Little Troublesome Site
Stream Restoration Monitoring Report
EEP Project # 749
Monitoring Year 02

Submitted to:

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

Construction Completed: December 2009
Data Collection: 2011
Submitted: December 2011

Design and Monitoring Firm

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Project No: 12071067C_LT11

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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The Little Troublesome Stream and Wetland Restoration Site, completed in December 2009, restored a total of 2,188 linear feet of stream in the Upper Cape Fear River Basin. In addition, there are approximately 4.5 acres of wetland preservation, 1.9 acres of wetland enhancement, and 2,754 linear feet of stream preservation within the site. The project is located in the USGS Hydrologic Unit 03030002-01-0030 of the Cape Fear River Basin. This HU is within the EEP's Upper Cape Fear Basin Local Watershed Plan and is also listed as a Targeted Local Watershed (TLW) in EEP's *Cape Fear River Basin Priorities Plan* (2009). The project goals and objectives are listed below.

Project Goals

- Restore a stable channel morphology to the project stream that is capable of moving the flows and sediment provided by its watershed.
- Improve water quality for an NCDWQ stream, classified as a Class C and Nutrient Sensitive Waters by reducing bank erosion and bed degradation.
- Enhance aquatic and terrestrial habitat.
- Enhance and preserve existing wetlands and forested buffers.

Project Objectives

- Restore 2,188 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a gravel transport system
- Restore a natural riparian buffer.
- Restore the hyporheic zone in the project streams and re-establish the natural stream features.
- Plug ditches to increase groundwater input to existing wetlands.
- Plant native trees and shrubs throughout the site.

The vegetation monitoring success criterion for the planted stream riparian zone is a density of 320 stems/acre after the third year of monitoring and an allowance for 10% mortality in the fourth and fifth years with a final density of 260 stems/acre. The second-year vegetation monitoring was based on the Level 2 CVS-EEP vegetation monitoring protocol. The site's average density for this monitoring period was 642 planted stems/acre, including live stakes, and 612 planted stems/acre, excluding live stakes. All of the eight plots had greater than 320 planted stems/acre. There are many volunteer woody stems throughout the site. Including volunteers, the monitoring plots averaged 3,065 total stems/acre. The 2011 monitoring found that the slope from the left bank of the tributary to the terrace (the north-facing slope) had sparse vegetation coverage with some bare areas. There has been high live stake survival along the tributary and variable survival along Little Troublesome Creek. Small sporadic areas of multiflora rose are present throughout the north side of Little Troublesome.

Second-year monitoring found Little Troublesome Creek to be stable, with only minor changes from the as-built and Year One conditions. The tributary has had areas of localized bed degradation and bank erosion since construction. These areas do not appear to be actively destabilizing and the plentiful streamside vegetation should continue to help stabilize these parts of the tributary. There are isolated areas of erosion on the south slope leading down to the tributary and on outer bends of Little Troublesome. These areas are not presently causing destabilization of the project, but should continue to be monitored. The longitudinal and cross-sectional data also reflect overall stability in the project streams. As a part of the stream success criterion, the stream must experience at least two bankfull events, each in separate monitoring years. The site has experienced multiple bankfull events since construction.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and

figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on the EEPs website. All raw data supporting the tables and figures in the appendices are available from EEP upon request.

2.0 METHODOLOGY

The survey data were collected with a total station instrument the week of July 18, 2011.

The stationing for the longitudinal profile is based on the thalweg stationing and has been adjusted to match grade control structures from previous longitudinal profiles.

Some of the cross-section surveys on Little Troublesome Creek showed slightly lower top of bank measurements than the baseline measurements. In the cases where the top of bank measurement was only nominally lower than the bankfull elevation, the bankfull width was limited to just include the distance between the tops of left and right banks. This ensures that the bankfull width measurement is representative of the cross-section, and not abnormally large because of insignificant changes in the surveyed cross-section.

The CVS-EEP protocol, Level 2 (http://cvs.bio.unc.edu/methods.htm) was used to collect vegetation data from the site. The vegetation monitoring was completed during the week of August 22, 2011.

3.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm)

NCEEP. 2004. Troublesome and Little Troublesome Local Watershed Plan. (http://www.nceep.net/services/lwps/Troublesome_Creek/trouble-summ.pdf)

NCEEP. 2009. Cape Fear River Basin Restoration Priorities. (http://www.nceep.net/services/lwps/cape_fear/RBRP%20Cape%20Fear%202008.pdf)

USACE. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

Appendix A

Project Vicinity Map and Background Tables

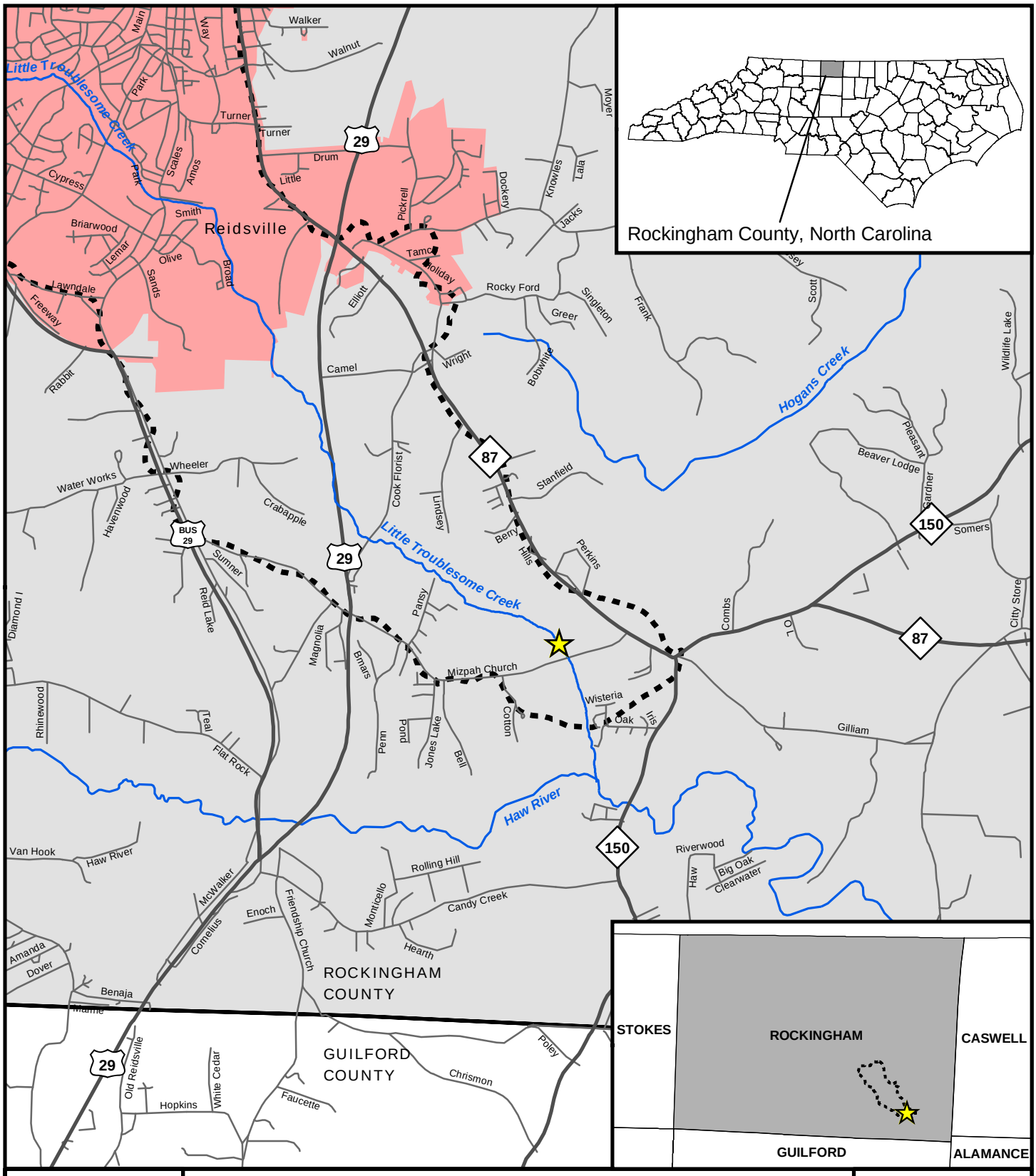

Figure 1. Vicinity Map

- Project Site Location
- Major Streams and Rivers
- Major Roads
- Other Roads
- Local Watershed Plan Boundary
- Cities and Towns
- County Boundaries

