared to the design pool to pool spacing, which included pools and plunge pools in the min and max values.

Table 11 Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reaches 1 and 2, Little Troublesome Creek, UT1
Monitoring Year 3

	Irvin Creek Reach 1																							
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Pool)						Cross-Section 4 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation																								
Bankfull Width (ft)	18.6	17.7	17.5	17.5			19.9	18.0	18.3	16.5			31.1	31.1	34.5	39.1			19.7	20.2	25.5	20.5		
Floodprone Width (ft)	200+	200+	200+	200+			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A			200+	200+	200+	200+		
Bankfull Mean Depth (ft)	1.6	1.5	1.5	1.4			1.9	2.2	2.4	2.7			1.9	1.9	1.6	1.3			1.7	1.7	1.3	1.4		
Bankfull Max Depth (ft)	2.4	2.5	2.4	2.4			3.7	4.0	3.9	4.0			4.2	4.2	4.5	4.4			2.6	2.7	2.6	2.5		
Bankfull Cross-Sectional Area (ft^2)	29.3	27.2	26.0	24.5			36.8	38.6	43.1	44.0			57.6	57.6	56.5	51.4			33.7	34.4	33.0	28.8		
Bankfull Width/Depth Ratio	11.8	11.6	11.8	12.6			10.7	8.4	7.8	6.2			16.8	16.8	21.1	29.8			11.5	11.9	19.8	14.6		
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A			2.2+	2.2+	2.2+	2.2+		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		
	Irvin Creek Reach 2																							
	Cross-Section 5 (Pool)						Cross-Section 6 (Riffle)						Cross-Section 7 (Riffle)						Cross-Section 8 (Pool)					
based on fixed bankfull elevation	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
Bankfull Width (ft)	35.3	35.6	36.9	34.2			18.1	18.6	18.0	18.2			20.9	20.9	32.3	19.5			29.2	32.0	35.7	26.6		
Floodprone Width (ft)	N/A	N/A	N/A	N/A			200+	200+	200+	200+			200+	200+	200+	200+			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	1.4	1.3	1.3	1.2			1.6	1.5	1.7	1.5			1.6	1.4	1.1	1.4			1.7	1.6	1.5	1.7		
Bankfull Max Depth (ft)	4.0	4.1	4.2	4.1			2.4	2.5	2.6	2.4			2.4	2.4	2.7	2.4			3.6	3.6	3.9	3.7		
Bankfull Cross-Sectional Area (ft^2)	47.9	46.0	49.2	42.3			29.0	27.8	30.7	27.8			32.7	28.7	35.1	27.3			50.1	50.0	54.8	45.5		
Bankfull Width/Depth Ratio	26.0	27.5	27.6	27.6			11.3	12.4	10.6	11.9			13.3	15.2	29.7	13.9			17.0	20.5	23.3	15.5		
Bankfull Entrenchment Ratio	N/A	N/A	N/A	N/A			2.2+	2.2+	2.2+	2.2+			2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio	1.0	1.0	1.1	1.0			1.0	1.0	0.8	1.0			1.0	1.0	0.9	1.0			1.0	1.0	0.9	1.0		
	UT1												Little Troublesome Creek											
	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**
based on fixed bankfull elevation																								
Bankfull Width (ft)	10.9	8.0	8.3	6.9			9.3	9.6	8.9	7.9			32.6	33.0	31.9	32.1			41.0	42.2	42.1	40.4		
Floodprone Width (ft)	36.7	35.7	34.3	33.9			N/A	N/A	N/A	N/A			200+	200+	200+	200+			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	0.5	0.5	0.5	0.5			0.7	0.6	0.5	0.4			2.7	2.6	2.6	2.6			3.1	3.1	3.2	3.5		
Bankfull Max Depth (ft)	1.0	1.0	1.0	0.9			1.2	1.2	1.1	1.2			4.1	4.0	3.9	3.9			5.9	6.5	7.4	8.3		
Bankfull Cross-Sectional Area (ft^2)	5.1	4.1	3.7	3.3			6.4	5.6	4.0	3.1			87.1	84.6	82.8	82.4			125.3	128.8	133.4	139.8		
Bankfull Width/Depth Ratio	23.0	15.5	18.5	14.2			13.5	16.6	19.7	19.9			12.2	12.9	12.3	12.5			13.4	13.8	13.3	11.7		
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A			2.2+	2.2+	2.2+	2.2+			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		
	Little Troublesome Creek																							
	Cross-Section 13 (Riffle)																							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**																		
based on fixed bankfull elevation																								
Bankfull Width (ft)	34.6	35.7	33.7	31.8																				
Floodprone Width (ft)	200+	200+	200+	200+																				
Bankfull Mean Depth (ft)	2.2	2.1	2.2	2.3																				
Bankfull Max Depth (ft)	4.2	3.9	3.9	3.9																				
Bankfull Cross-Sectional Area (ft^2)	77.4	74.8	74.4	73.6																				
Bankfull Width/Depth Ratio	15.5	17.1	15.3	13.8																				
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+																				
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0																				

Table 12a. Monitoring Data - Stream Reach Data Summary
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 1
Monitoring Year 3

Parameter	As-Built/Baseline		MY1			MY2			MY3			MY4			MY5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	18.6	19.7	17.7	19.0	20.2	17.5	21.5	25.5	17.5	19.0	20.5						
Floodprone Width (ft)	200+	200+	200+	200+	200+	200+	200+	200+	200+	200+	200+						
Bankfull Mean Depth	1.6	1.7	1.5	1.6	1.7	1.3	1.4	1.5	1.4	1.4	1.4						
Bankfull Max Depth	2.4	2.6	2.5	2.6	2.7	2.4	2.5	2.6	2.4	2.5	2.5						
Bankfull Cross-sectional Area (ft^2)	29.3	33.7	27.2	30.8	34.4	26.0	29.5	33.0	24.5	26.7	28.8						
Width/Depth Ratio	11.5	11.8	11.6	11.7	11.9	11.8	15.8	19.8	12.6	13.6	14.6						
Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+						
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0						
D50 (mm)			35.0	-	44.2	23.7	-	41.1	13.1	-	29.3						
Profile																	
Riffle Length (ft)	18	92	11	41	79	33	47	98	26	47	87						
Riffle Slope (ft/ft)	0.0039	0.0215	0.0008	0.0075	0.0174	0.0038	0.0060	0.0117	0.0023	0.0102	0.0142						
Pool Length (ft)	32	141	33	63	153	42	64	141	45	65	146						
Pool Max Depth (ft)	3.7	4.2	4.0	4.2	4.3	3.9	4.2	4.5	4.0	4.2	4.4						
Pool Spacing (ft)	57	236	63	105	227	86	120	203	81	115	278						
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	52	151															
Radius of Curvature (ft)	38	59															
Rc:Bankfull Width (ft/ft)	2.0	3.1															
Meander Wave Length (ft)	150	235															
Meander Width Ratio	2.7	7.9															
Additional Reach Parameters																	
Rosgen Classification	C		C			C			C								
Channel Thalweg Length (ft)	2,095		2,095			2,095			2,095								
Sinuosity (ft)	1.3		1.3			1.3			1.3								
Water Surface Slope (ft/ft)	N/A		0.0044			0.0039			0.0038								
Bankfull Slope (ft/ft)	0.0045		0.0048			0.0043			0.0043								
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	SC/SC/23/49/64/128		0.2/0.7/10/38/58/362			0.1/0.5/2/47/80/128			0.2/0.7/2.0/26.9/43.1/256								
% of Reach with Eroding Banks			0%			0%			0%								

(-): Data was not provided

Table 12b. Monitoring Data - Stream Reach Data Summary
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 2
Monitoring Year 3

Parameter	As-Built/Baseline		MY1			MY2			MY3			MY4			MY5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	18.1	20.9	18.6	19.8	20.9	18.0	25.1	32.3	18.2	18.9	19.5						
Floodprone Width (ft)	200+	200+	200+	200+	200+	200+	200+	200+	200+	200+	200+						
Bankfull Mean Depth	1.6	1.6	1.4	1.5	1.5	1.1	1.4	1.7	1.4	1.5	1.5						
Bankfull Max Depth	2.4	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.4	2.4	2.4						
Bankfull Cross-sectional Area (ft^2)	29.0	32.7	27.8	28.3	28.7	30.7	32.9	35.1	27.3	27.6	27.8						
Width/Depth Ratio	11.3	13.3	12.4	13.8	15.2	10.6	20.1	29.7	11.9	12.9	13.9						
Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+						
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.9	1.0	1.0	1.0						
D50 (mm)			18.6	-	39.8	20.7	-	42.7	11.3	-	14.8						
Profile																	
Riffle Length (ft)	17	73	21	59	72	29	59	72	35	59	79						
Riffle Slope (ft/ft)	0.0021	0.0280	0.0026	0.0087	0.0149	0.0016	0.0078	0.0169	0.0040	0.0081	0.0151						
Pool Length (ft)	46	85	52	64	89	42	66	109	52	64	87						
Pool Max Depth (ft)	3.6	4.0	3.6	3.9	4.1	3.9	4.1	4.2	3.7	3.9	4.1						
Pool Spacing (ft)	91	142	89	123	139	88	126	140	87	124	162						
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	49	86															
Radius of Curvature (ft)	38	62															
Rc:Bankfull Width (ft/ft)	2	3															
Meander Wave Length (ft)	166	229															
Meander Width Ratio	3	5															
Additional Reach Parameters																	
Rosgen Classification	C		C			C			C								
Channel Thalweg Length (ft)	1,932		1,932			1,932			1,932								
Sinuosity (ft)	1.2		1.2			1.2			1.2								
Water Surface Slope (ft/ft)	N/A		0.0045			0.0048			0.0047								
Bankfull Slope (ft/ft)	0.0047		0.0049			0.0046			0.0050								
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	SC/SC/19/48/79/180		0.1/0.4/6/66/104/512			5/13/21/51/80/256			0.1/1.1/3.6/64/113.8/362								
% of Reach with Eroding Banks			0%			0%			0%								

(-): Data was not provided

Table 12c. Monitoring Data - Stream Reach Data Summary
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
UT1
Monitoring Year 3

Parameter	As-Built/Baseline		MY1			MY2			MY3			MY4			MY5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	10.9		8.0			8.3			6.9								
Floodprone Width (ft)	36.7		35.7			34.3			33.9								
Bankfull Mean Depth	0.5		0.5			0.5			0.5								
Bankfull Max Depth	1.0		1.0			1.0			0.9								
Bankfull Cross-sectional Area (ft^2)	5.1		4.1			3.7			3.3								
Width/Depth Ratio	23.0		15.5			18.5			14.2								
Entrenchment Ratio	2.2+		2.2+			2.2+			2.2+								
Bank Height Ratio	1.0		1.0			1.0			1.0								
D50 (mm)			13.3			42.4			36.7								
Profile																	
Riffle Length (ft)	11	26	14	20	31	9	17	28	21	25	27						
Riffle Slope (ft/ft)	0.0231	0.0600	0.0089	0.0217	0.0448	0.0225	0.0274	0.0446	0.0070	0.0173	0.0235						
Pool Length (ft)	18	48	15	23	36	20	28	43	17	27	31						
Pool Max Depth (ft)	1.2		1.2			1.1			1.2								
Pool Spacing (ft)	35	59	43	52	62	47	58	60	36	-	67						
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	27	62															
Radius of Curvature (ft)	16	23															
Rc:Bankfull Width (ft/ft)	2.0	3.0															
Meander Wave Length (ft)	62	94															
Meander Width Ratio	3.5	8.0															
Additional Reach Parameters																	
Rosgen Classification	C5		C5			C5			C5								
Channel Thalweg Length (ft)	233		233			233			233								
Sinuosity (ft)	1.2		1.2			1.2			1.2								
Water Surface Slope (ft/ft)	N/A		0.0120			0.0136			0.0093								
Bankfull Slope (ft/ft)	0.0126		0.0121			0.0108			0.0113								
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	SC/SC/0.4/44/64/128		SC/0.1/0.5/501/90/128			SC/0.4/0.9/43/76/180			SC/0.3/0.4/50.6/90/180								
% of Reach with Eroding Banks			0%			0%			0%								

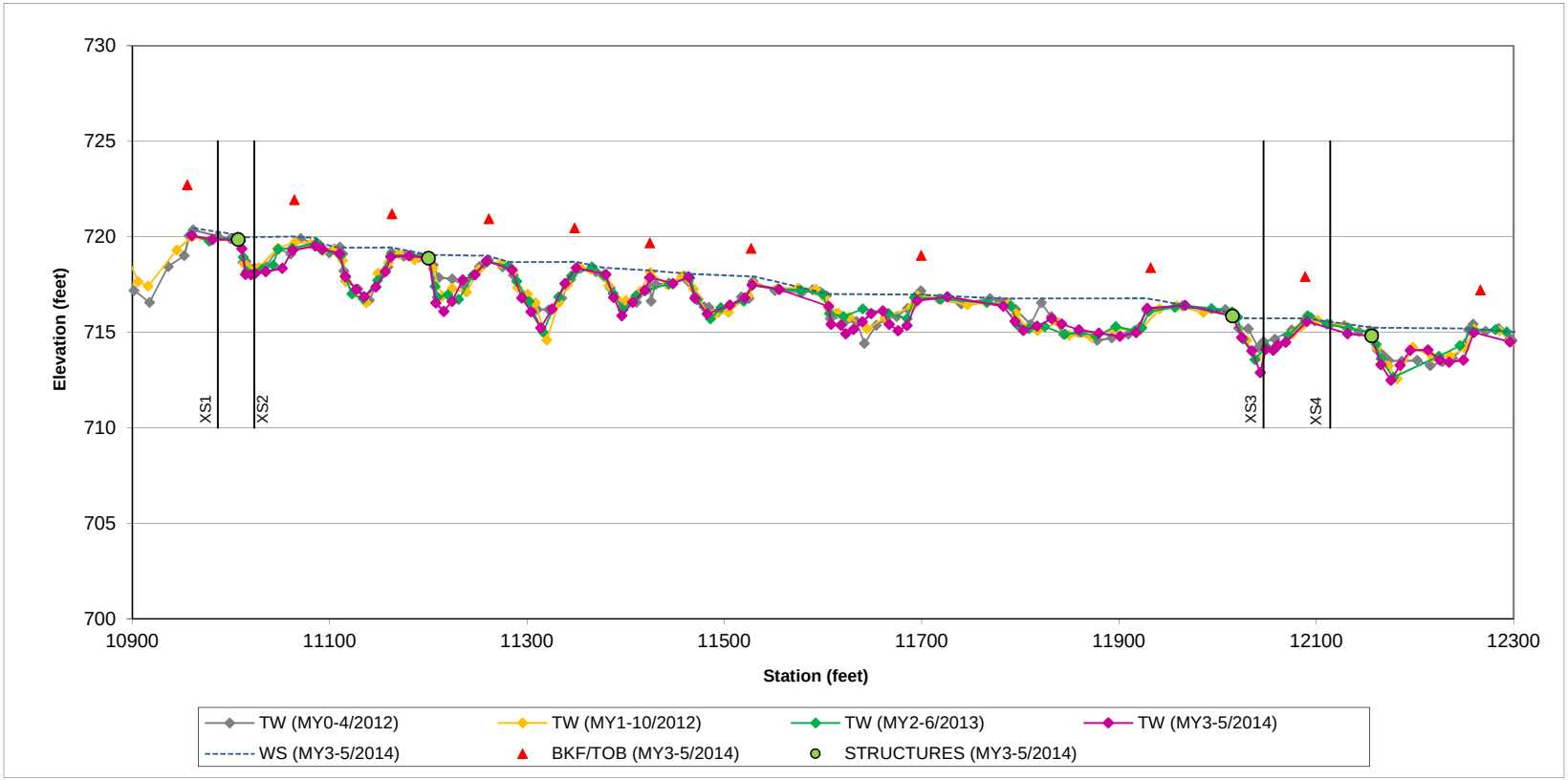
(-): Data was not provided

Table 12d. Monitoring Data - Stream Reach Data Summary
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Little Troublesome Creek
Monitoring Year 3

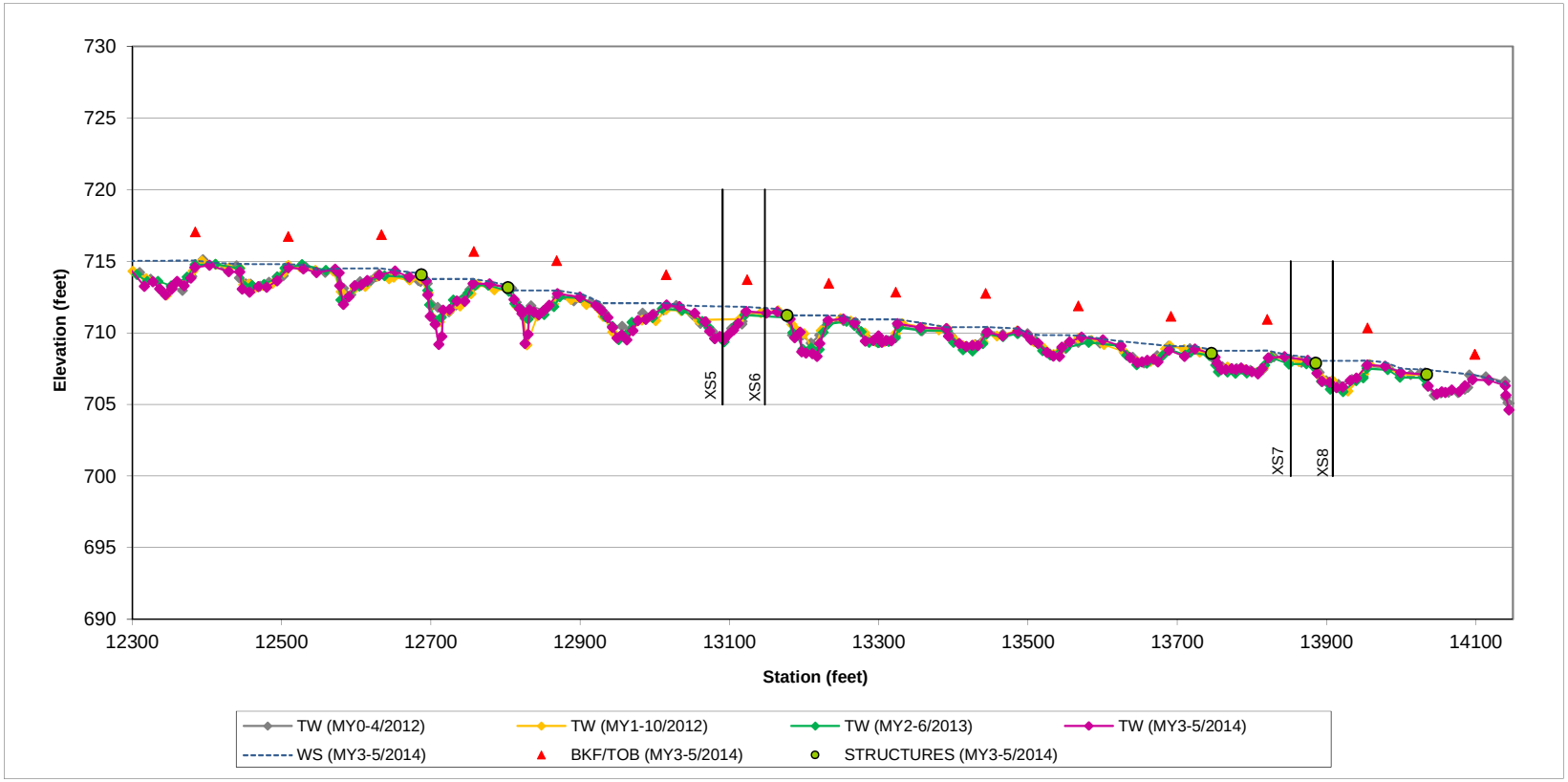
Parameter	As-Built/Baseline		MY1			MY2			MY3			MY4			MY5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	32.6	48.8	33.0	34.4	35.7	31.9	32.8	33.7	31.8	32.0	32.1						
Floodprone Width (ft)	200+		200+	200+	200+	200+	200+	200+	200+	200+	200+						
Bankfull Mean Depth	1.6	2.7	2.1	2.4	2.6	2.2	2.4	2.6	2.3	2.5	2.6						
Bankfull Max Depth	4.1	4.2	3.9	4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.9						
Bankfull Cross-sectional Area (ft^2)	79.6	87.1	74.8	79.7	84.6	74.4	78.6	82.8	73.6	78.0	82.4						
Width/Depth Ratio	12.2	30	12.9	15.0	17.1	12.3	13.8	15.3	12.5	13.2	13.8						
Entrenchment Ratio	2.2+		0.0	-	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+						
Bank Height Ratio	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0						
d50 (mm)			32.7	-	39.7	41.8	-	47.3	34.5	-	35.0						
Profile																	
Riffle Length (ft)	79	142	74	107	147	77	100	141	71	112	146						
Riffle Slope (ft/ft)	0.0063	0.0126	0.0061	0.0071	0.0178	0.0056	0.0080	0.0127	0.0056	0.0080	0.0139						
Pool Length (ft)	88	159	88	121	168	83	127	162	89	121	155						
Pool Max Depth (ft)	5.9			6.5			7.4			8.3							
Pool Spacing (ft)	206	267	194	219	297	208	242	289	218	223	316						
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	113	258															
Radius of Curvature (ft)	65	97															
Rc:Bankfull Width (ft/ft)	2.0	3.0															
Meander Wave Length (ft)	258	388															
Meander Width Ratio	3.5	8.0															
Additional Reach Parameters																	
Rosgen Classification	C4		C4			C4			C4								
Channel Thalweg Length (ft)	1,171		1,171			1,171			1,171								
Sinuosity (ft)	1.3		1.3			1.3			1.3								
Water Surface Slope (ft/ft)	N/A		0.0039			0.0038			0.0034								
Bankfull Slope (ft/ft)	0.0038		0.0039			0.0037			0.0030								
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	SC/SC/21/62/110/180		SC/0.3/8/74/165/512			0.1/0.3/0.7/60/130/362			0.3/1.2/73.4/196.6/362								
% of Reach with Eroding Banks			0%			0%			4%								

(-): Data was not provided

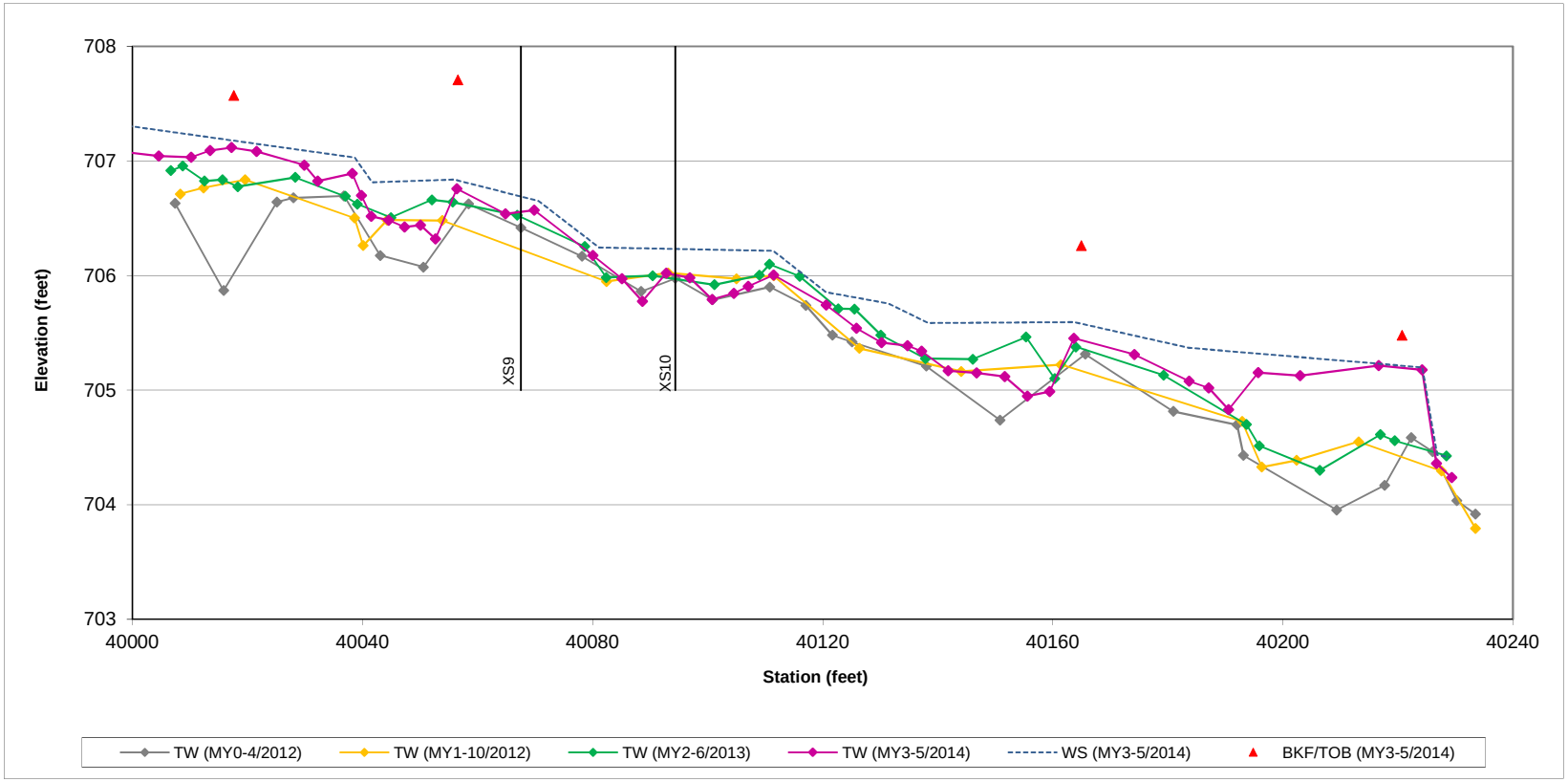
Longitudinal Profile Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 1
Monitoring Year 3



Longitudinal Profile Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 2
Monitoring Year 3



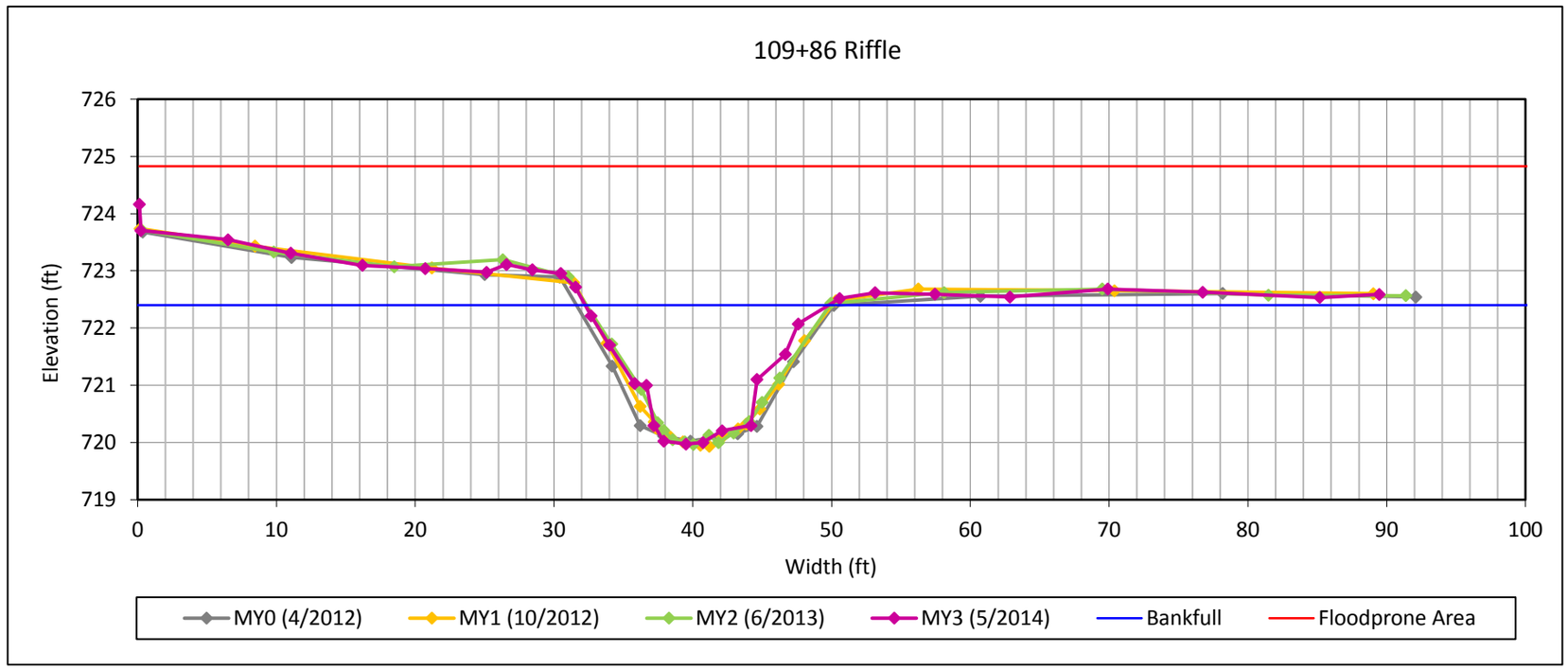
Longitudinal Profile Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
UT1
Monitoring Year 3



Longitudinal Profile Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Little Troublesome Creek
Monitoring Year 3

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 1 - Irvin Creek Reach 1



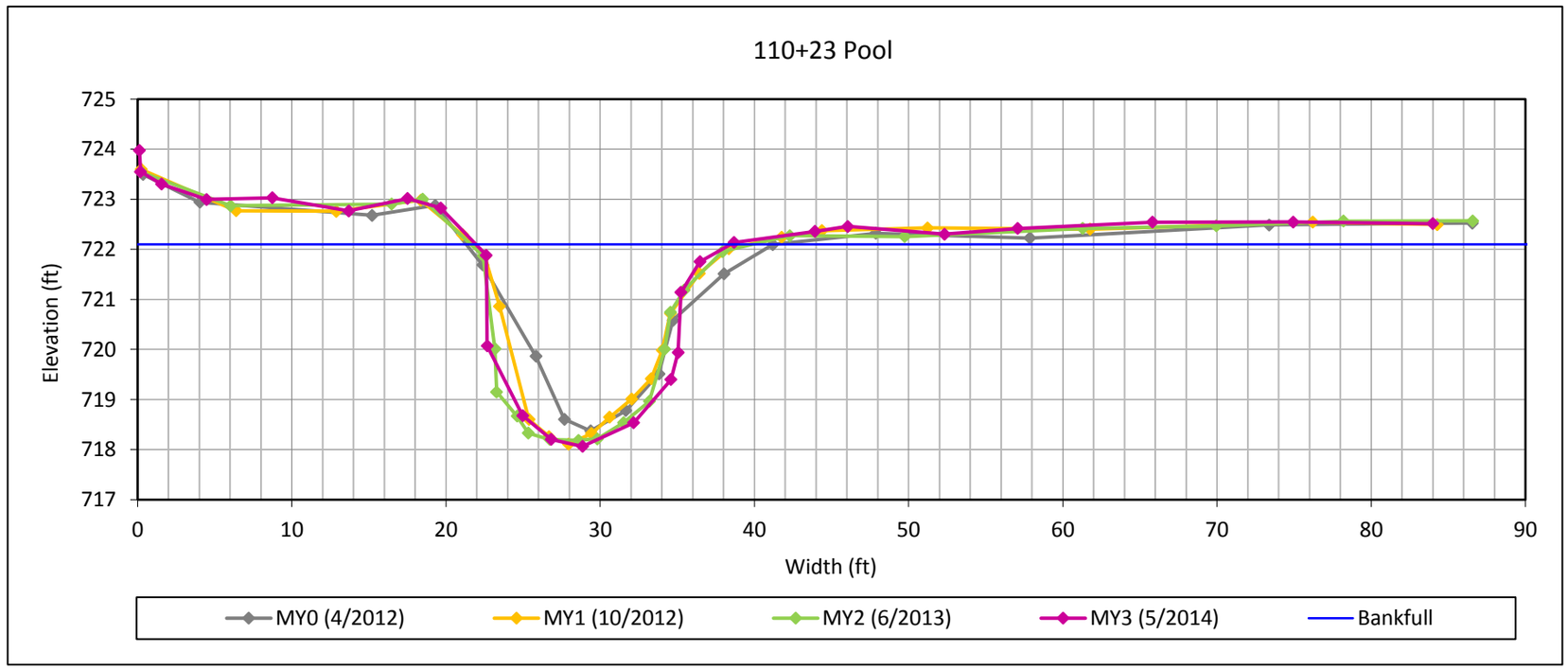
Bankfull Dimensions	
24.5	x-section area (ft.sq.)
17.5	width (ft)
1.4	mean depth (ft)
2.4	max depth (ft)
18.9	wetted parimeter (ft)
1.3	hyd radi (ft)
12.6	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 2 - Irvin Creek Reach 1



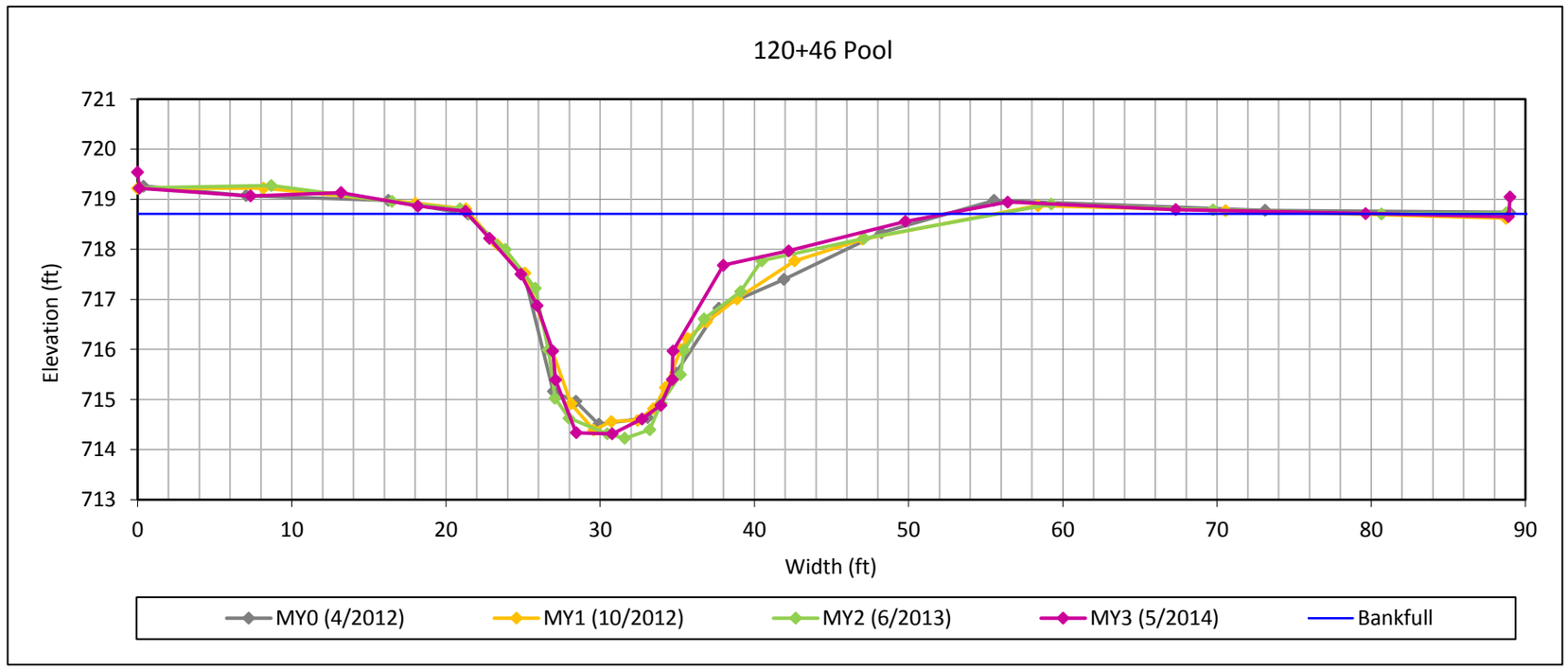
Bankfull Dimensions	
44.0	x-section area (ft.sq.)
16.5	width (ft)
2.7	mean depth (ft)
4.0	max depth (ft)
20.4	wetted parimeter (ft)
2.2	hyd radi (ft)
6.2	width-depth ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 3 - Irvin Creek Reach 1



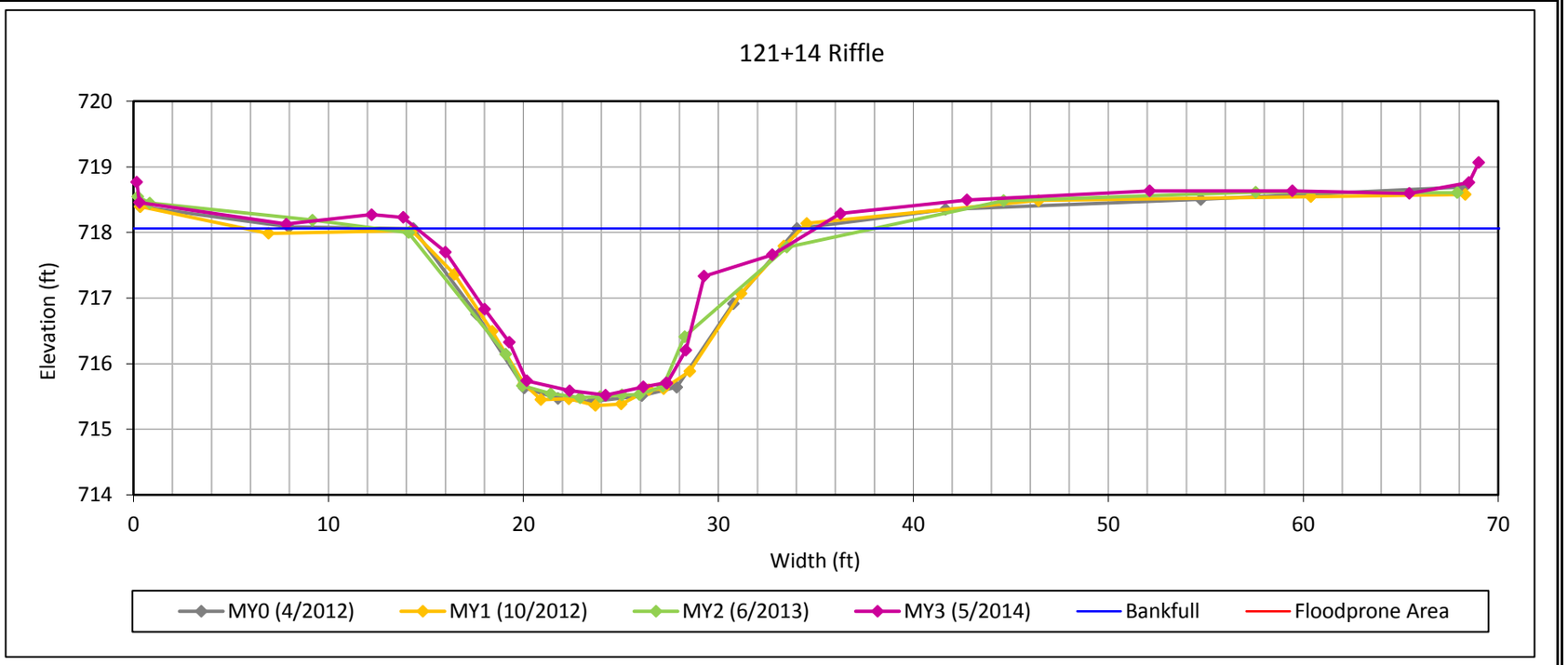
Bankfull Dimensions	
51.4	x-section area (ft.sq.)
39.1	width (ft)
1.3	mean depth (ft)
4.4	max depth (ft)
41.9	wetted parimeter (ft)
1.2	hyd radi (ft)
29.8	width-depth ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 4 - Irvin Creek Reach 1