1:63,360
1 inch = 1 miles

0 0.5 1 Miles

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Ecosystem Enhancement PROGRAM

Conservation Easement Boundary
Stream Preservation
Stream Restoration
Other Streams
Other Drainage Features
Previous Stream Alignment
FEMA 100 yr Floodplain Boundary
Riparian Wetland Preservation
Riparian Wetland Enhancement

Wetland #1
Preservation Wetland
Wetland #2
LTC
UT 1
UT 2
Mizpah Church Road

Figure 2. Site Map
Little Troublesome Creek, Rockingham County, EEP Project 749

1:2,400

1 inch = 200 feet

200 100 0 200 Feet

N W E S

Source: NC Statewide Orthoimagery, 2010

12/19/2011

Ecosystem Enhancement PROGRAM

KCI ASSOCIATES OF NC

Table 1. Project Components and Mitigation Credits
Little Troublesome / Project No. 749

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	2188	551		1.86					

Project Components

Project Component	Stationing/Location	Existing Footage/ Acreage	Approach	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
Little Troublesome Creek	10+00 - 11+75	175	P3	R	175	1:1
Little Troublesome Creek	11+75 - 21+95	975	P2	R	1020	1:1
Little Troublesome Creek	21+95 - 23+75	179	P3	R	180	1:1
UT1	50+00 - 58+13	813	P3	R	813	1:1
UT2	see Fig 2.	2754	-	RE	2754	5:1
Enhancement Wetland #1	see Fig 2.	1.17	-	RE	1.17	2:1
Enhancement Wetland #2	see Fig 2.	0.74	-	RE	0.74	2:1
Preservation Wetland	see Fig 2.	4.5	-	RE	4.5	5:1

Component Summation

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2188					
Enhancement		1.91				
Enhancement I						
Enhancement II						
Creation						
Preservation	2754	4.5				
High Quality Preservation						

Table 2. Project Activity & Reporting History Little Troublesome / Project No. 749		
Elapsed Time Since Grading and Planting Complete: 2 yr 0 months **Number of Reporting Years: 2**		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Environmental Resource Technical Report	Sep 2006	Sep 2006
Restoration Plan	May 2007	June 2007
Final Design - Construction Plans		Feb 2007
Construction		Dec 2009
Temporary S&E mix applied		Oct 2009
Permanent seed mix applied		Dec 2009
Planting		Dec 2009
Baseline Monitoring	Feb 2010	May 2010
Year 1 Monitoring	Sep 2010	Dec 2010
Year 2 Monitoring	Jul 2011	Dec 2011

Table 3. Project Contacts Table Little Troublesome / Project No. 749	
Designer	KCI Associates of North Carolina 4601 Six Forks Road, Suite 220 Raleigh, NC 27609
Primary Project Design POC	April Helms (919) 783-9214
Construction Contractor	Angler Environmental 12811 Randolph Ridge Lane Manassas, VA 20109
Construction Contractor POC	Andrew Griffey (703) 393-4844
Planting Contractor	HARP, Inc. 301 McCullough Drive, 4th Floor Charlotte, NC 28262
Planting Contractor POC	Alan Peoples (704) 841-2841
Seeding Contractor	Angler Environmental Manassas, VA 20109
Seeding Contractor POC	Andrew Griffey (703) 393-4844
Seed Mix Sources	MD Seed and Environmental Services Gaithersburg, MD 20879
Monitoring Performers	KCI Associates of North Carolina 4601 Six Forks Road, Suite 220 Raleigh, NC 27609
Monitoring POC	Adam Spiller (919) 278-2514

Table 4. Project Attribute Table Little Troublesome / Project No. 749		
Project County	Rockingham County	
Physiographic Region	Piedmont	
Ecoregion	Northern Inner Piedmont	
River Basin	Cape Fear	
USGS HUC	03030002010030	
NCDWQ Sub-Basin	03-06-01	
Within Extent of EEP Watershed Plan	Yes - Upper Cape Fear Basin LWP	
WRC Class	Warm	
% of Project Easement Demarcated	100%	
Beaver Activity Observed During Design Phase	No	
Restoration Component Attributes		
	LTC	**UT1**
Drainage Area (sq.mi.)	12.09	0.1
Stream Order	Third	First
Restored Length (feet)	1,375	813
Perennial or Intermittent	Perennial	Perennial
Watershed Type	Suburban	Suburban
Watershed LULC Distribution		
Forest/Wetland	49%	
Pasture/Managed Herbaceous	21%	
Developed	30%	
Watershed Impervious Cover	21%	
NCDWQ AU/Index Number	16-7	
NCDWQ Classification	C; NSW	
303d Listed	Yes	
Upstream of 303d Listed Segment	Yes	
Reasons for 303d Listing or Stressor	Aquatic life	
Total Acreage of Easement	30.3	
Total Vegetated Acreage within Easement	30.0	
Total Planted Acreage as Part of Restoration	12.2	
Rosgen Classification of Pre-Existing	E4	G4c
Rosgen Classification of As-Built	E4/C4	B4c
Valley Type		
Valley Slope	0.002	0.021
Valley Side Slope Range		
Valley Toe Slope Range		
Cowardin Classification		
Trout Waters Designation	No	
Species of Concern, Endangered, Etc.	Carolina ladle crayfish (*Cambarus davidi*)	
Dominant Soil Series and Characteristics		
Series	Chewacla	
Depth	Deep	
Clay%		
K		
T		

Appendix B

Visual Assessment Data

LEGEND

- EASEMENT BOUNDARY
- AS-BUILT STATIONED
- CENTERLINE AND TOP OF BANK
- PHOTO POINT
- CROSS-SECTION
- OLD STREAM CHANNEL
- RIFFLE GRADE CONTROL
- LOG SILL
- ROCK CROSS VANE
- BED STABILIZATION

PROJECT CONDITION

- STREAM BED DEGRADATION
- BANK EROSION
- UNDERCUT BANK
- MASS WASTING OF BANK
- VEG PLOT ACHIEVING DENSITY CRITERION
- VEG PLOT BELOW DENSITY CRITERION