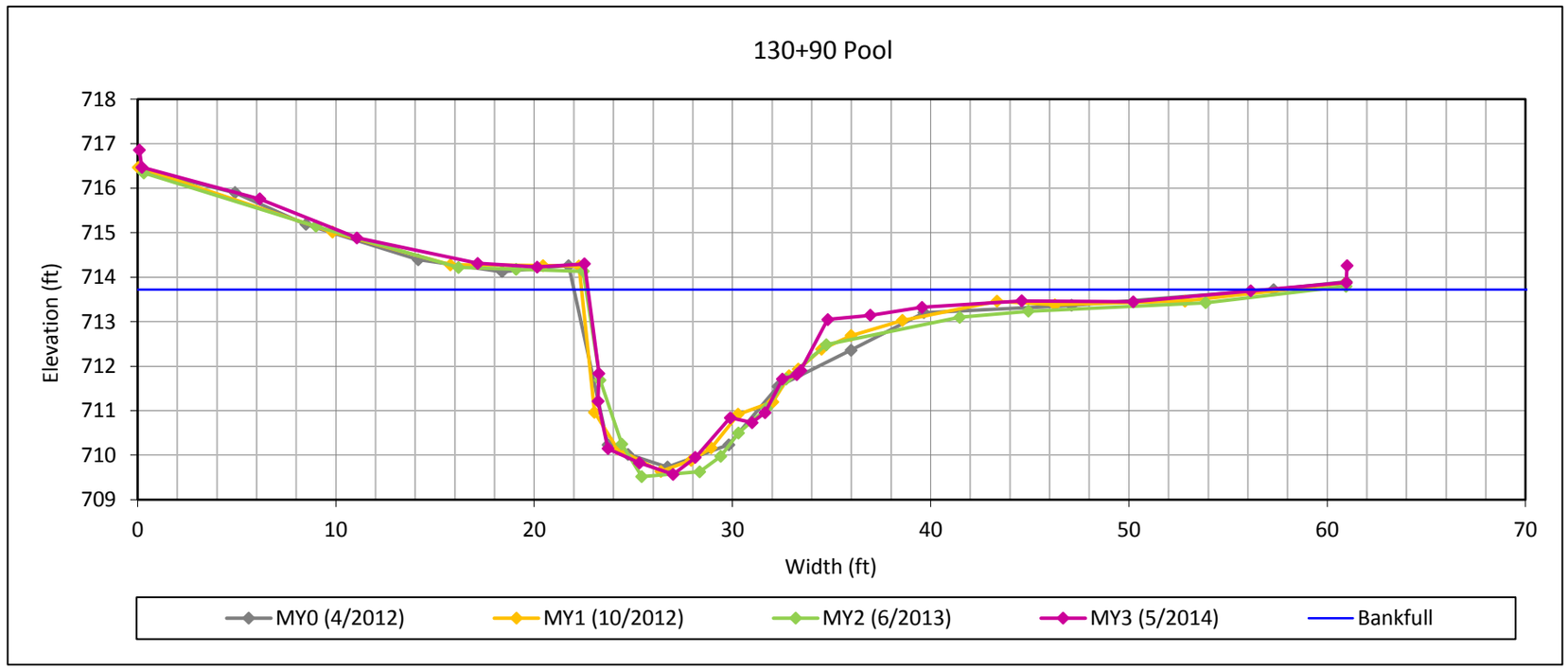
Bankfull Dimensions	
28.8	x-section area (ft.sq.)
20.5	width (ft)
1.4	mean depth (ft)
2.5	max depth (ft)
21.7	wetted parimeter (ft)
1.3	hyd radi (ft)
14.6	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 5 - Irvin Creek Reach 2



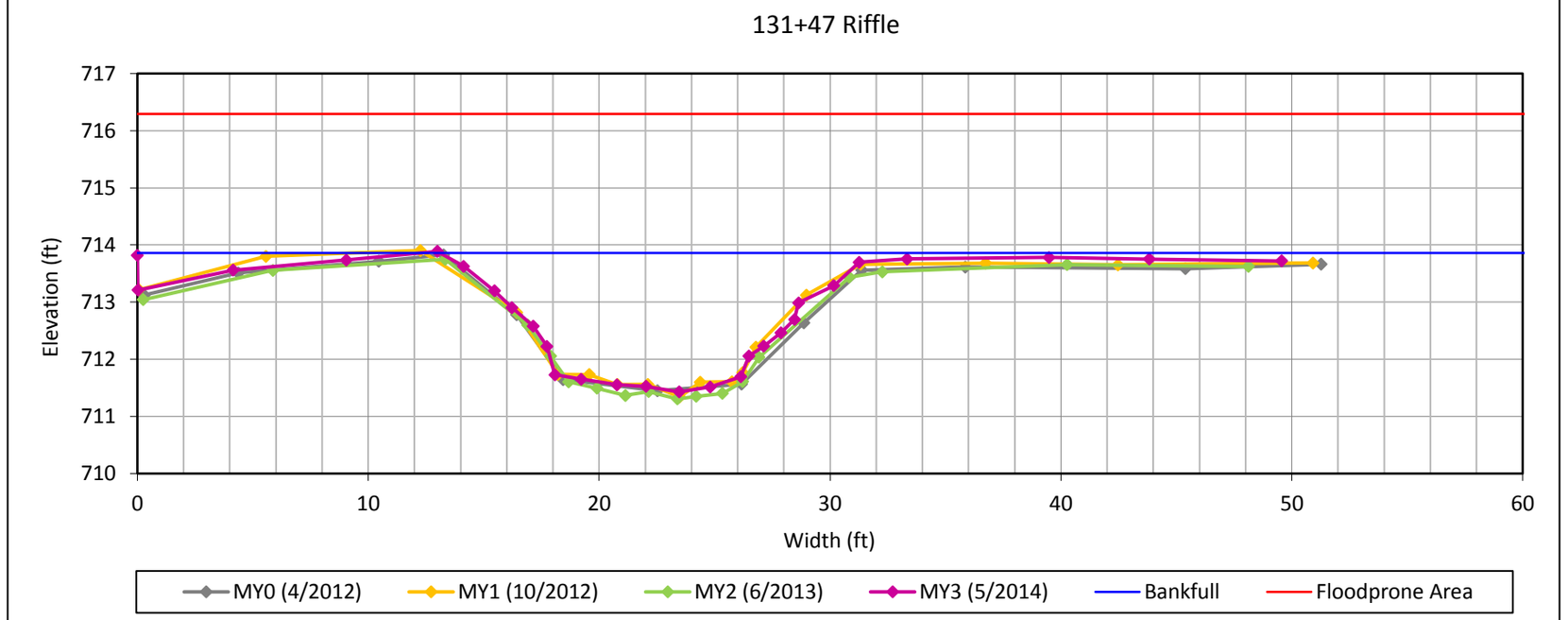
Bankfull Dimensions	
42.3	x-section area (ft.sq.)
34.2	width (ft)
1.2	mean depth (ft)
4.1	max depth (ft)
38.1	wetted parimeter (ft)
1.1	hyd radi (ft)
27.6	width-depth ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 6 - Irvin Creek Reach 2



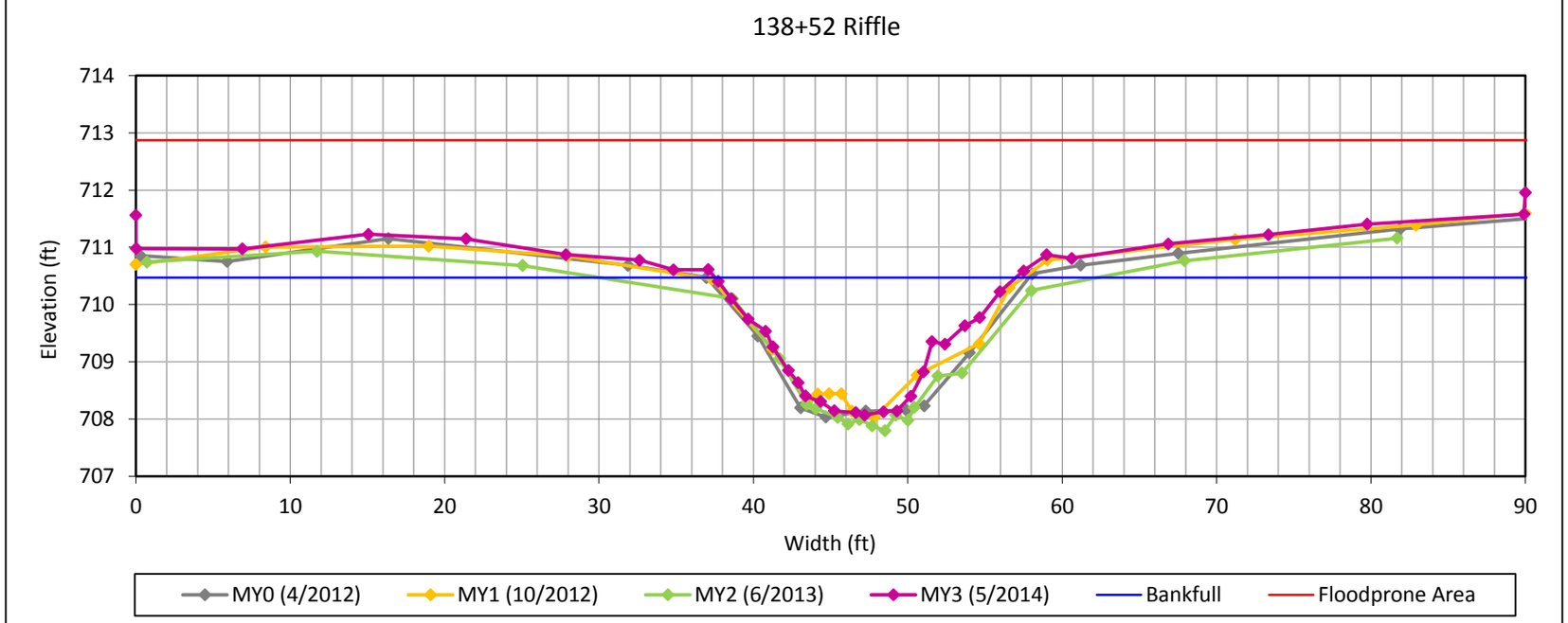
Bankfull Dimensions	
27.8	x-section area (ft.sq.)
18.2	width (ft)
1.5	mean depth (ft)
2.4	max depth (ft)
19.3	wetted parimeter (ft)
1.4	hyd radi (ft)
11.9	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 7 - Irvin Creek Reach 2



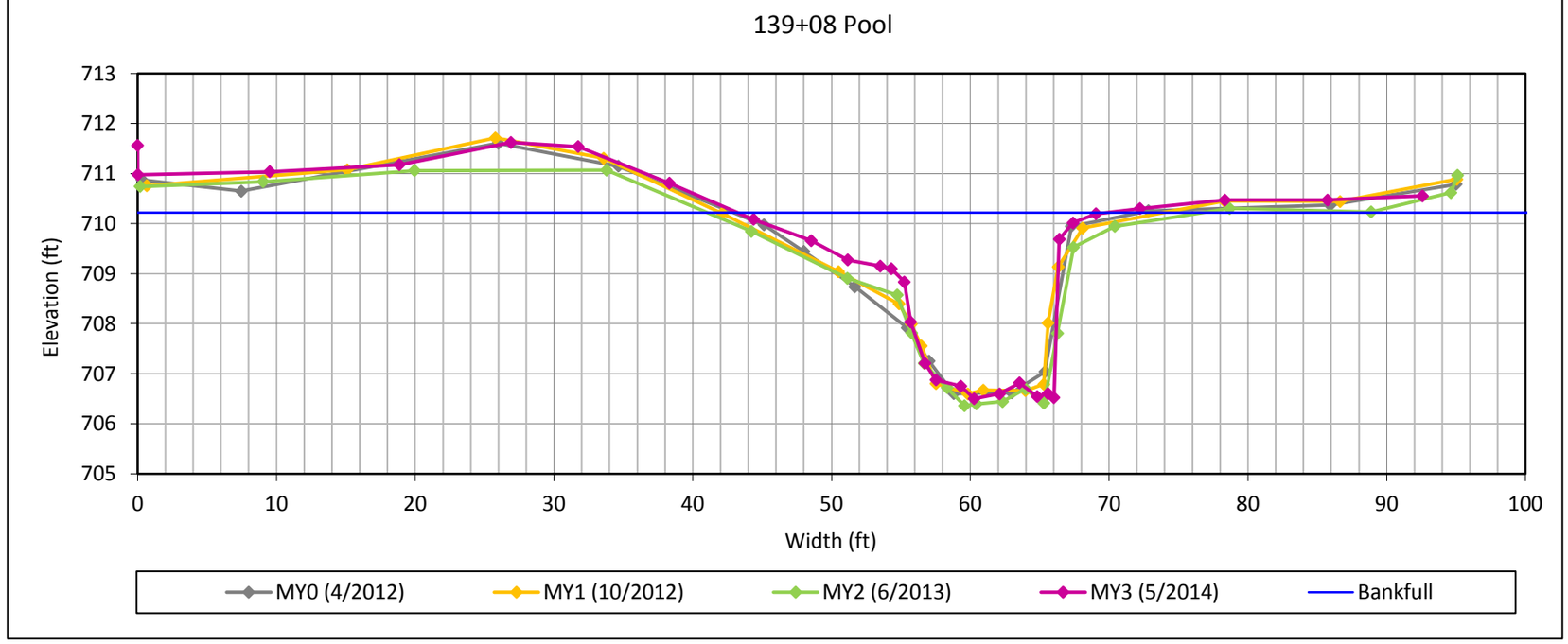
Bankfull Dimensions	
27.3	x-section area (ft.sq.)
19.5	width (ft)
1.4	mean depth (ft)
2.4	max depth (ft)
20.4	wetted parimeter (ft)
1.3	hyd radi (ft)
13.9	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 8 - Irvin Creek Reach 2



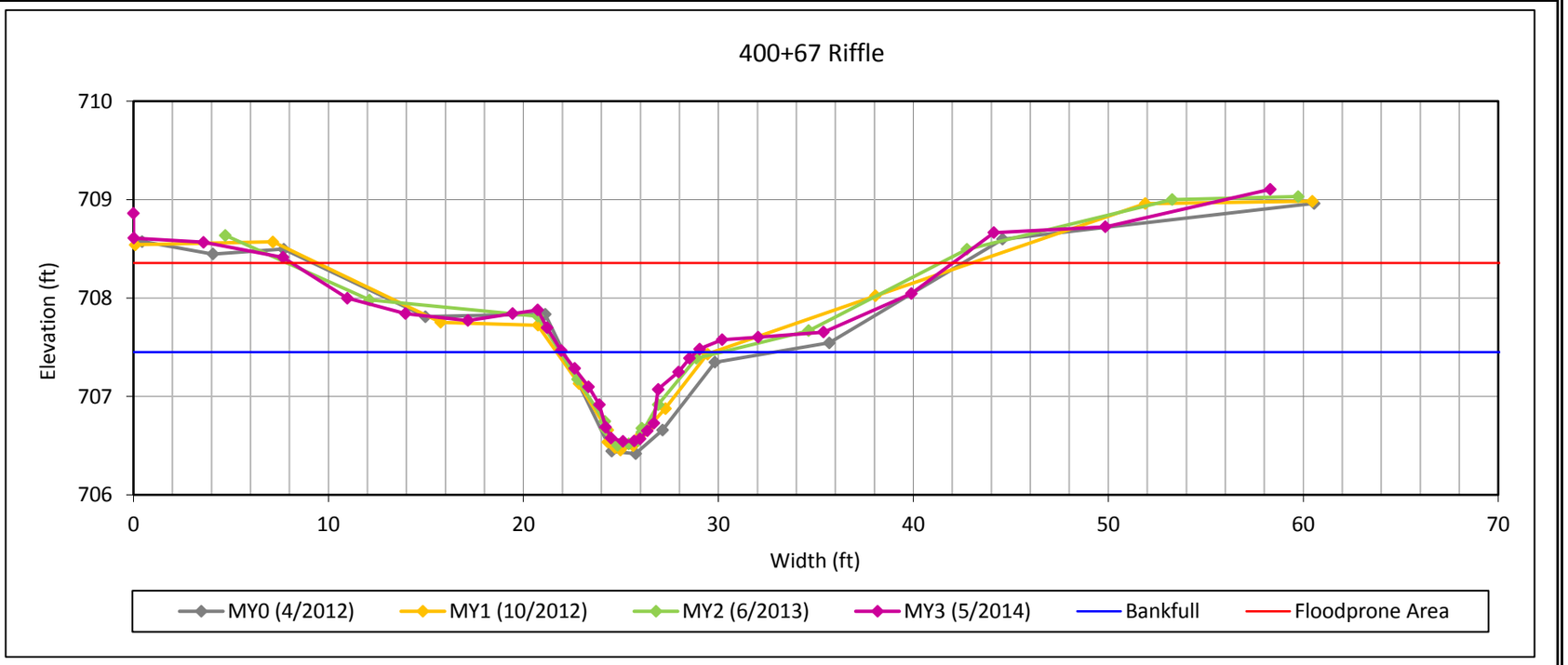
Bankfull Dimensions	
45.5	x-section area (ft.sq.)
26.6	width (ft)
1.7	mean depth (ft)
3.7	max depth (ft)
30.4	wetted parimeter (ft)
1.5	hyd radi (ft)
15.5	width-depth ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 9 - UT1



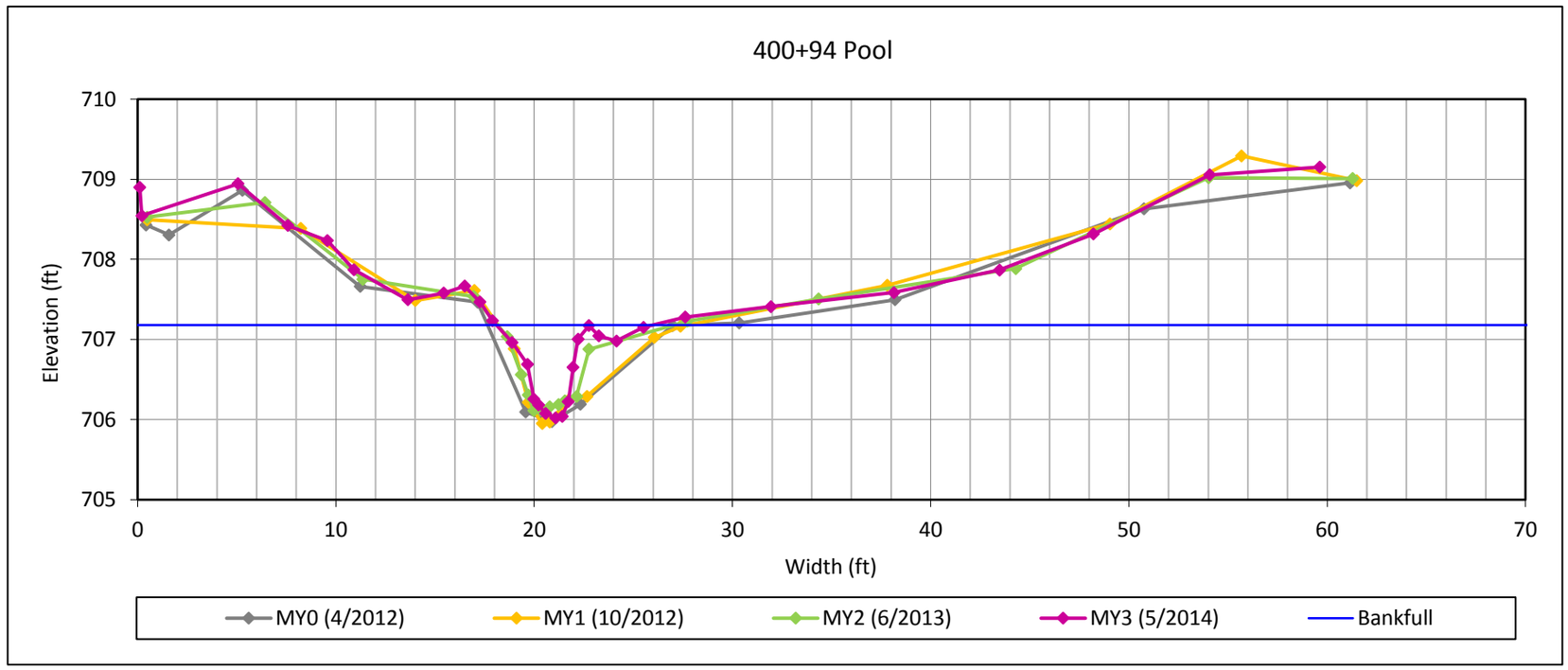
Bankfull Dimensions	
3.3	x-section area (ft.sq.)
6.9	width (ft)
0.5	mean depth (ft)
0.9	max depth (ft)
7.3	wetted parimeter (ft)
0.5	hyd radi (ft)
14.2	width-depth ratio
33.9	W flood prone area (ft)
4.9	entrenchment ratio
---	low bank height ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 10 - UT1



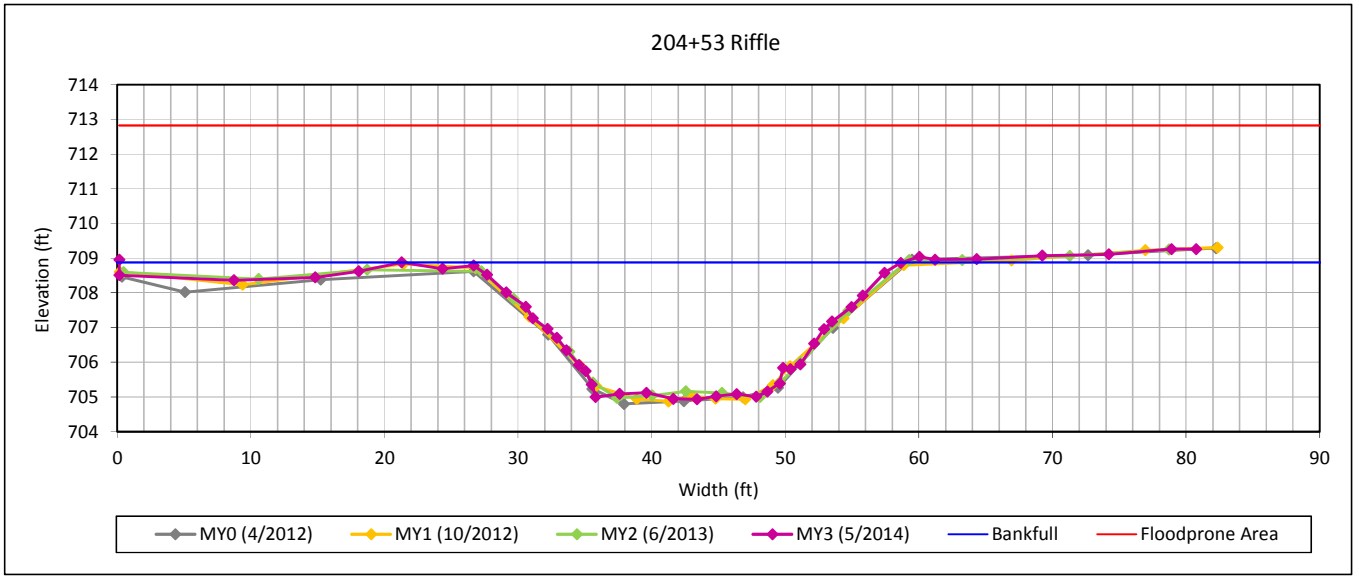
Bankfull Dimensions	
3.1	x-section area (ft.sq.)
7.9	width (ft)
0.4	mean depth (ft)
1.2	max depth (ft)
8.7	wetted parimeter (ft)
0.4	hyd radi (ft)
19.9	width-depth ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 11 - Little Troublesome Creek



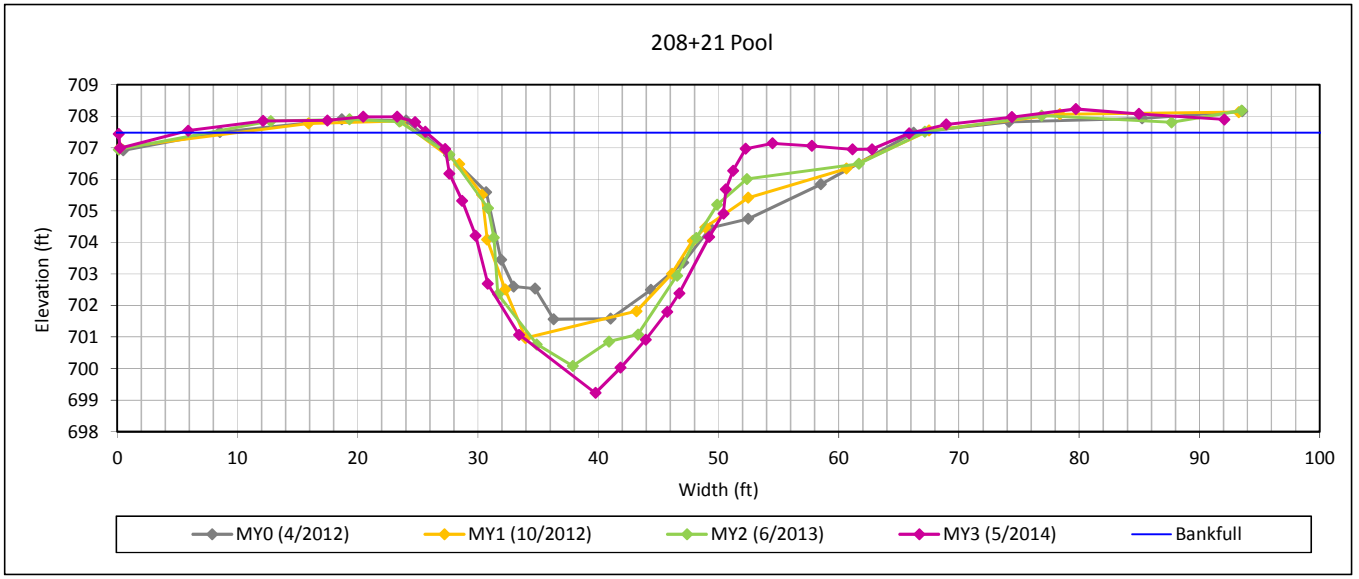
Bankfull Dimensions	
82.4	x-section area (ft.sq.)
32.1	width (ft)
2.6	mean depth (ft)
3.9	max depth (ft)
33.9	wetted parimeter (ft)
2.4	hyd radi (ft)
12.5	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

Survey Date: 5/2014
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

Cross Section 12 - Little Troublesome Creek



Bankfull Dimensions	
139.8	x-section area (ft.sq.)
40.4	width (ft)
3.5	mean depth (ft)
8.3	max depth (ft)
45.9	wetted parimeter (ft)
3.0	hyd radi (ft)
11.7	width-depth ratio

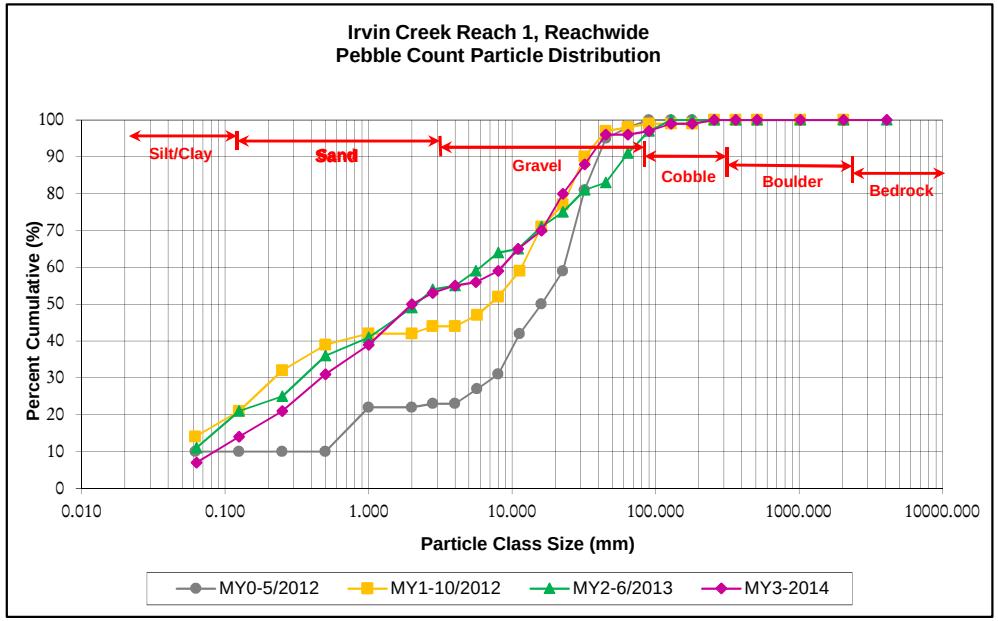
Survey Date: 5/2014
Field Crew: Wildlands Engineering

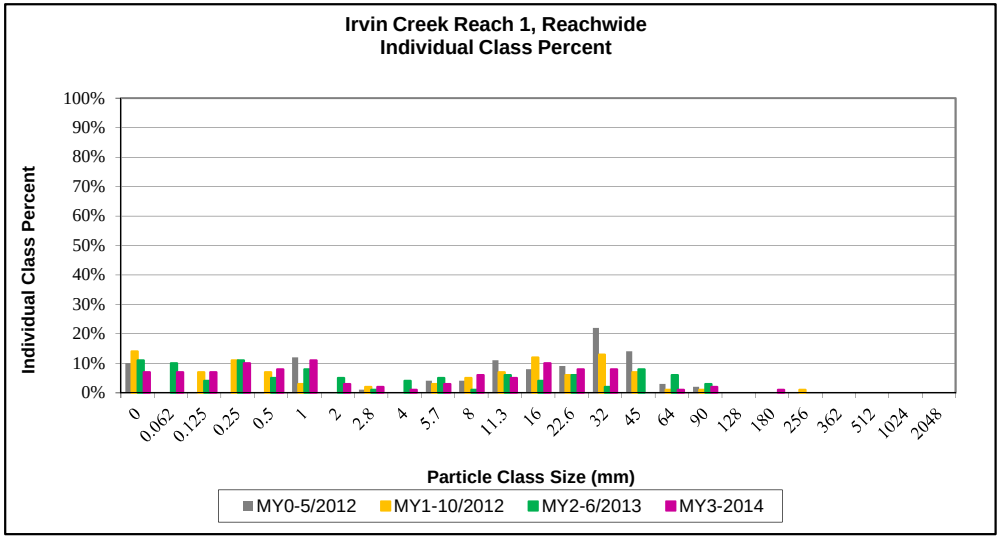
View Downstream

Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 1, Reachwide
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count			Irvin Creek Reach 1 Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	6	7	7	7
SAND	Very fine	0.062	0.125		7	7	7	14
	Fine	0.125	0.250	1	6	7	7	21
	Medium	0.250	0.500		10	10	10	31
	Coarse	0.5	1.0	1	7	8	8	39
	Very Coarse	1.0	2.0	3	8	11	11	50
GRAVEL	Very Fine	2.0	2.8	1	2	3	3	53
	Very Fine	2.8	4.0		2	2	2	55
	Fine	4.0	5.7	1		1	1	56
	Fine	5.7	8.0	3		3	3	59
	Medium	8.0	11.3	5	1	6	6	65
	Medium	11.3	16.0	5		5	5	70
	Coarse	16.0	22.6	10		10	10	80
	Coarse	22.6	32	8		8	8	88
	Very Coarse	32	45	7	1	8	8	96
	Very Coarse	45	64			0	0	96
COBBLE	Small	64	90	1		1	1	97
	Small	90	128	2		2	2	99
	Large	128	180					99
	Large	180	256	1		1	1.00	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.2
D_{35} =	0.7
D_{50} =	2.0
D_{84} =	26.9
D_{95} =	43.1
D_{100} =	256.0

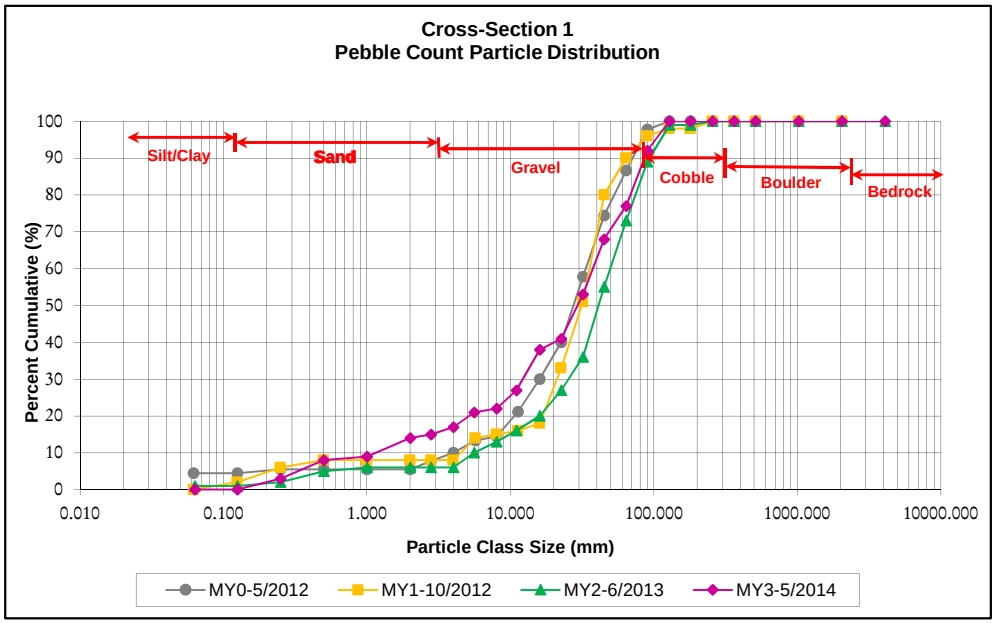


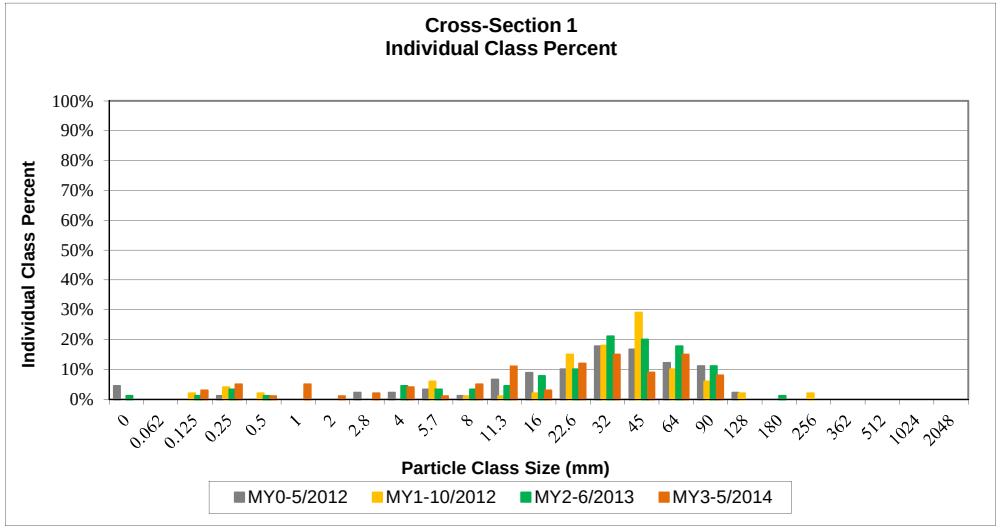


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 1, Cross-Section 1 (Riffle)
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count	Cross-Section 1 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	0	0	0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	3	3	3
	Medium	0.250	0.500	5	5	8
	Coarse	0.5	1.0	1	1	9
	Very Coarse	1.0	2.0	5	5	14
GRAVEL	Very Fine	2.0	2.8	1	1	15
	Very Fine	2.8	4.0	2	2	17
	Fine	4.0	5.7	4	4	21
	Fine	5.7	8.0	1	1	22
	Medium	8.0	11.3	5	5	27
	Medium	11.3	16.0	11	11	38
	Coarse	16.0	22.6	3	3	41
	Coarse	22.6	32	12	12	53
	Very Coarse	32	45	15	15	68
	Very Coarse	45	64	9	9	77
COBBLE	Small	64	90	15	15	92
	Small	90	128	8	8	100
	Large	128	180			100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 1	
Channel materials (mm)	
D_{16} =	3.3
D_{35} =	14.4
D_{50} =	29.3
D_{84} =	75.0
D_{95} =	102.7
D_{100} =	128.0