PROJECT CONDITION DETAILS

VEG PLOT TOTAL / PLANTED STEM DENSITY 2306/607

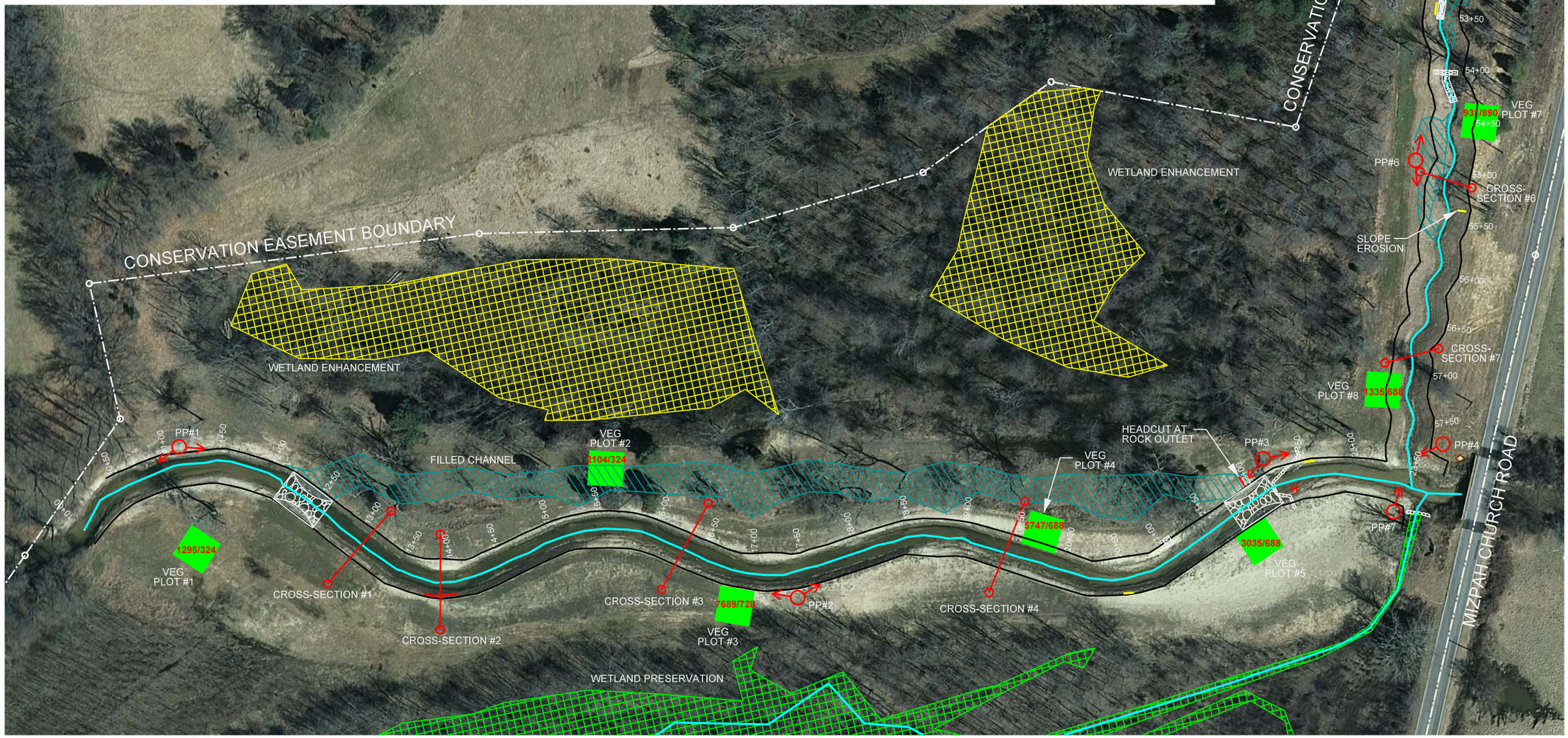
STRUCTURE NOT PROVIDING INTENDED POOL HABITAT ..... H

IMAGE SOURCE: NC 2010 STATEWIDE ORTHOIMAGERY

NC GRID NAD 83

–50 –25 0 50 100

GRAPHIC SCALE



STA	DESCRIPTION	DATE	APPROVED
	REVISIONS		

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE TROUBLESOME CREEK PROJECT #749 - MONITORING YEAR 02

ROCKINGHAM COUNTY, NORTH CAROLINA

LITTLE TROUBLESOME CREEK AND UT1

DATE: NOV 2011

SCALE: 1" = 100'

CURRENT CONDITION PLAN VIEW

SHEET 1 OF 1

Table 5. Visual Stream Morphology Stability Assessment
Project Number and Name: 749 - Little Troublesome
Assessed Length 1,375 **Reach - Little Troublesome**

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	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	7	7			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	6	7			86%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	7	7			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	7	7			100%			
		2. Thalweg centering at downstream of meander (Glide)	7	7			100%			
2. Bank	**1. Scoured/Eroding**	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			2	40	99%	0	0	99%
				Totals	2	40	99%	0	0	99%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	3	3			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	3	3			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%. (See guidance for this table in EEP monitoring guidance document)	1	1			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	1			0%			

Table 5. Visual Stream Morphology Stability Assessment
Project Number and Name: 749 - Little Troublesome
Assessed Length 813 **Reach - UT1**

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	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			3	37	95%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	11	13			85%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	14	16			88%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	7	14			50%			
	4.**Thalweg Position**[+]	1. Thalweg centering at upstream of meander bend (Run)					N/A			
		2. Thalweg centering at downstream of meander (Glide)					N/A			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			8	80	95%	1	12	96%
	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.			1	10	99%	0	0	99%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	9	90	94%	1	12	95%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	2	2			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	0	0			N/A			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	0			N/A			

[+]Due to this reach's small size and the scale of the pattern, the exact position of the thalweg in relation to the meanders and morphological features is inconsistent and not practical to evaluate .

Table 6. Vegetation Condition Assessment
Project Number and Name: 749 - Little Troublesome

Planted Acreage 12.2 **Easement Acreage 30.3**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acre	Pattern and Color*	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acre	Pattern and Color+	2	0.30	2.5%
			Total	2	0.30	2.5%
3. 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 acre	Pattern and Color	0	0.00	0.0%
			Cumulative Total	2	0.30	2.5%
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1,000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

*These areas were not depicted on the CCPV. Generally, the left slope of UT1 has many small scattered bare areas that are below the mapping threshold, but are significant when combined.

+These areas were not depicted on the CCPV. Generally, the left and right slopes of UT1 have many scattered areas of noticable low stem densities that are below the mapping threshold, but are significant when combined.

Stream Station Photos

Photo Point 1u: View looking upstream near Station 11+10. 2/23/10 – Baseline

Photo Point 1u: View looking upstream near Station 11+10. 11/18/2011 – MY-02

Photo Point 1d: View looking downstream near Station 11+10. 2/23/10 – Baseline

Photo Point 1d: View looking downstream near Station 11+10. 11/18/2011 – MY-02

Photo Point 2u: View looking upstream taken near Station 17+40. 2/23/10 – Baseline

Photo Point 2u: View looking upstream taken near Station 17+40. 11/18/2011 – MY-02

Photo Point 2d: View looking downstream taken near Station 17+40. 2/23/10 – Baseline

Photo Point 2d: View looking downstream taken near Station 17+40. 11/18/2011 – MY-02

Photo Point 3u: View looking upstream near Station 22+25. 2/23/10 – Baseline

Photo Point 3u: View looking upstream near Station 22+25. 11/18/2011 – MY-02

Photo Point 3d: View looking downstream near Station 22+25. 2/23/10 – Baseline

Photo Point 3d: View looking downstream near Station 22+25. 11/18/2011 – MY-02

Photo Point 4: View looking upstream near Station 24+00. 2/23/10 – Baseline

Photo Point 4: View looking upstream near Station 24+00. 11/18/2011 – MY-02

Photo Point 5: View looking downstream near Station 50+00. 2/23/10 – Baseline

Photo Point 5: View looking downstream near Station 50+00. 11/18/2011 – MY-02

Photo Point 6u: View looking upstream near Station 54+90. 2/23/10 – Baseline

Photo Point 6u: View looking upstream near Station 54+90. 11/18/2011 – MY-02

Photo Point 6d: View looking downstream near Station 54+90. 2/23/10 – Baseline

Photo Point 6d: View looking downstream near Station 54+90. 11/18/2011 – MY-02

Photo Point 7: View looking upstream at the tributary confluence. 2/23/10 – Baseline

Photo Point 7: View looking upstream at the tributary confluence. 11/18/2011 – MY-02

Vegetation Monitoring Plot Photos

Plot 1 Photo: 8/22/11 – MY02

Plot 2 Photo: 8/22/11 – MY02

Plot 3 Photo: 8/22/11 – MY02

Plot 4 Photo: 8/22/11 – MY02

Plot 5 Photo: 8/22/11 – MY02

Plot 6 Photo: 8/22/11 – MY02

Plot 7 Photo: 8/22/11 – MY02

Plot 8 Photo: 8/22/11 – MY02

Appendix C

Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Little Troublesome / Project No. 749	
Vegetation Plot ID	**Vegetation Survival Threshold Met?**
1	Yes
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes
8	Yes

Table 8. CVS Vegetation Plot Metadata Little Troublesome / Project No. 749	
Report Prepared By	April Helms
Date Prepared	12/5/2011 9:47
database name	KCI-2011-LT.mdb
database location	M:\2007\12071067_2007 EEP OPEN END\Veg_database
computer name	12-CV76KF1
file size	55836672
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	749
project Name	Little Troublesome Creek
Description	Stream and Wetland Restoration Site
River Basin	Cape Fear
length(ft)	2200
stream-to-edge width (ft)	60
area (sq m)	24523.92
Required Plots (calculated)	8
Sampled Plots	8

Table 9. CVS Stem Count Total and Planted by Plot and Species																											Annual Means								
			E749-A-0001			E749-A-0002			E749-A-0003			E749-A-0004			E749-A-0005			E749-A-0006			E749-A-0007			E749-A-0008			MY2 (2011)			MY1 (2010)			MY0 (2010)		
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	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree																													13			
Acer rubrum	red maple	Tree						7			1			1			3			1											13			33			
Aronia arbutifolia	Red Chokeberry	Shrub										1	1	1										1	1	1	2	2	2	2	2	2			
Betula nigra	river birch	Tree	3	3	3	1	1	1				1	1	20	8	8	13	3	3	3	4	4	4	7	7	11	27	27	55	31	31	60	35	35	35
Celtis laevigata	sugarberry	Shrub Tree						1	2	2	2			2	3	3	3						1				5	5	9	5	5	17			
Cornus amomum	silky dogwood	Shrub											1	1														1	1	1	3	3			
Diospyros virginiana	common persimmon	Tree			11													1	1	32	2	2	2			7	3	3	52	2	2	36			
Fraxinus pennsylvanica	green ash	Tree			7			15			110			80			34								1			247			190			
Ilex sp.	holly	Shrub Tree																						1	1	1	1	1	1	1	1	1			
Juglans nigra	black walnut	Tree												1															1			1			
Liquidambar styraciflua	sweetgum	Tree			1			7						2						12						1			23			16			
Liriodendron tulipifera	tuliptree	Tree						1						1															2			1			
Pinus taeda	loblolly pine	Tree																		1									1			1			
Platanus occidentalis	American sycamore	Tree	1	1	1	1	1	6	6	6	8	3	3	11	2	2	2	4	4	4	10	10	10	1	1	2	28	28	44	28	28	51	29	29	29
Quercus sp.	oak	Shrub Tree	1	1	1																1	1	1				2	2	2	2	2	2	22	22	22
Quercus michauxii	swamp chestnut oak	Tree	3	3	3	3	3	3	4	4	4	8	8	9	2	2	2	4	4	4	4	4	4	2	2	2	30	30	31	32	32	32			
Quercus palustris	pin oak	Tree							3	3	3	3	3	3										3	3	3	9	9	9	9	9	9			
Quercus phellos	willow oak	Tree				3	3	5	2	2	3	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	11	11	14	12	12	12	4	4	4
Rhus sp.	sumac																															1			
Salix sp.	willow	Shrub Tree																																6	6
Salix sericea	silky willow	Shrub Tree											5	5														5	5		5	5			
Sambucus canadensis	Common Elderberry	Shrub Tree																																1	1
Ulmus sp.	elm	Tree																														101			
Ulmus americana	American elm	Tree			5			6			58			4			16								2			91						
Unknown		unknown							1	1	1													1	1	1	2	2	2	6	6	6	59	59	59
Viburnum nudum	possumhaw	Shrub Tree													1	1	1										1	1	1	1	1	1			
	Stem count		8	8	32	8	8	52	18	18	190	17	23	142	17	17	75	14	14	59	22	22	23	17	17	33	121	127	606	131	137	592	150	159	159
	size (ares)		1			1			1			1			1			1			1			1			8			8			8		
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.20			0.20			0.20		
	Species count		4	4	8	4	4	10	6	6	9	6	8	15	6	6	9	5	5	8	6	6	7	8	8	12	12	14	21	12	14	23	6	8	8
	Stems per ACRE		324	324	1295	324	324	2104	728	728	7689	688	931	5747	688	688	3035	567	567	2388	890	890	931	688	688	1335	612	642	3065	663	693	2995	759	804	804

Appendix D

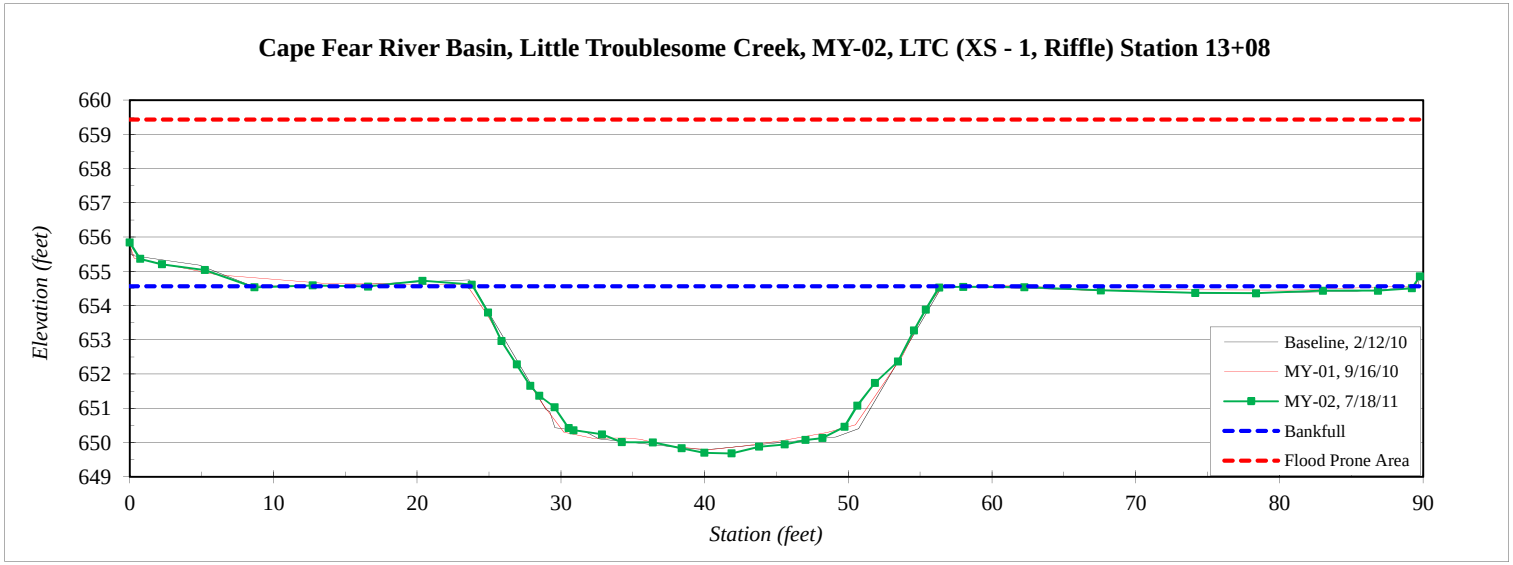
Stream Survey Data

River Basin:	Cape Fear
Watershed:	Little Troublesome Creek, MY-02
XS ID	LTC (XS - 1, Riffle) Station 13+08
Drainage Area (sq mi):	12.09
Date:	7/18/2011
Field Crew:	A. French, J. Anders

Station	Elevation
0.0	655.84
0.7	655.36
2.2	655.21
5.2	655.04
8.7	654.53
12.7	654.59
16.6	654.56
20.4	654.73
23.8	654.61
24.9	653.80
25.9	652.97
26.9	652.28
27.9	651.66
28.5	651.37
29.6	651.04
30.6	650.42
30.9	650.36
32.9	650.24
34.2	650.01
36.4	650.01
38.4	649.83
40.0	649.70
41.9	649.68
43.8	649.88
45.6	649.95
47.0	650.08
48.2	650.13
49.7	650.46
50.6	651.07
51.8	651.74
53.5	652.37
54.6	653.27
55.4	653.88
56.3	654.53

SUMMARY DATA	
Bankfull Elevation:	654.6
Bankfull Cross-Sectional Area:	117.4
Bankfull Width:	33.2
Flood Prone Area Elevation:	659.4
Flood Prone Width:	>200
Max Depth at Bankfull:	4.9
Mean Depth at Bankfull:	3.5
W / D Ratio:	9.4
Entrenchment Ratio:	>6.0
Bank Height Ratio:	1.0