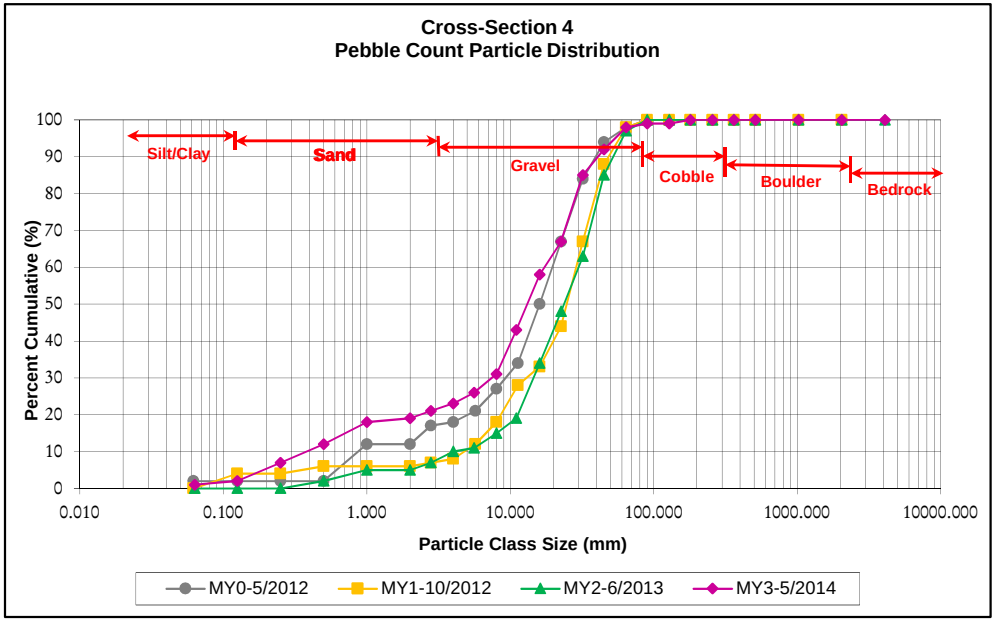


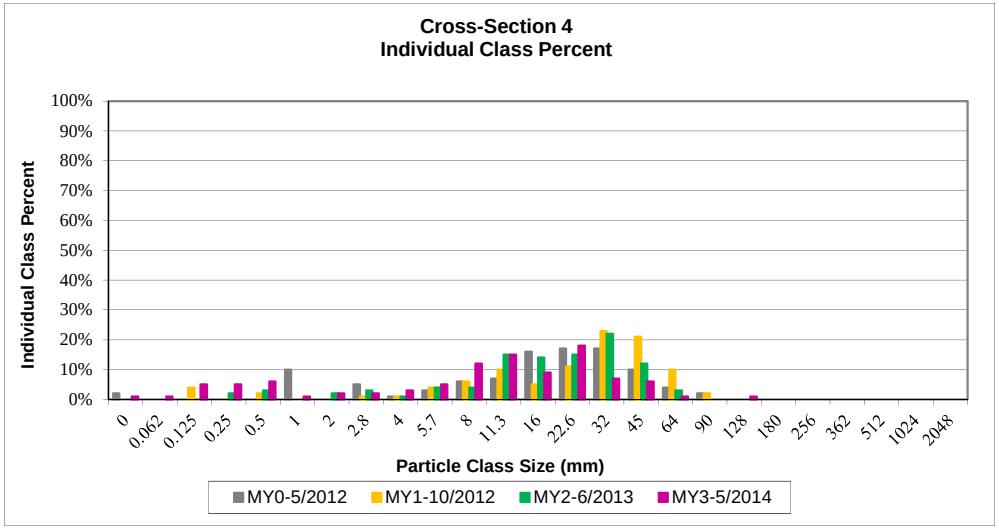


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 1, Cross-Section 4 (Riffle)
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count	Cross-Section 4 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125	1	1	2
	Fine	0.125	0.250	5	5	7
	Medium	0.250	0.500	5	5	12
	Coarse	0.5	1.0	6	6	18
	Very Coarse	1.0	2.0	1	1	19
GRAVEL	Very Fine	2.0	2.8	2	2	21
	Very Fine	2.8	4.0	2	2	23
	Fine	4.0	5.7	3	3	26
	Fine	5.7	8.0	5	5	31
	Medium	8.0	11.3	12	12	43
	Medium	11.3	16.0	15	15	58
	Coarse	16.0	22.6	9	9	67
	Coarse	22.6	32	18	18	85
	Very Coarse	32	45	7	7	92
	Very Coarse	45	64	6	6	98
COBBLE	Small	64	90	1	1	99
	Small	90	128			99
	Large	128	180	1	1	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 4 Channel materials (mm)	
D_{16} =	0.8
D_{35} =	8.9
D_{50} =	13.1
D_{84} =	31.4
D_{95} =	53.7
D_{100} =	180.0

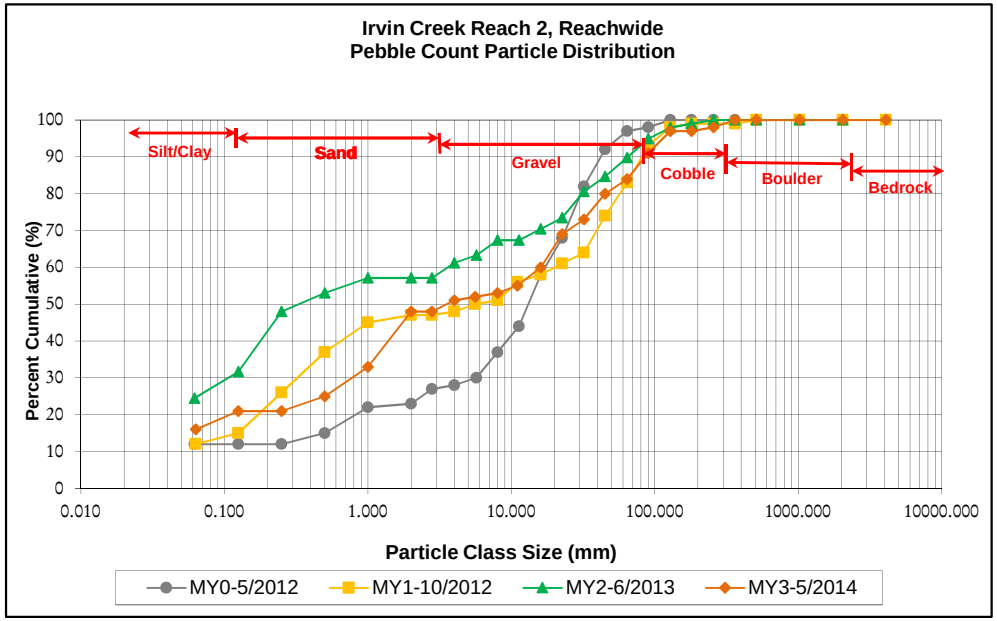


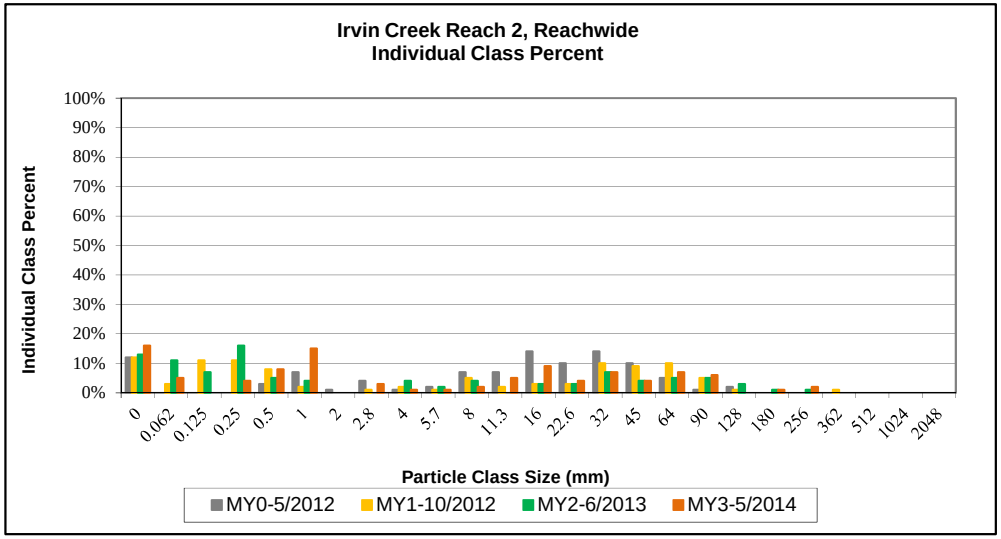


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 2, Reachwide
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count			Irvin Creek Reach 2 Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		16	16	16	16
SAND	Very fine	0.062	0.125		5	5	5	21
	Fine	0.125	0.250					21
	Medium	0.250	0.500	1	3	4	4	25
	Coarse	0.5	1.0	1	7	8	8	33
	Very Coarse	1.0	2.0	1	14	15	15	48
GRAVEL	Very Fine	2.0	2.8					48
	Very Fine	2.8	4.0	2	1	3	3	51
	Fine	4.0	5.7	1		1	1	52
	Fine	5.7	8.0	1		1	1	53
	Medium	8.0	11.3	2		2	2	55
	Medium	11.3	16.0	3	2	5	5	60
	Coarse	16.0	22.6	8	1	9	9	69
	Coarse	22.6	32	4		4	4	73
	Very Coarse	32	45	6	1	7	7	80
	Very Coarse	45	64	4		4	4	84
COBBLE	Small	64	90	7		7	7	91
	Small	90	128	6		6	6	97
	Large	128	180					97
	Large	180	256	1		1	1	98
BOULDER	Small	256	362	2		2	2	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.1
D_{35} =	1.1
D_{50} =	3.6
D_{84} =	64.0
D_{95} =	113.8
D_{100} =	362.0

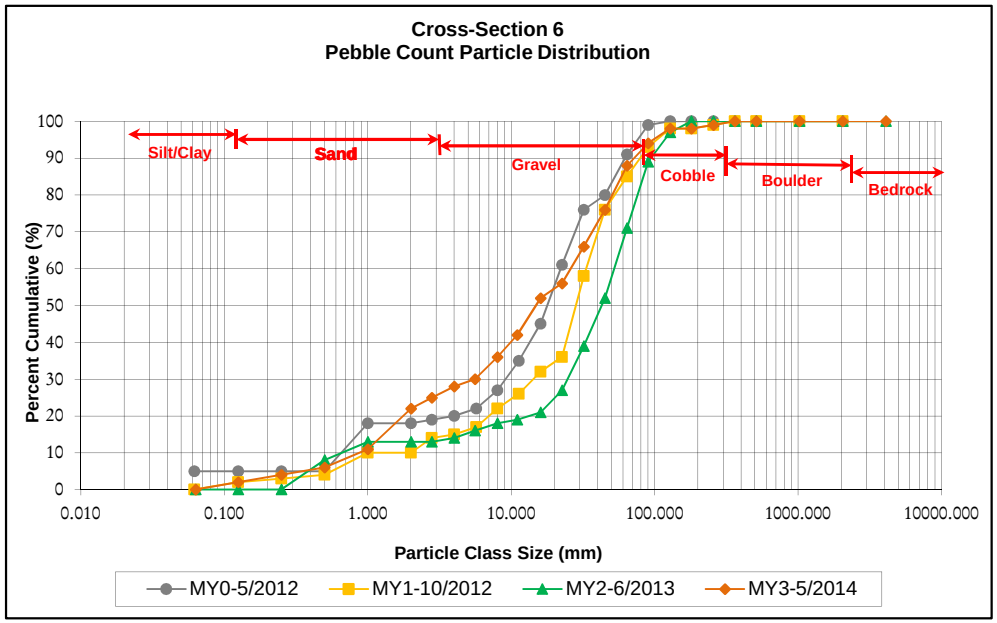


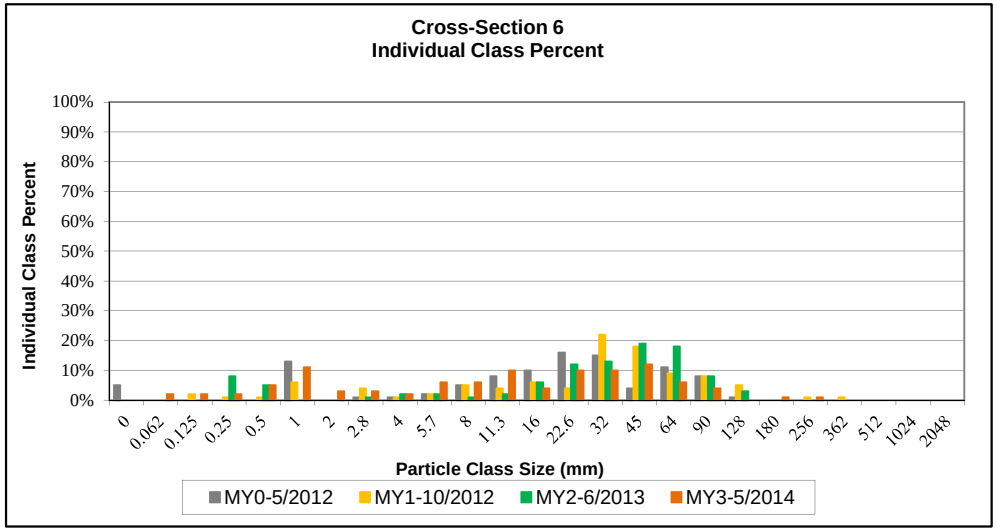


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 2, Cross-Section 6 (Riffle)
Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 6 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125	2	2	2
	Fine	0.125	0.250	2	2	4
	Medium	0.250	0.500	2	2	6
	Coarse	0.5	1.0	5	5	11
	Very Coarse	1.0	2.0	11	11	22
GRAVEL	Very Fine	2.0	2.8	3	3	25
	Very Fine	2.8	4.0	3	3	28
	Fine	4.0	5.7	2	2	30
	Fine	5.7	8.0	6	6	36
	Medium	8.0	11.3	6	6	42
	Medium	11.3	16.0	10	10	52
	Coarse	16.0	22.6	4	4	56
	Coarse	22.6	32	10	10	66
	Very Coarse	32	45	10	10	76
	Very Coarse	45	64	12	12	88
COBBLE	Small	64	90	6	6	94
	Small	90	128	4	4	98
	Large	128	180			98
	Large	180	256	1	1	99
BOULDER	Small	256	362	1	1	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 6	
Channel materials (mm)	
D_{16} =	1.4
D_{35} =	7.5
D_{50} =	14.8
D_{84} =	56.9
D_{95} =	98.3
D_{100} =	362.0

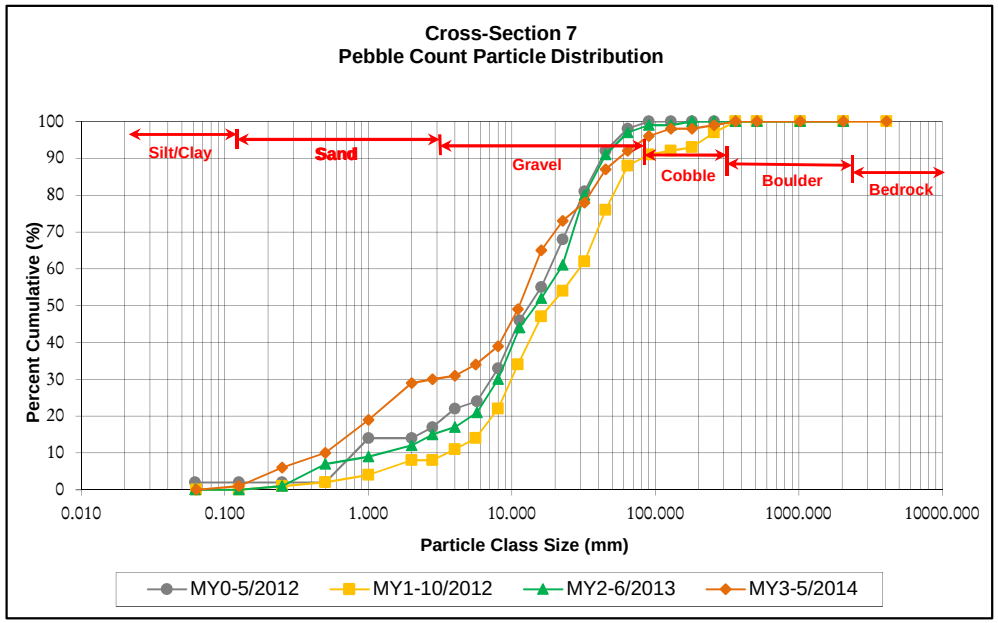


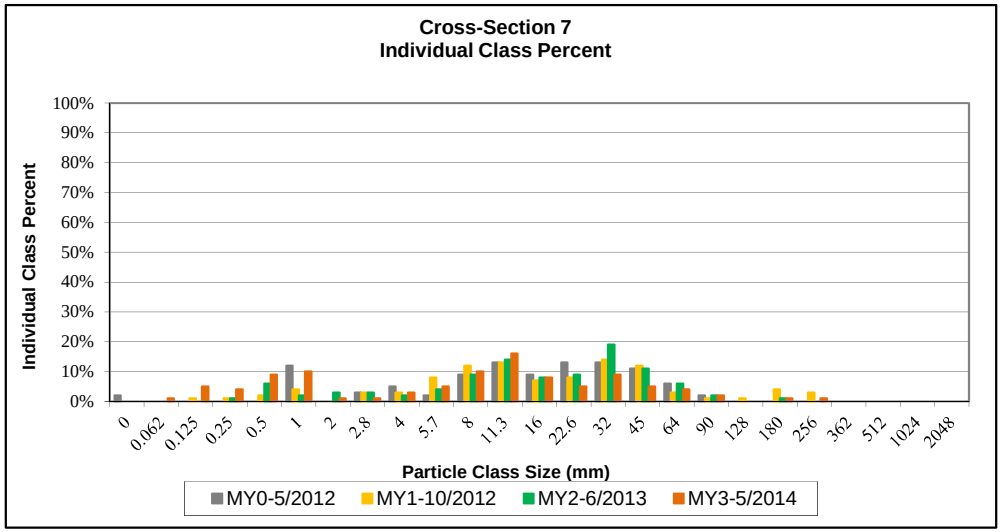


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Irvin Creek Reach 2, Cross-Section 7 (Riffle)
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count	Cross-Section 7 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125	1	1	1
	Fine	0.125	0.250	5	5	6
	Medium	0.250	0.500	4	4	10
	Coarse	0.5	1.0	9	9	19
	Very Coarse	1.0	2.0	10	10	29
GRAVEL	Very Fine	2.0	2.8	1	1	30
	Very Fine	2.8	4.0	1	1	31
	Fine	4.0	5.7	3	3	34
	Fine	5.7	8.0	5	5	39
	Medium	8.0	11.3	10	10	49
	Medium	11.3	16.0	16	16	65
	Coarse	16.0	22.6	8	8	73
	Coarse	22.6	32	5	5	78
	Very Coarse	32	45	9	9	87
	Very Coarse	45	64	5	5	92
COBBLE	Small	64	90	4	4	96
	Small	90	128	2	2	98
	Large	128	180			98
	Large	180	256	1	1	99
BOULDER	Small	256	362	1	1	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 7	
Channel materials (mm)	
D_{16} =	0.8
D_{35} =	6.0
D_{50} =	11.3
D_{84} =	40.2
D_{95} =	82.6
D_{100} =	362.0

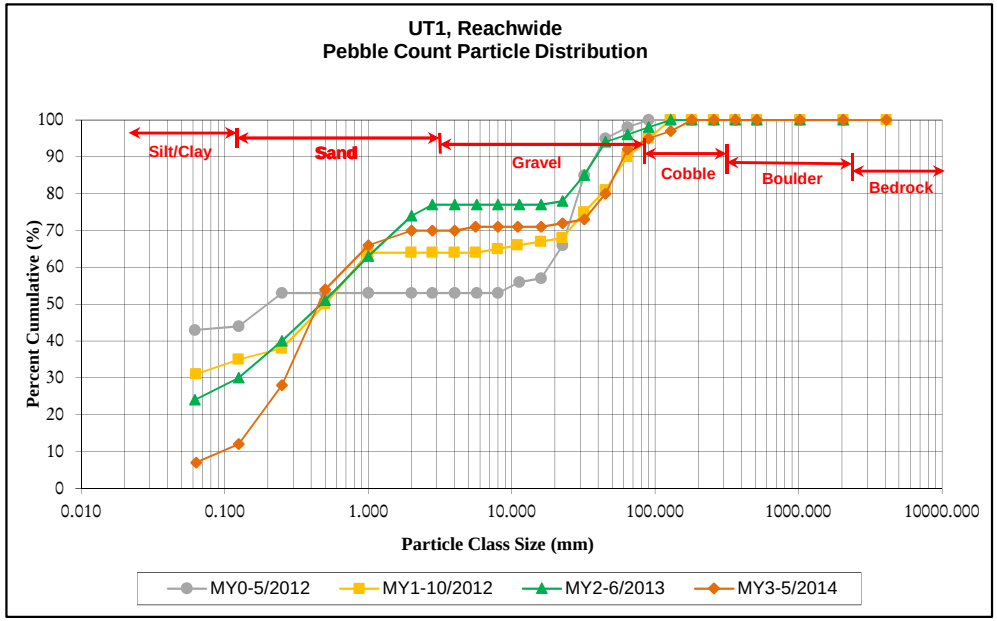


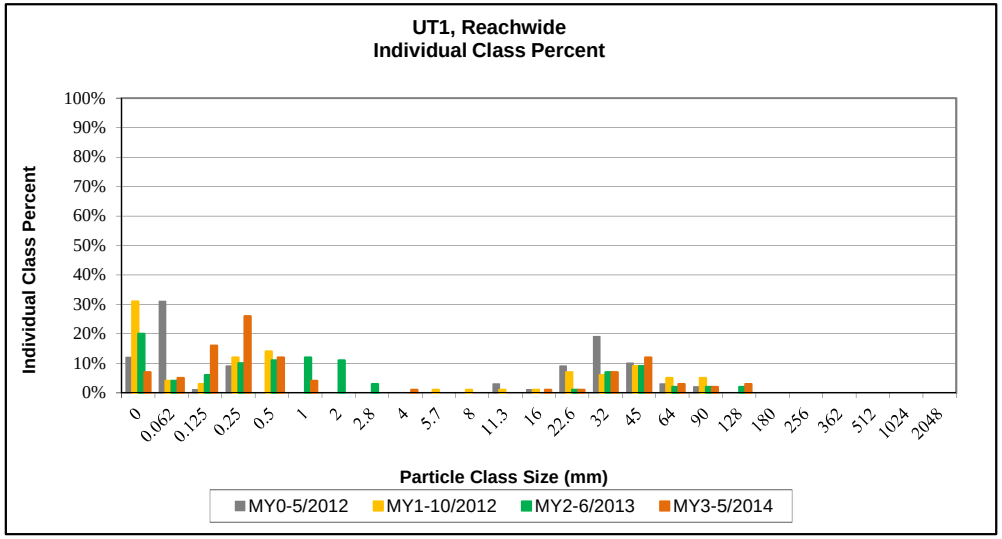


Reachwide and Cross-Section Pebble Count Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
UT1, Reachwide
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count			UT1 Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	5	7	7	7
SAND	Very fine	0.062	0.125	1	4	5	5	12
	Fine	0.125	0.250	3	13	16	16	28
	Medium	0.250	0.500	8	18	26	26	54
	Coarse	0.5	1.0	2	10	12	12	66
	Very Coarse	1.0	2.0	4		4	4	70
GRAVEL	Very Fine	2.0	2.8					70
	Very Fine	2.8	4.0					70
	Fine	4.0	5.7	1		1	1	71
	Fine	5.7	8.0					71
	Medium	8.0	11.3					71
	Medium	11.3	16.0					71
	Coarse	16.0	22.6	1		1	1	72
	Coarse	22.6	32	1		1	1	73
	Very Coarse	32	45	7		7	7	80
	Very Coarse	45	64	12		12	12	92
COBBLE	Small	64	90	3		3	3	95
	Small	90	128	2		2	2	97
	Large	128	180	3		3	3	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/ Clay
D_{35} =	0.3
D_{50} =	0.4
D_{84} =	50.6
D_{95} =	90.0
D_{100} =	180.0