Stream Type	E4/C4



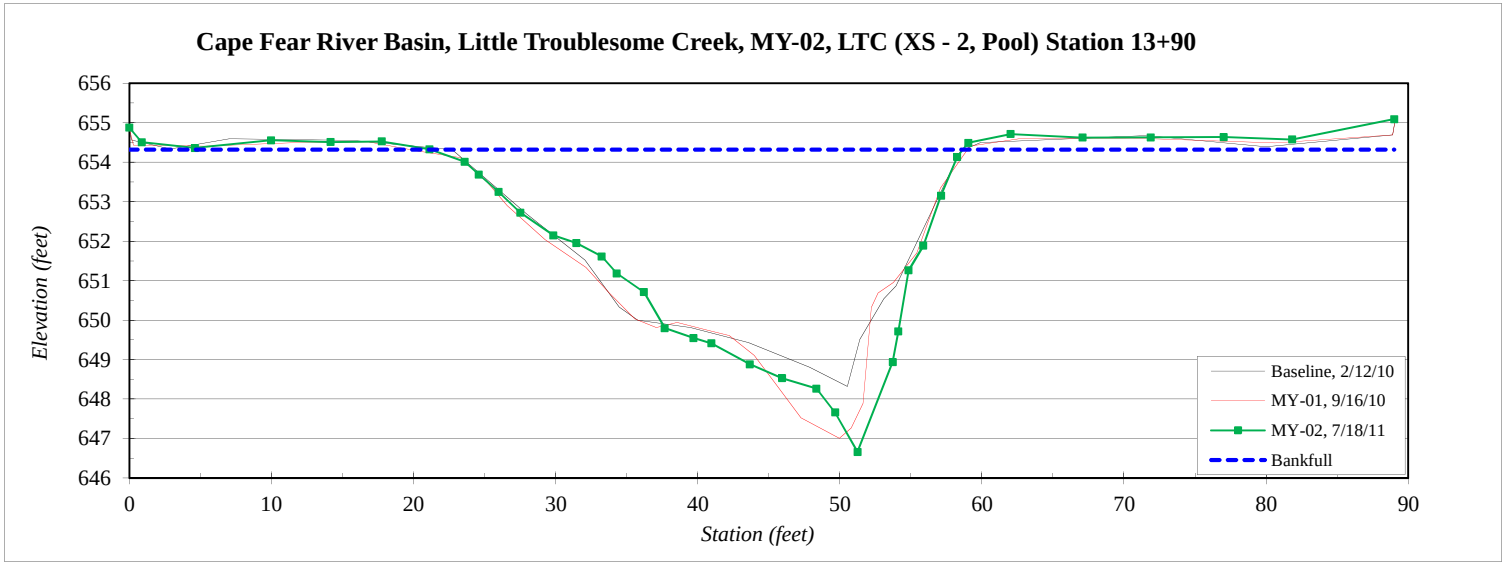
*Other shots not included due to space

River Basin:	Cape Fear
Watershed:	Little Troublesome Creek, MY-02
XS ID	LTC (XS - 2, Pool) Station 13+90
Drainage Area (sq mi):	12.09
Date:	7/18/2011
Field Crew:	A. French, J. Anders

Station	Elevation
0.0	654.88
0.9	654.50
4.6	654.36
10.0	654.55
14.2	654.51
17.8	654.53
21.1	654.33
23.6	654.01
24.6	653.69
26.0	653.25
27.5	652.72
29.8	652.15
31.5	651.95
33.2	651.61
34.3	651.18
36.2	650.71
37.7	649.80
39.7	649.54
41.0	649.41
43.7	648.88
45.9	648.53
48.4	648.27
49.7	647.66
51.2	646.66
53.7	648.94
54.1	649.72
54.8	651.26
55.9	651.89
57.1	653.15
58.3	654.13
59.0	654.49
62.0	654.71
67.1	654.63
71.9	654.63

SUMMARY DATA	
Bankfull Elevation:	654.3
Bankfull Cross-Sectional Area:	135.0
Bankfull Width:	37.5
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	7.7
Mean Depth at Bankfull:	3.6
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E4/C4



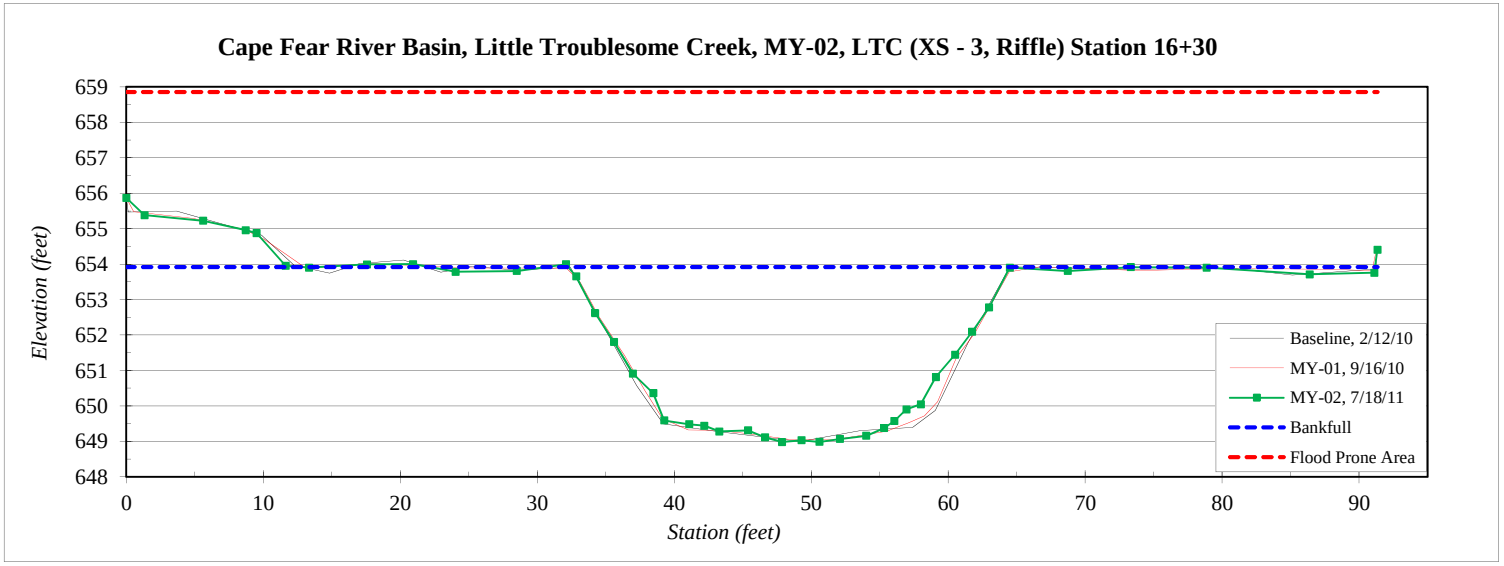
*Other shots not included due to space

River Basin:	Cape Fear
Watershed:	Little Troublesome Creek, MY-02
XS ID	LTC (XS - 3, Riffle) Station 16+30
Drainage Area (sq mi):	12.09
Date:	7/18/2011
Field Crew:	A. French, J. Anders

Station	Elevation
0.0	655.87
1.3	655.38
5.6	655.22
8.7	654.96
9.5	654.87
11.6	653.95
13.3	653.90
17.6	653.99
20.9	654.00
24.0	653.78
28.5	653.81
32.1	653.99
32.8	653.65
34.2	652.62
35.6	651.80
37.0	650.91
38.5	650.36
39.3	649.59
41.1	649.48
42.2	649.44
43.3	649.28
45.4	649.31
46.6	649.11
47.9	648.98
49.3	649.03
50.6	648.99
52.1	649.07
54.0	649.16
55.3	649.37
56.1	649.58
56.9	649.90
58.0	650.05
59.1	650.81
60.5	651.45

SUMMARY DATA	
Bankfull Elevation:	653.9
Bankfull Cross-Sectional Area:	114.8
Bankfull Width:	32.2
Flood Prone Area Elevation:	658.9
Flood Prone Width:	>200
Max Depth at Bankfull:	4.9
Mean Depth at Bankfull:	3.6
W / D Ratio:	9.0
Entrenchment Ratio:	>6.0
Bank Height Ratio:	1.0

Stream Type	E4/C4



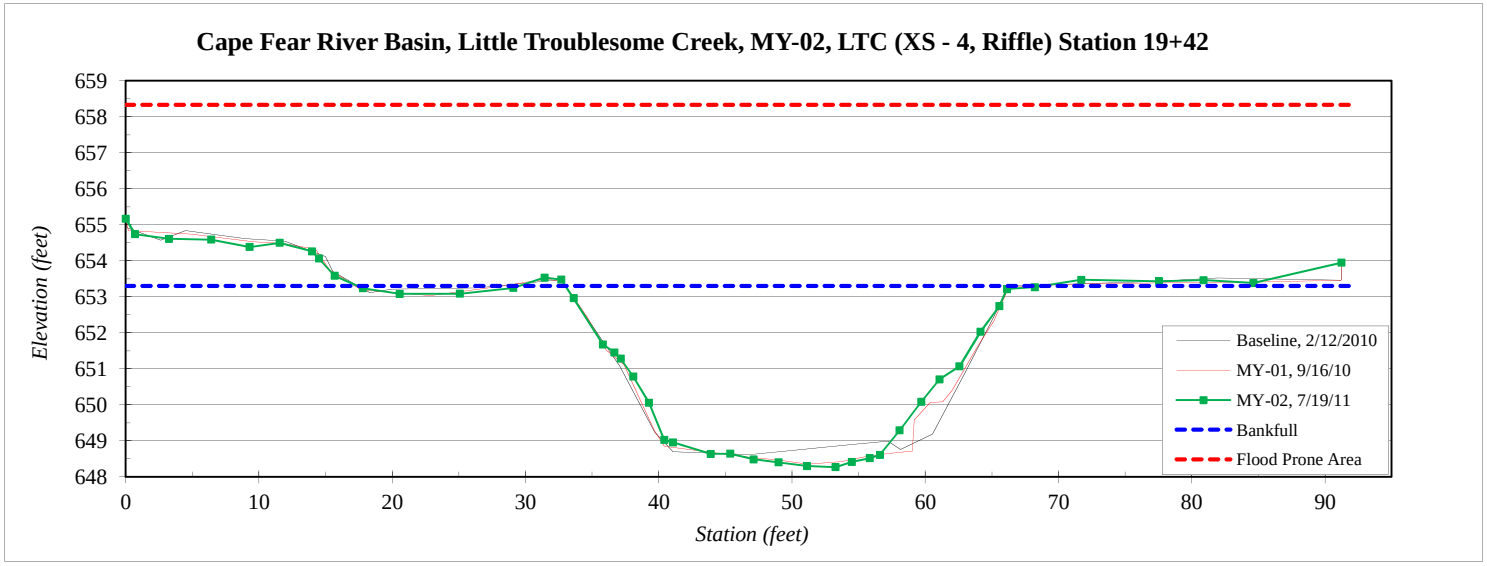
*Other shots not included due to space

River Basin:	Cape Fear
Watershed:	Little Troublesome Creek, MY-02
XS ID	LTC (XS - 4, Riffle) Station 19+42
Drainage Area (sq mi):	12.09
Date:	7/19/2011
Field Crew:	A. French, J. Anders

Station	Elevation
0.0	655.17
0.7	654.74
3.3	654.61
6.4	654.59
9.3	654.38
11.6	654.50
14.0	654.26
14.5	654.06
15.7	653.58
17.8	653.24
20.6	653.08
25.1	653.09
29.1	653.25
31.4	653.54
32.7	653.48
33.6	652.96
35.8	651.68
36.7	651.46
37.1	651.28
38.1	650.79
39.3	650.05
40.4	649.03
41.1	648.96
43.9	648.64
45.4	648.64
47.1	648.48
49.0	648.40
51.1	648.30
53.3	648.27
54.5	648.42
55.8	648.52
56.6	648.61
58.1	649.29
59.7	650.08

SUMMARY DATA	
Bankfull Elevation:	653.3
Bankfull Cross-Sectional Area:	115.9
Bankfull Width:	33.1
Flood Prone Area Elevation:	658.3
Flood Prone Width:	>200
Max Depth at Bankfull:	5.0
Mean Depth at Bankfull:	3.5
W / D Ratio:	9.5
Entrenchment Ratio:	>6.0
Bank Height Ratio:	1.0

Stream Type	E4/C4



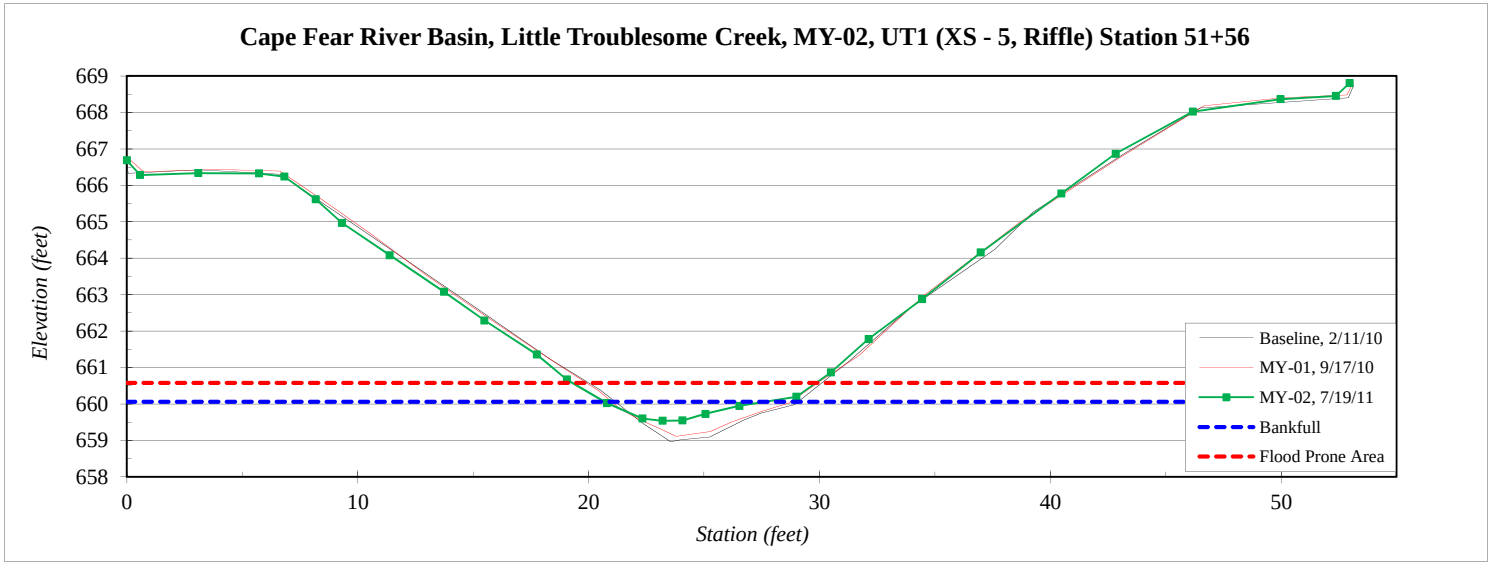
*Other shots not included due to space

River Basin:	Cape Fear
Watershed:	Little Troublesome Creek, MY-02
XS ID	UT1 (XS - 5, Riffle) Station 51+56
Drainage Area (sq mi):	0.10
Date:	7/19/2011
Field Crew:	A. French, J. Anders

Station	Elevation
0.0	666.69
0.6	666.28
3.1	666.33
5.7	666.33
6.8	666.24
8.2	665.61
9.3	664.97
11.4	664.08
13.7	663.08
15.5	662.29
17.8	661.36
19.1	660.67
20.8	660.03
22.3	659.60
23.2	659.54
24.1	659.55
25.1	659.73
26.5	659.95
29.0	660.20
30.5	660.86
32.1	661.78
34.4	662.88
37.0	664.16
40.5	665.78
42.8	666.87
46.2	668.02
50.0	668.36
52.4	668.45
53.0	668.81

SUMMARY DATA	
Bankfull Elevation:	660.1
Bankfull Cross-Sectional Area:	2.0
Bankfull Width:	6.9
Flood Prone Area Elevation:	660.6
Flood Prone Width:	10.5
Max Depth at Bankfull:	0.5
Mean Depth at Bankfull:	0.3
W / D Ratio:	23.8
Entrenchment Ratio:	1.5
Bank Height Ratio:	1.0