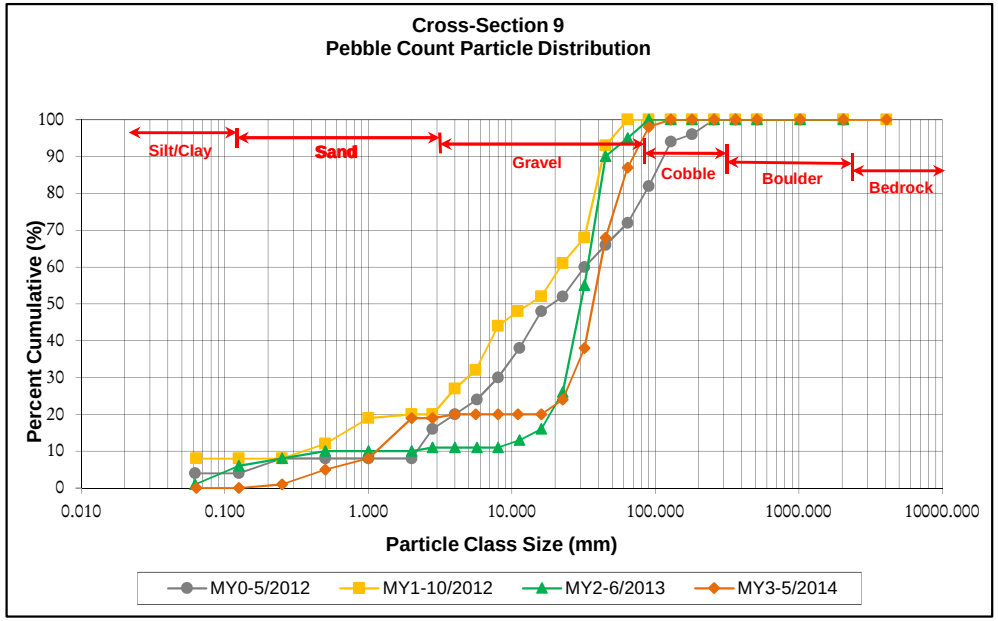


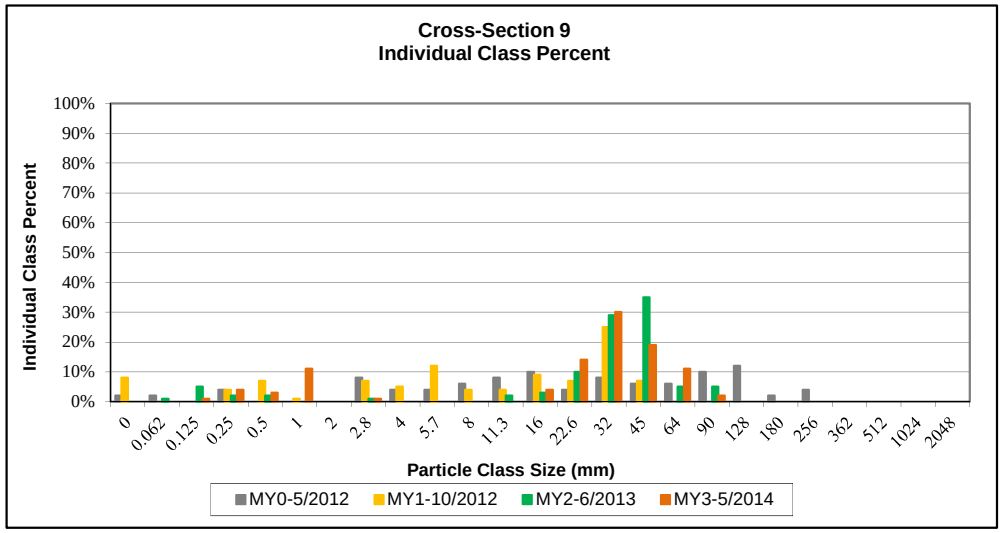


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
UT1, Cross-Section 9 (Riffle)
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count	Cross-Section 9 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	1	1	1
	Medium	0.250	0.500	4	4	5
	Coarse	0.5	1.0	3	3	8
	Very Coarse	1.0	2.0	11	11	19
GRAVEL	Very Fine	2.0	2.8			19
	Very Fine	2.8	4.0	1	1	20
	Fine	4.0	5.7			20
	Fine	5.7	8.0			20
	Medium	8.0	11.3			20
	Medium	11.3	16.0			20
	Coarse	16.0	22.6	4	4	24
	Coarse	22.6	32	14	14	38
	Very Coarse	32	45	30	30	68
	Very Coarse	45	64	19	19	87
COBBLE	Small	64	90	11	11	98
	Small	90	128	2	2	100
	Large	128	180			100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 9 Channel materials (mm)	
D_{16} =	1.7
D_{35} =	29.7
D_{50} =	36.7
D_{84} =	60.5
D_{95} =	82.0
D_{100} =	128.0

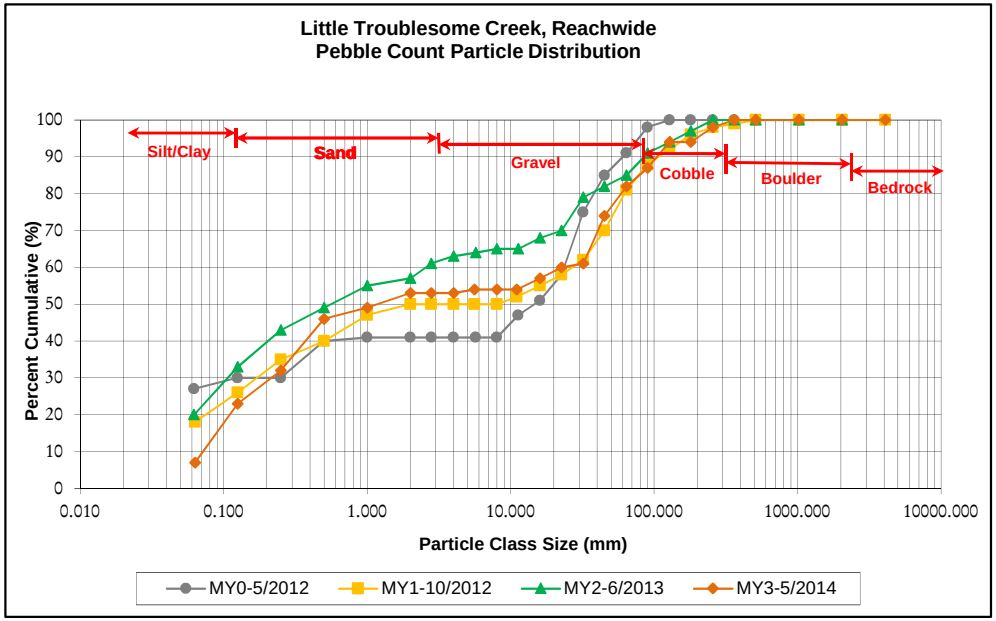


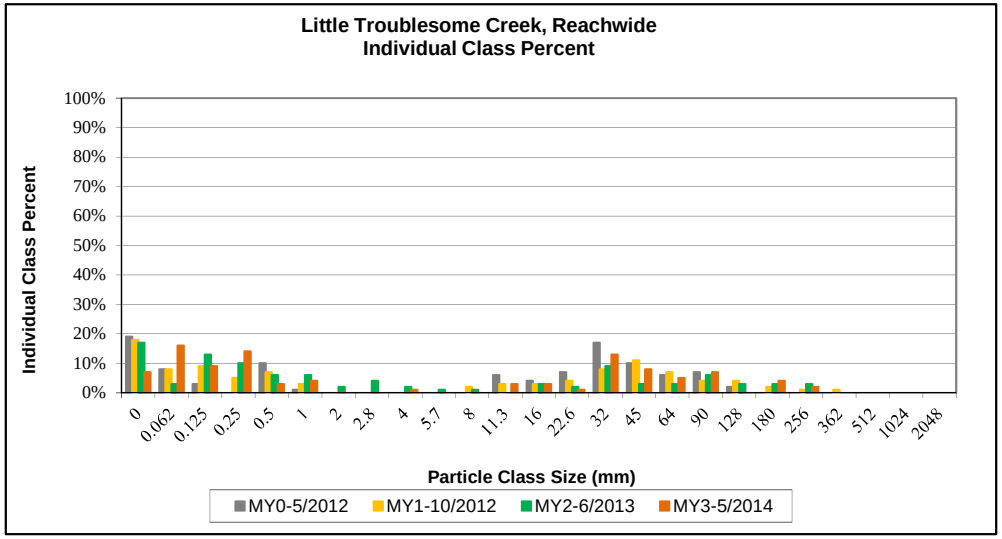


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Little Troublesome Creek, Reachwide
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count			Little Troublesome Creek Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	6	7	7	7
SAND	Very fine	0.062	0.125		16	16	16	23
	Fine	0.125	0.250		9	9	9	32
	Medium	0.250	0.500		14	14	14	46
	Coarse	0.5	1.0	1	2	3	3	49
	Very Coarse	1.0	2.0	2	2	4	4	53
GRAVEL	Very Fine	2.0	2.8					53
	Very Fine	2.8	4.0					53
	Fine	4.0	5.7	1		1	1	54
	Fine	5.7	8.0					54
	Medium	8.0	11.3					54
	Medium	11.3	16.0	3		3	3	57
	Coarse	16.0	22.6	3		3	3	60
	Coarse	22.6	32	1		1	1	61
	Very Coarse	32	45	12	1	13	13	74
	Very Coarse	45	64	8		8	8	82
COBBLE	Small	64	90	5		5	5	87
	Small	90	128	7		7	7	94
	Large	128	180					94
	Large	180	256	4		4	4	98
BOULDER	Small	256	362	2		2	2	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/ Clay
D_{35} =	0.3
D_{50} =	1.2
D_{84} =	73.4
D_{95} =	196.6
D_{100} =	362.0

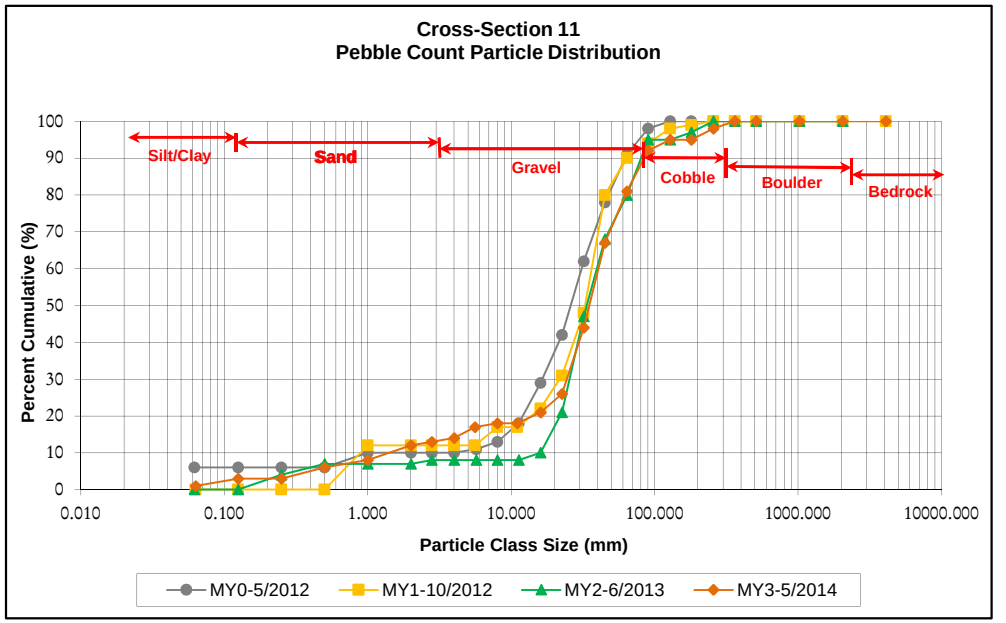


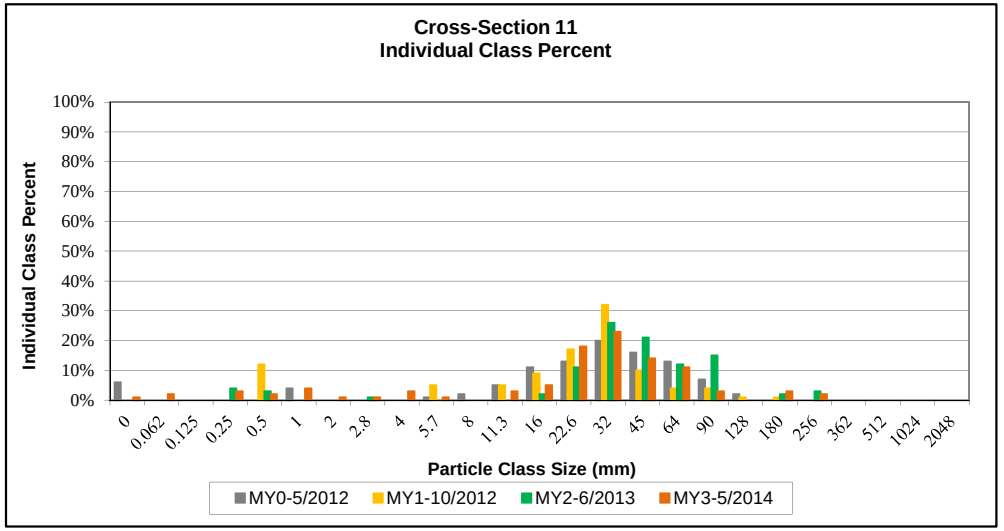


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Little Troublesome Creek , Cross-Section 11 (Riffle)
Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 11 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125	2	2	3
	Fine	0.125	0.250			3
	Medium	0.250	0.500	3	3	6
	Coarse	0.5	1.0	2	2	8
	Very Coarse	1.0	2.0	4	4	12
GRAVEL	Very Fine	2.0	2.8	1	1	13
	Very Fine	2.8	4.0	1	1	14
	Fine	4.0	5.7	3	3	17
	Fine	5.7	8.0	1	1	18
	Medium	8.0	11.3			18
	Medium	11.3	16.0	3	3	21
	Coarse	16.0	22.6	5	5	26
	Coarse	22.6	32	18	18	44
	Very Coarse	32	45	23	23	67
	Very Coarse	45	64	14	14	81
COBBLE	Small	64	90	11	11	92
	Small	90	128	3	3	95
	Large	128	180			95
	Large	180	256	3	3	98
BOULDER	Small	256	362	2	2	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	100	100	100

Cross-Section 11	
Channel materials (mm)	
D_{16} =	5.0
D_{35} =	26.9
D_{50} =	35.0
D_{84} =	70.2
D_{95} =	180.0
D_{100} =	362.0

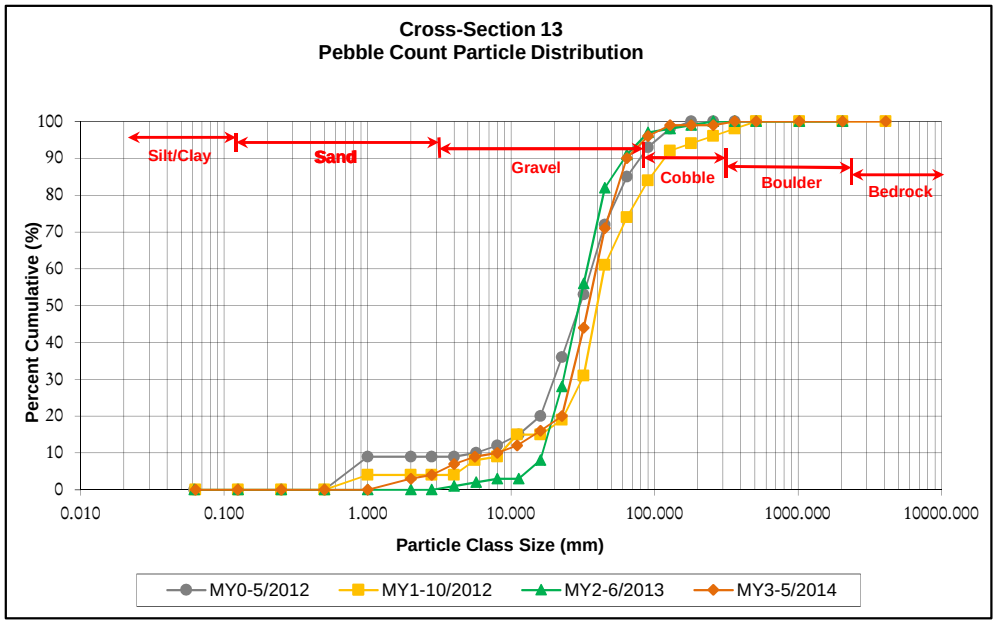


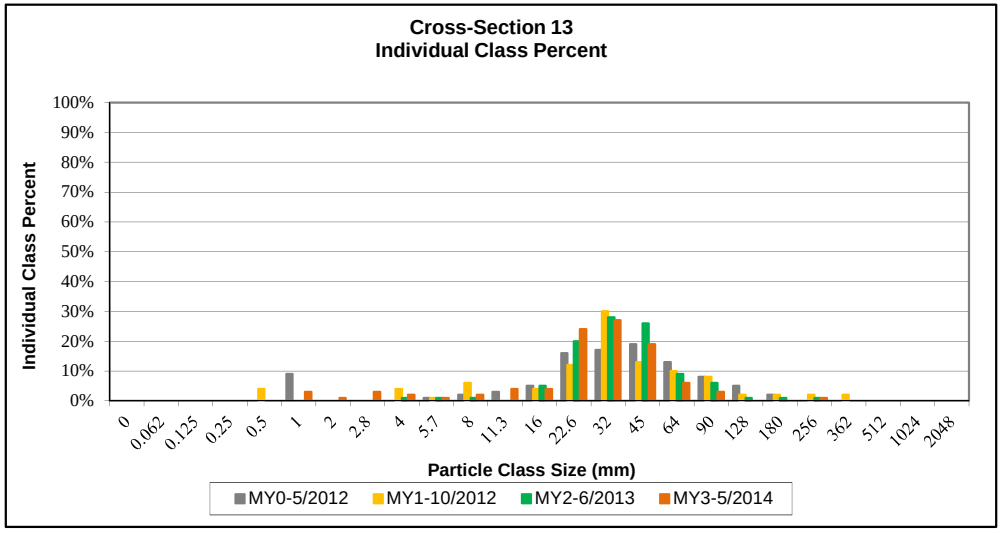


Reachwide and Cross-Section Substrate Plots
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Little Troublesome Creek , Cross-Section 13 (Riffle)
Monitoring Year 3