Stream Type	B4c

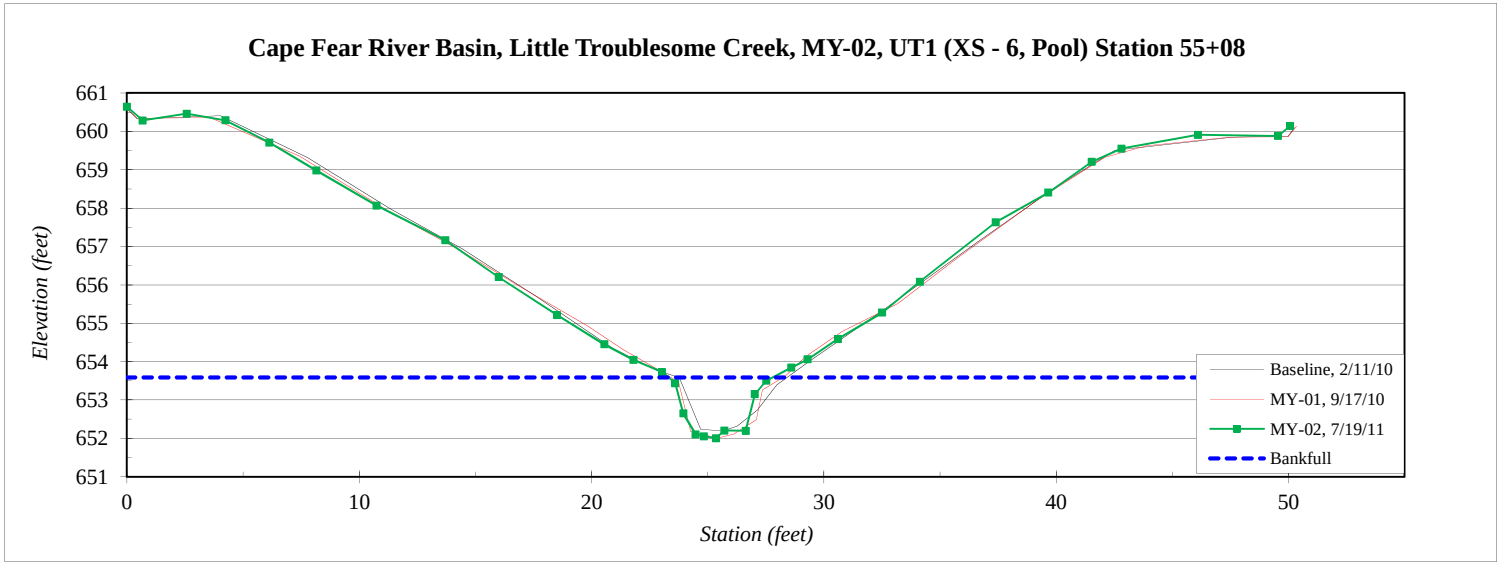


River Basin:	Cape Fear
Watershed:	Little Troublesome Creek, MY-02
XS ID	UT1 (XS - 6, Pool) Station 55+08
Drainage Area (sq mi):	0.10
Date:	7/19/2011
Field Crew:	A. French, J. Anders

Station	Elevation
0.0	660.64
0.7	660.28
2.6	660.46
4.2	660.29
6.1	659.71
8.2	658.98
10.7	658.07
13.7	657.16
16.0	656.20
18.5	655.21
20.6	654.45
21.8	654.04
23.0	653.73
23.6	653.44
24.0	652.65
24.5	652.11
24.8	652.06
25.4	652.00
25.7	652.21
26.6	652.20
27.0	653.15
27.5	653.50
28.6	653.84
29.3	654.06
30.6	654.59
32.5	655.28
34.1	656.08
37.4	657.63
39.7	658.40
41.5	659.20
42.8	659.55
46.1	659.91
49.6	659.88
50.1	660.14

SUMMARY DATA	
Bankfull Elevation:	653.6
Bankfull Cross-Sectional Area:	4.5
Bankfull Width:	4.5
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	1.0
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	B4c

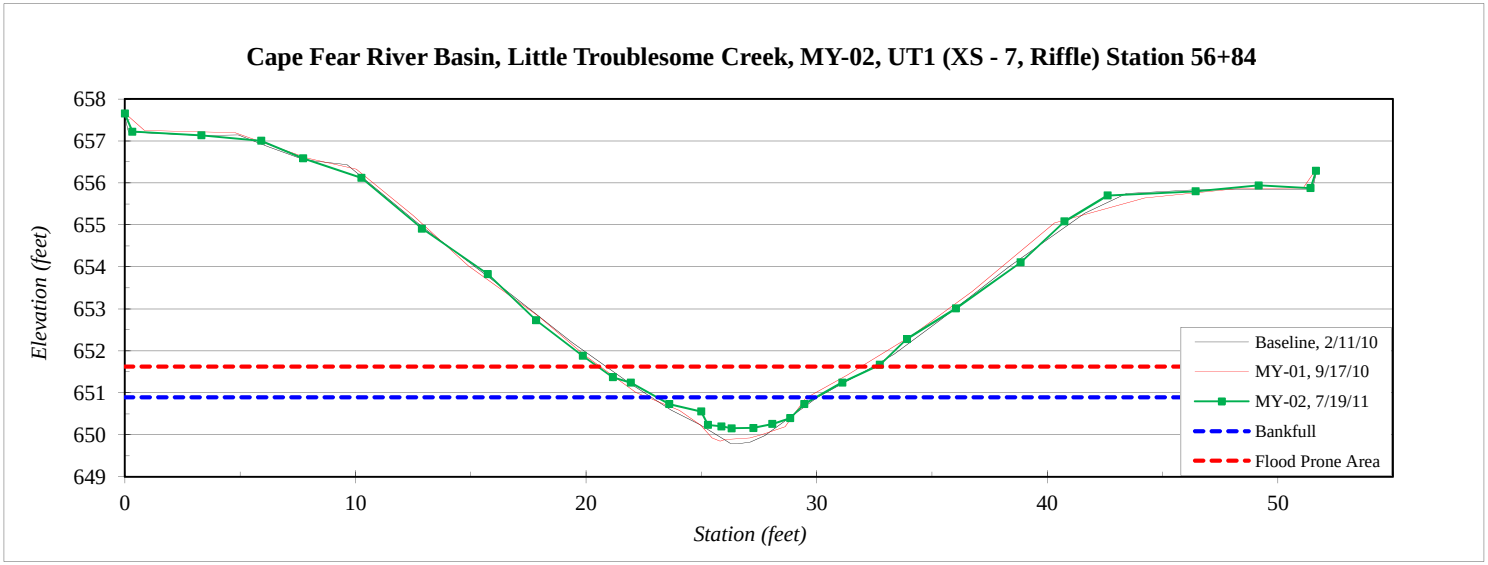


River Basin:	Cape Fear
Watershed:	Little Troublesome Creek, MY-02
XS ID	UT1 (XS - 7, Riffle) Station 56+84
Drainage Area (sq mi):	0.10
Date:	7/19/2011
Field Crew:	A. French, J. Anders