Particle Class		Diameter (mm)		Particle Count	Cross-Section 13 Summary	
		min	max	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.250	0.500			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0	3	3	3
GRAVEL	Very Fine	2.0	2.8	1	1	4
	Very Fine	2.8	4.0	3	3	7
	Fine	4.0	5.7	2	2	9
	Fine	5.7	8.0	1	1	10
	Medium	8.0	11.3	2	2	12
	Medium	11.3	16.0	4	4	16
	Coarse	16.0	22.6	4	4	20
	Coarse	22.6	32	24	24	44
	Very Coarse	32	45	27	27	71
	Very Coarse	45	64	19	19	90
COBBLE	Small	64	90	6	6	96
	Small	90	128	3	3	99
	Large	128	180			99
	Large	180	256			99
BOULDER	Small	256	362	1	1	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 13 Channel materials (mm)	
D_{16} =	16.0
D_{35} =	28.1
D_{50} =	34.5
D_{84} =	57.3
D_{95} =	85.0
D_{100} =	362.0





APPENDIX 5. Hydrology Summary Data and Plots

Table 13. Verification of Bankfull Events
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

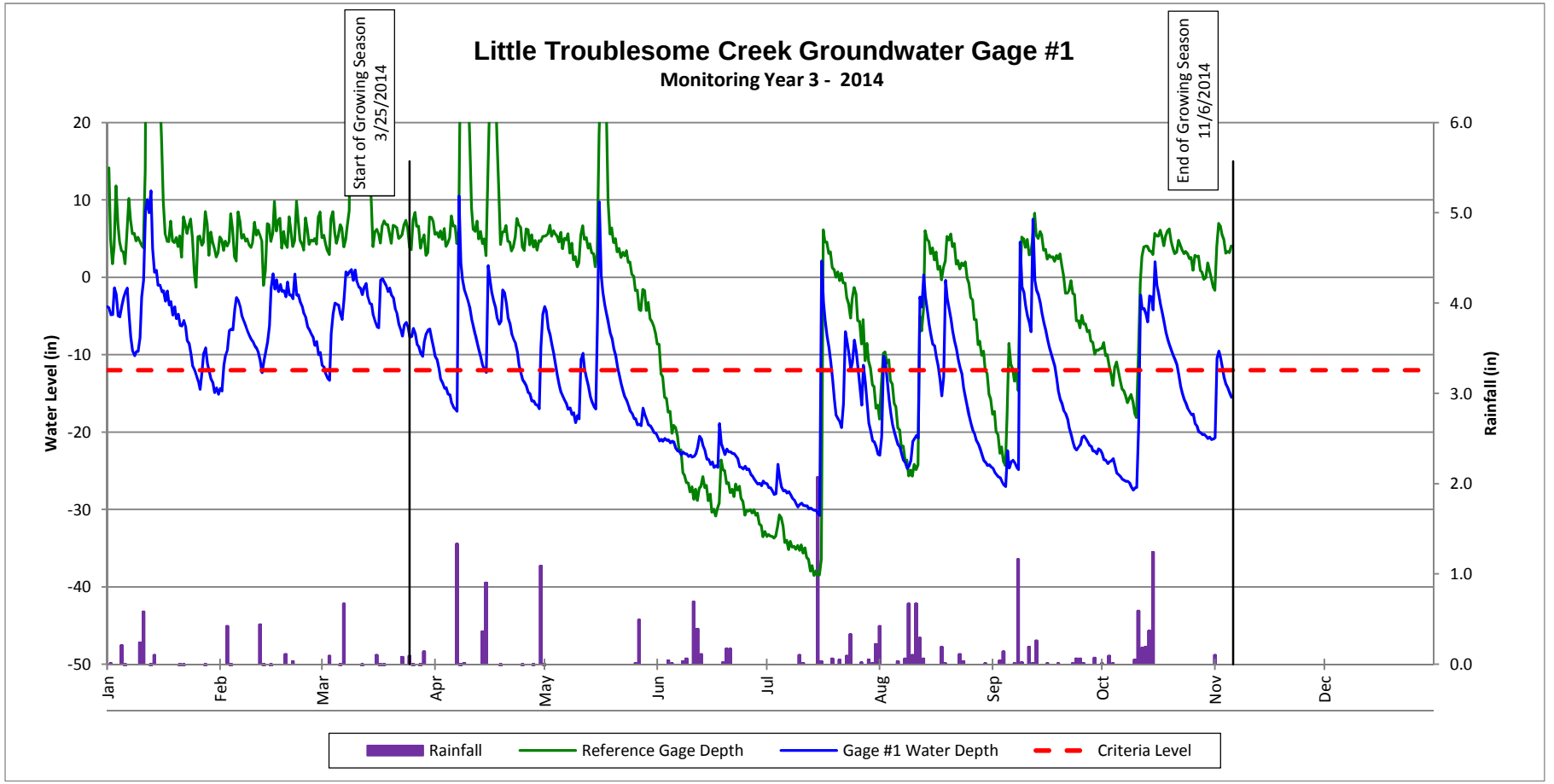
Monitoring Year	Reach	Date of Data Collection	Date of Occurrence	Method
MY1	**Irvin Creek**	5/21/2012	U	Crest Gage
	Little Troublesome Creek	6/28/2012	U	Wrack Lines
	UT1	5/21/2012	U	Crest Gage
MY2	**Irvin Creek**	11/7/2013	U	Crest Gage
	Little Troublesome Creek	11/7/2013	U	Crest Gage
	UT1	11/7/2013	U	Crest Gage
MY3	**Irvin Creek**	5/12/2014	U	Crest Gage
		11/5/2014	U	
	Little Troublesome	5/12/2014	U	Crest Gage
		11/5/2014	U	
	UT1	5/12/2014	U	Crest Gage
		11/5/2014	U	

u: unknown

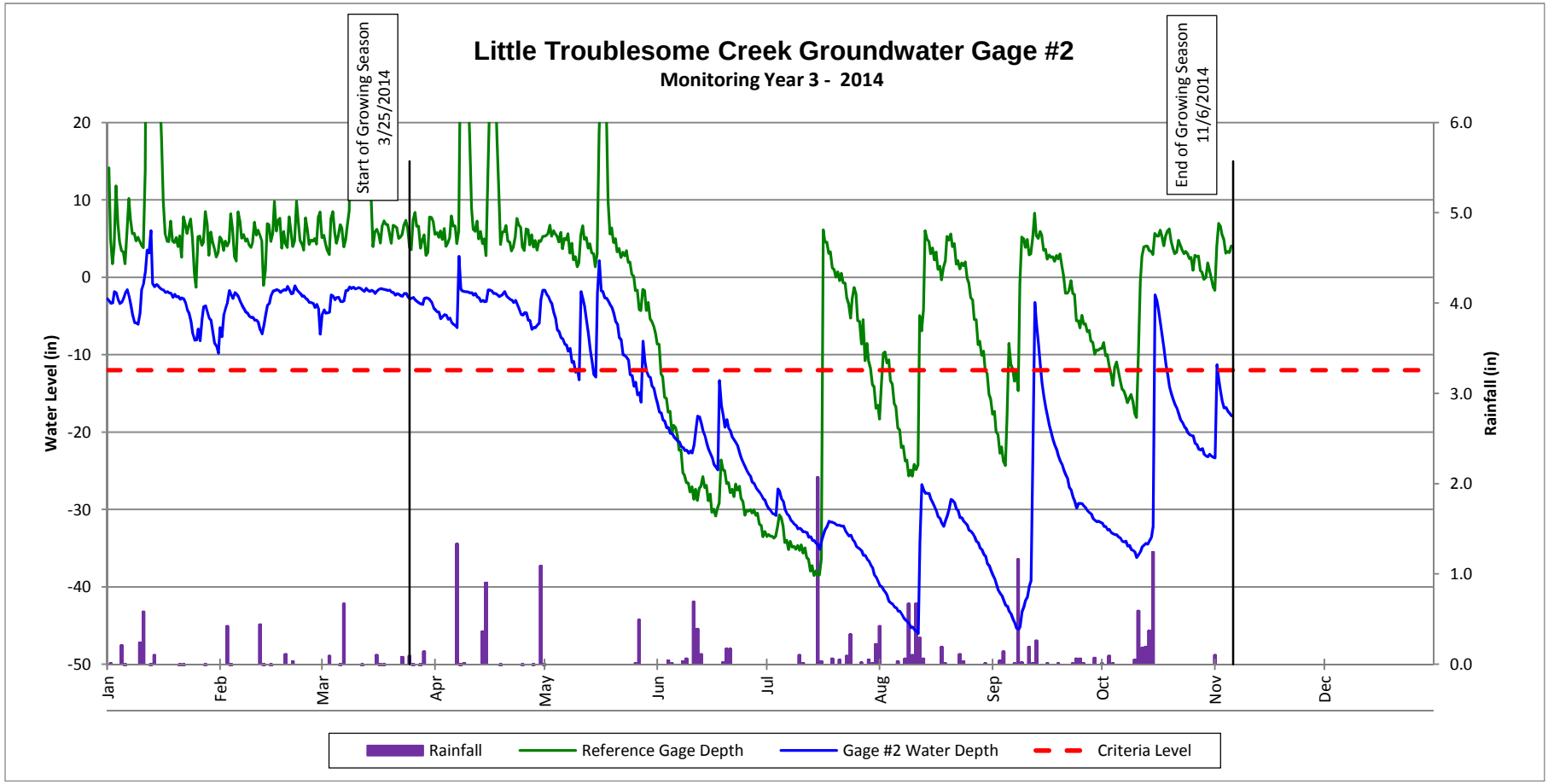
Table 14. Wetland Gage Attainment Summary
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3

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/5.5 Days (2.4%)	Yes/18.0 Days (8.0%)	Yes/17.0 Days (7.5%)				
2	Yes/26/5 Days (11.7%)	Yes/61.5 Days (27.2%)	Yes/50.5 Days (22.3%)				
3	Yes/87.5 Days (38.7%)	Yes/195.5 Days (86.5%)	Yes/98.5 Days (43.6%)				
4	Yes/65.5 Days (29%)	Yes/165.5 Days (73.2%)	Yes/74.0 Days (32.7%)				
5	Yes/60.5 Days (26.8%)	Yes/24.0 Days (10.6%)	Yes/45.5 Days (20.1%)				
6	No/6.0 Days (2.7%)	Yes/17.5 Days (7.7%)	Yes/19.5 Days (8.6%)				
7	Yes/83.0 Days (36.7%)	Yes/70.0 Days (31.0%)	Yes/60.0 Days (26.5%)				
8	No/11.5 Days (5.1%)	Yes/31.5 Days (13.9%)	Yes/44.5 Days (19.7%)				

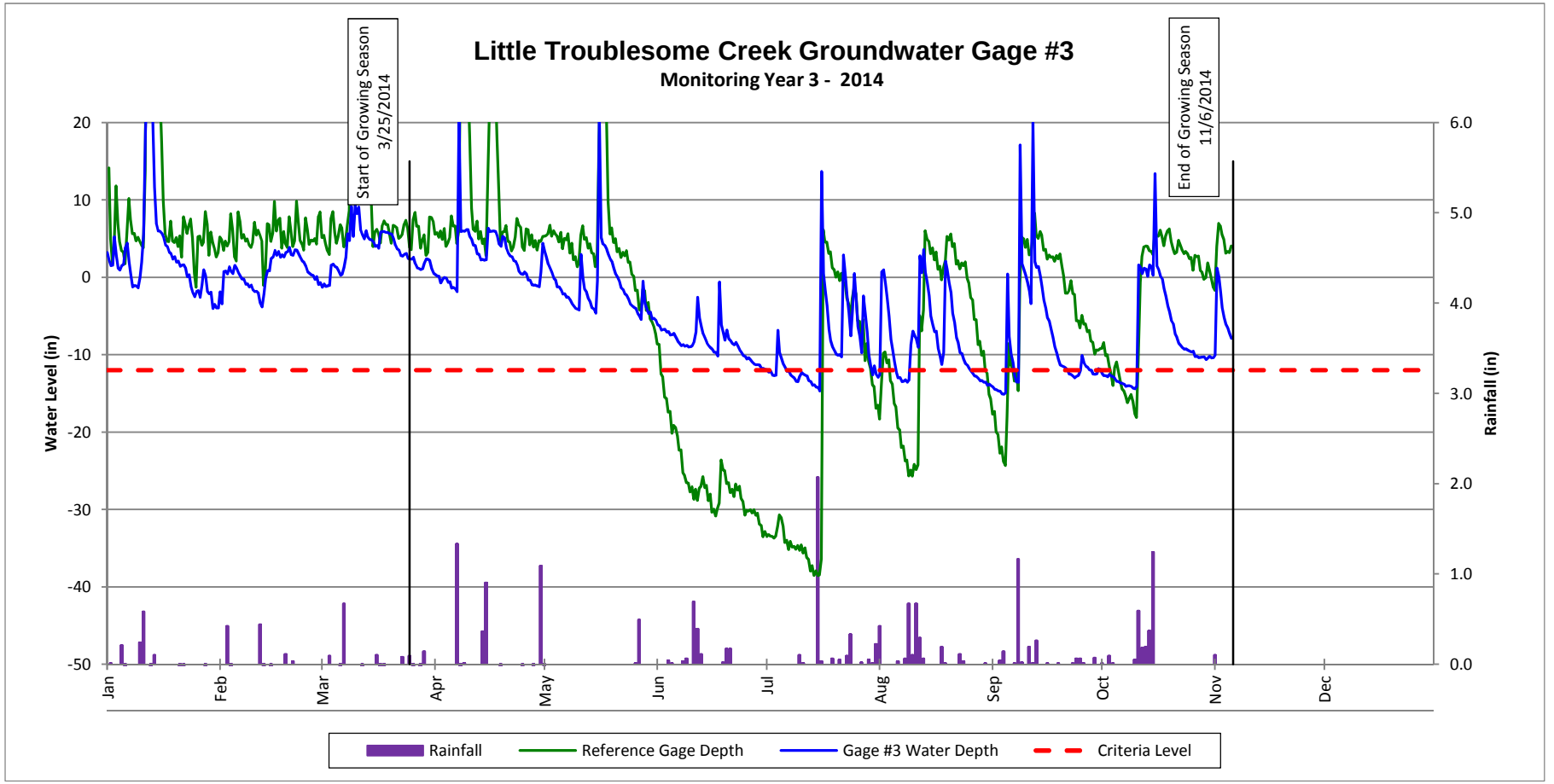
Groundwater Gage Plots
Little Troublesome Creek Wetland (EEP Project No. 94640)
Wetland RW1
Monitoring Year 3 - 2014



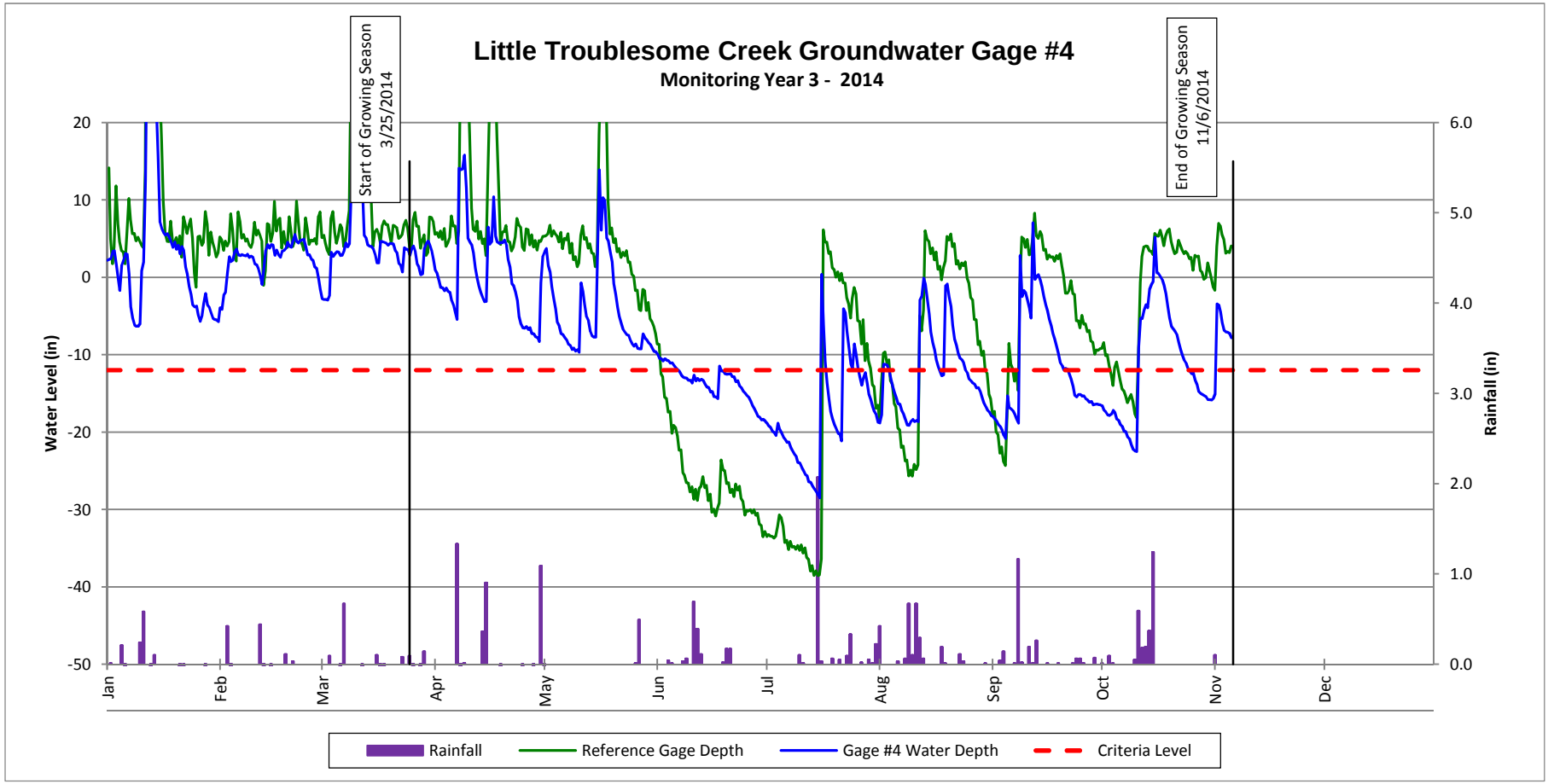
Groundwater Gage Plots
Little Troublesome Creek Wetland (EEP Project No. 94640)
Wetland RW1
Monitoring Year 3 - 2014



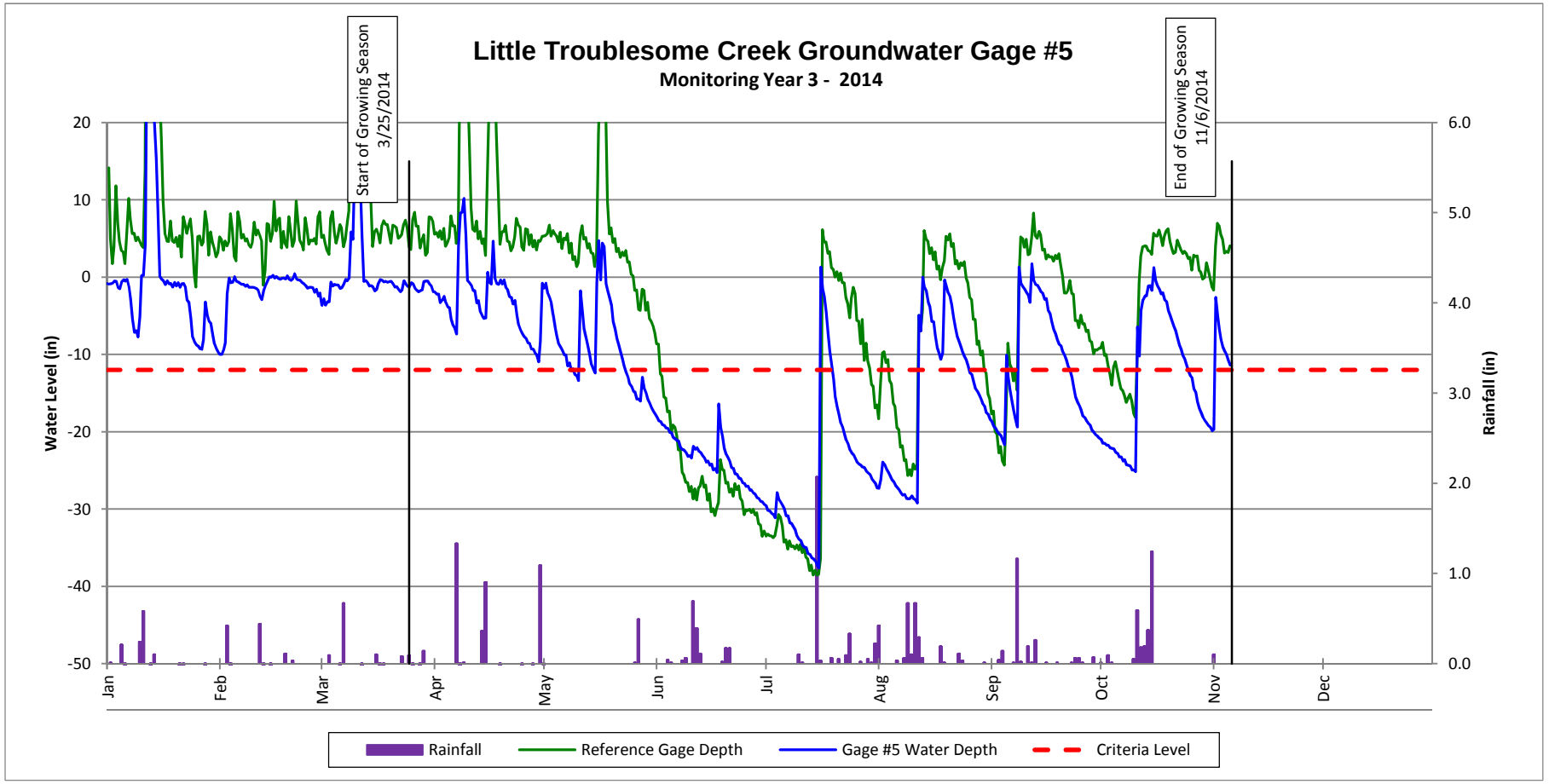
Groundwater Gage Plots
Little Troublesome Creek Wetland (EEP Project No. 94640)
Wetland RW1
Monitoring Year 3 - 2014



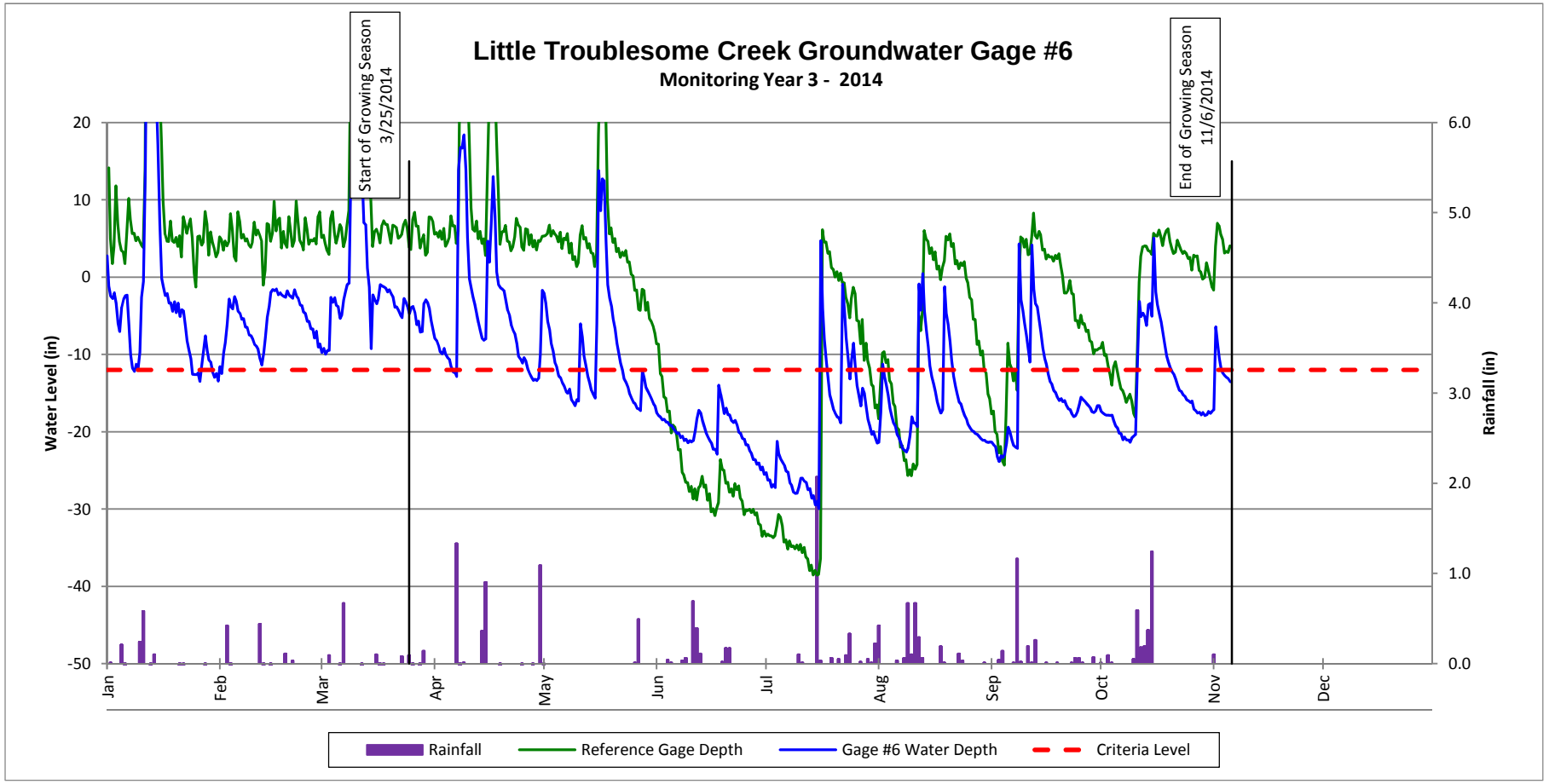
Groundwater Gage Plots
Little Troublesome Creek Wetland (EEP Project No. 94640)
Wetland RW1
Monitoring Year 3 - 2014



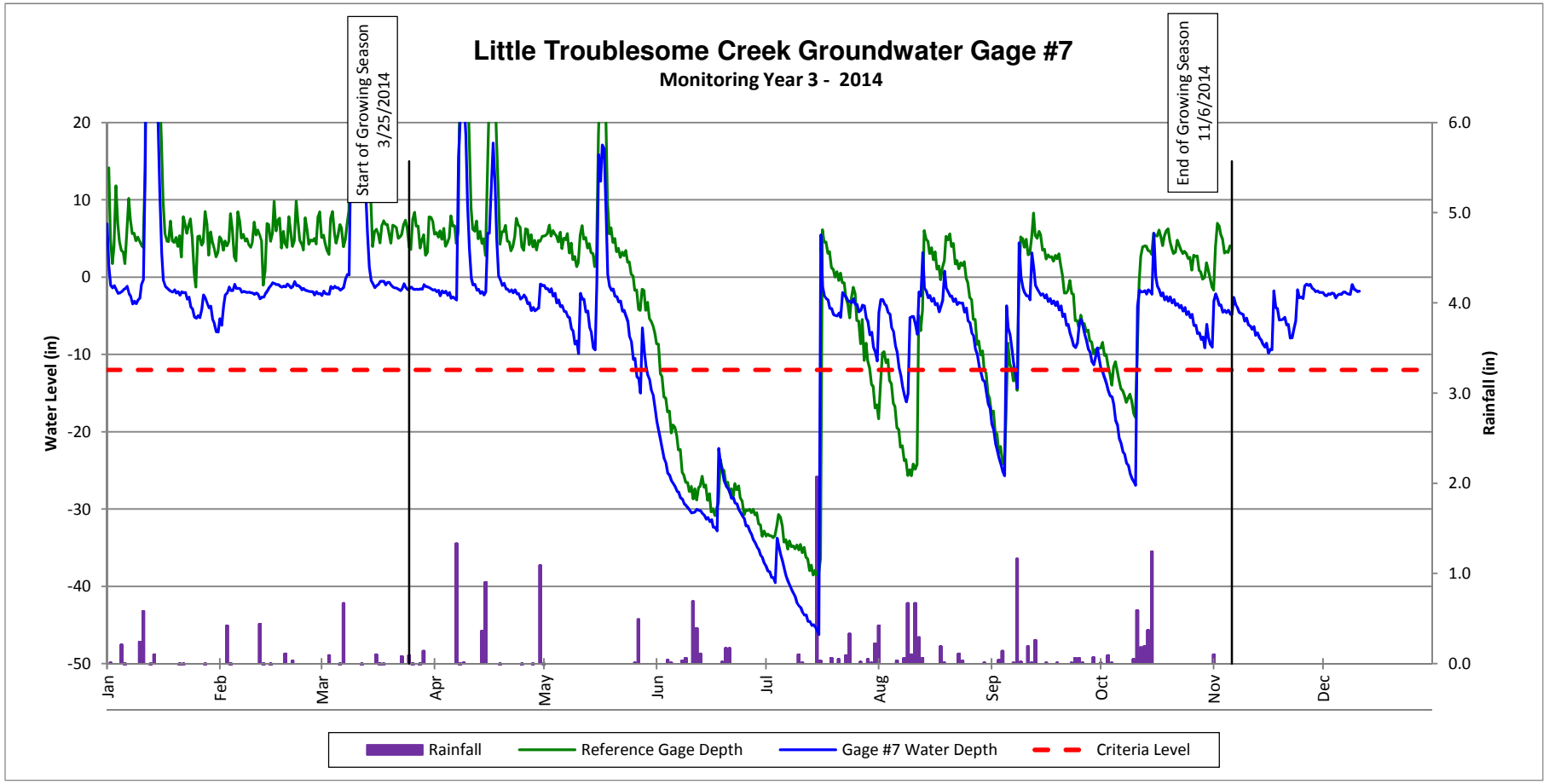
Groundwater Gage Plots
Little Troublesome Creek Wetland (EEP Project No. 94640)
Wetland RW1
Monitoring Year 3 - 2014



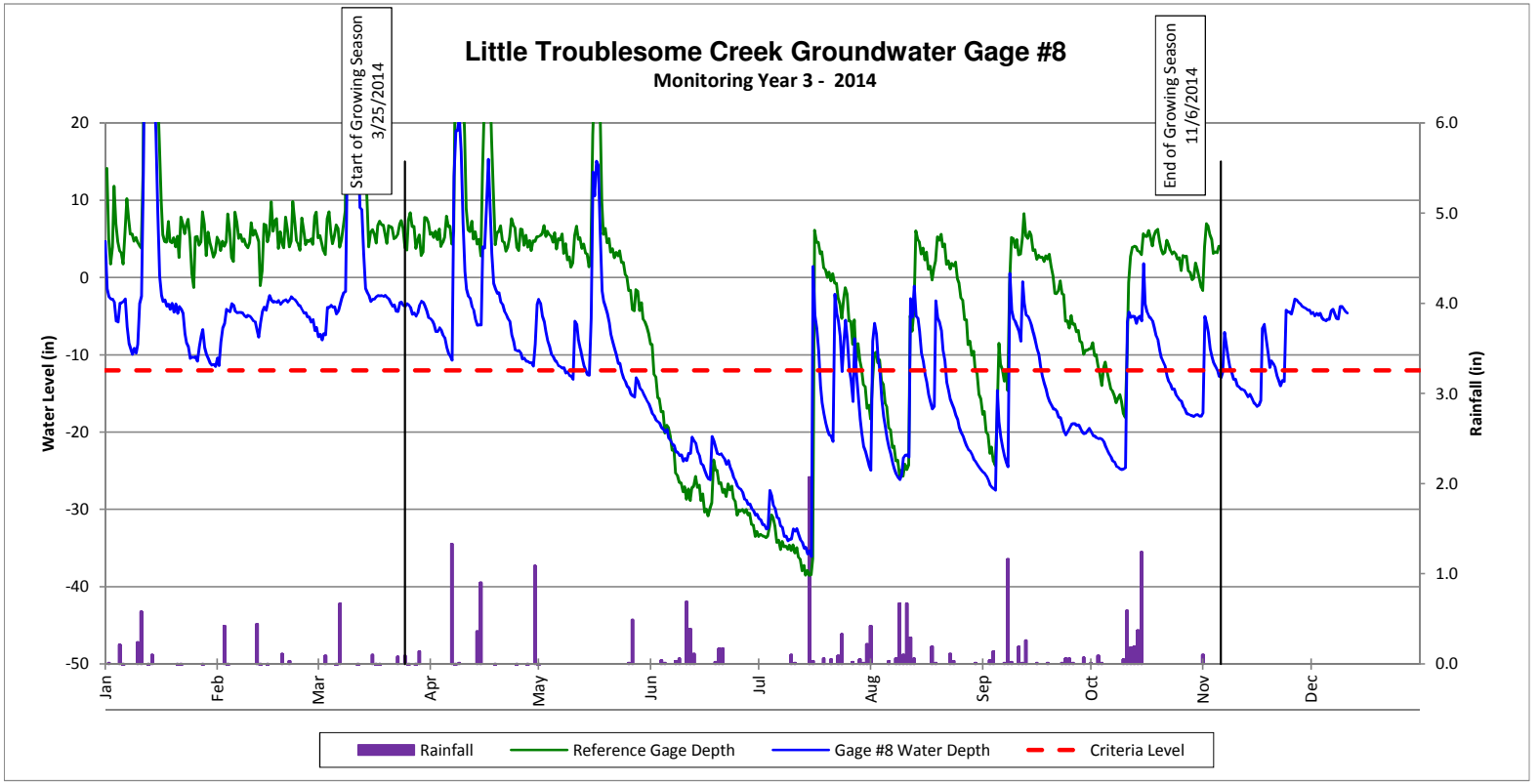
Groundwater Gage Plots
Little Troublesome Creek Wetland (EEP Project No. 94640)
Wetland RW1
Monitoring Year 3 - 2014



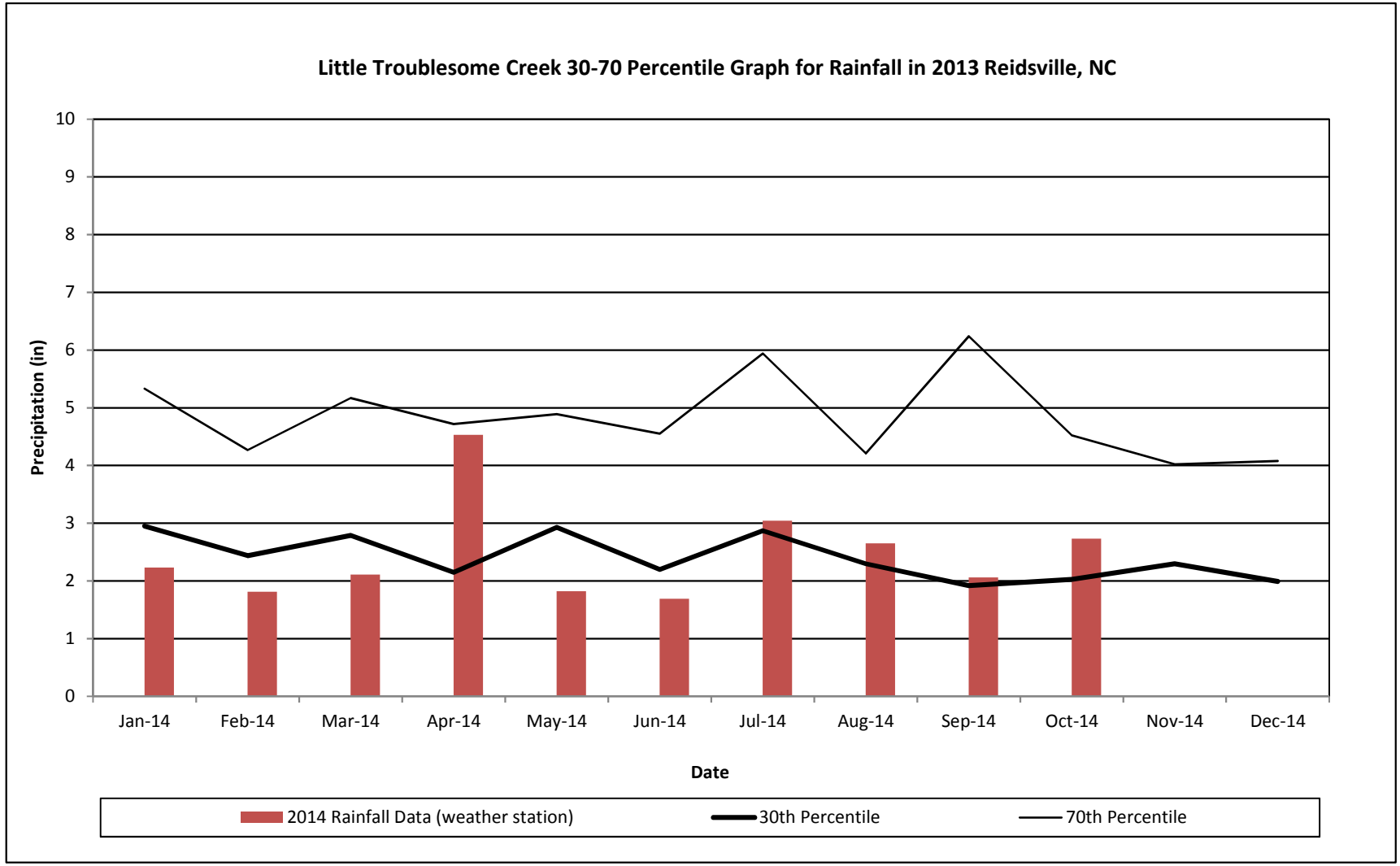
Groundwater Gage Plots
Little Troublesome Creek Wetland (EEP Project No. 94640)
Wetland RW1
Monitoring Year 3 - 2014



Groundwater Gage Plots
Little Troublesome Creek Wetland (EEP Project No. 94640)
Wetland RW1
Monitoring Year 3 - 2014



Monthly Rainfall Data
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)
Monitoring Year 3



[1] 2014 monthly rainfall collected by Weather Underground Station KNCBROWN2 (Reidsville, NC).

[2] 30th and 70th percentile rainfall data collected from weather station NC7202, in Reidsville, NC (USDA, 2002).