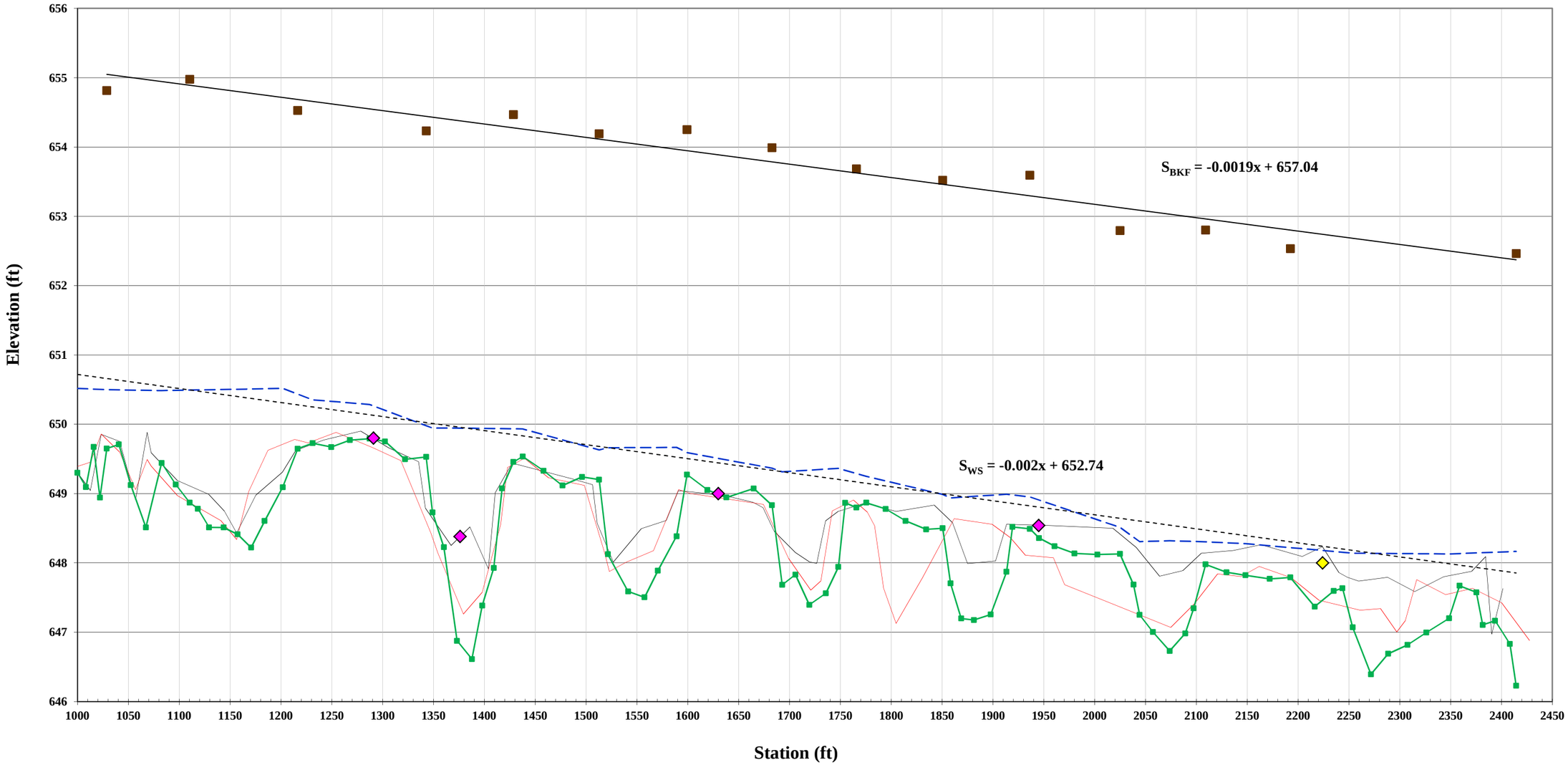
Station	Elevation
0.0	657.65
0.3	657.22
3.3	657.13
5.9	657.00
7.7	656.58
10.3	656.12
12.9	654.91
15.7	653.83
17.8	652.73
19.9	651.88
21.2	651.37
21.9	651.24
23.6	650.73
25.0	650.56
25.3	650.24
25.9	650.20
26.3	650.16
27.3	650.16
28.1	650.26
28.9	650.40
29.5	650.73
31.1	651.25
32.7	651.67
33.9	652.28
36.0	653.01
38.9	654.11
40.8	655.08
42.6	655.70
46.4	655.80
49.2	655.94
51.4	655.88
51.7	656.29

SUMMARY DATA	
Bankfull Elevation:	650.9
Bankfull Cross-Sectional Area:	3.2
Bankfull Width:	6.9
Flood Prone Area Elevation:	651.6
Flood Prone Width:	12.0
Max Depth at Bankfull:	0.7
Mean Depth at Bankfull:	0.5
W / D Ratio:	14.9
Entrenchment Ratio:	1.7
Bank Height Ratio:	1.0

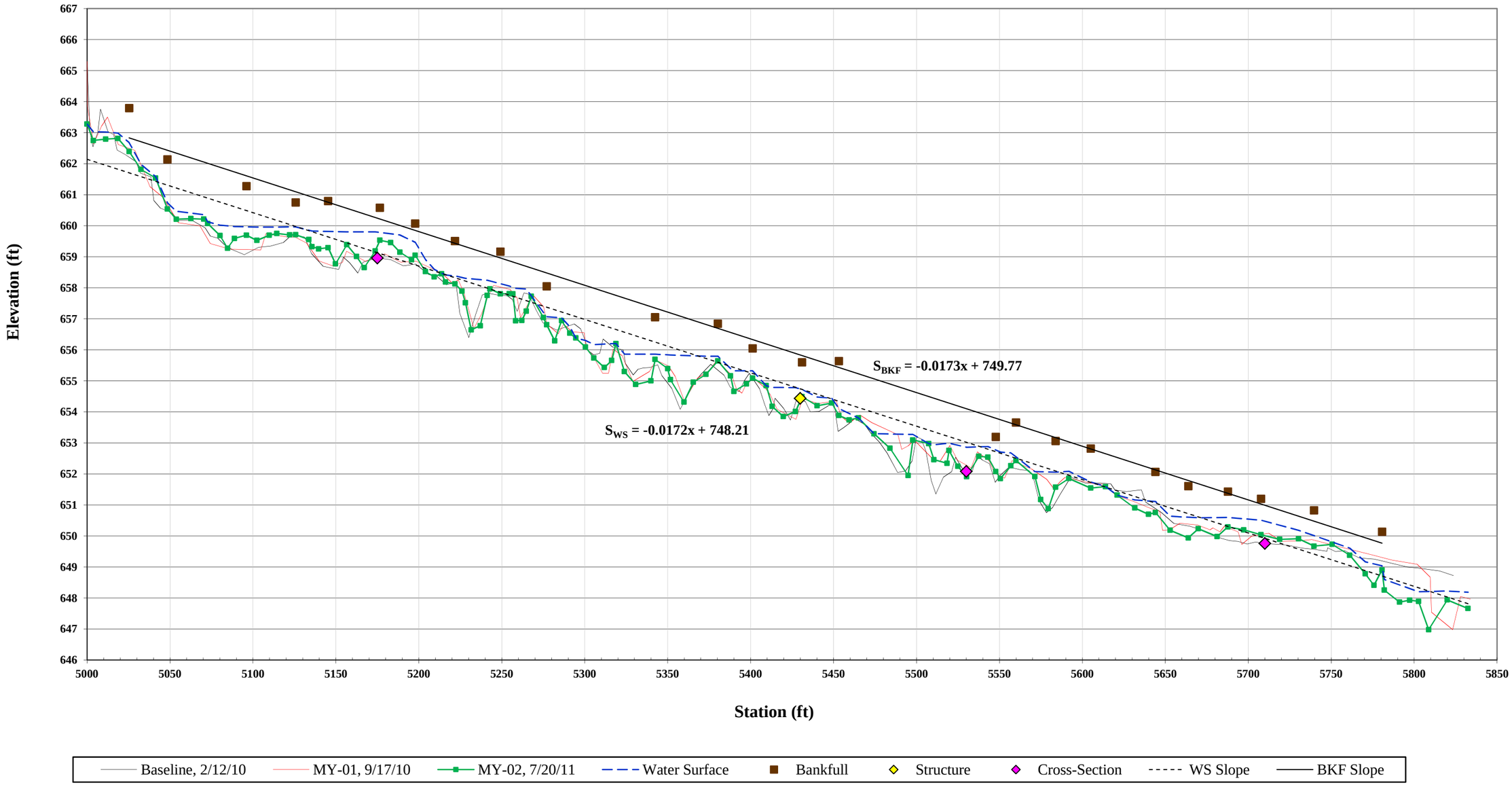
Stream Type	B4c



Longitudinal Profile
Little Troublesome Creek
EEP Project Number - 749
Station 10+00 - 24+50

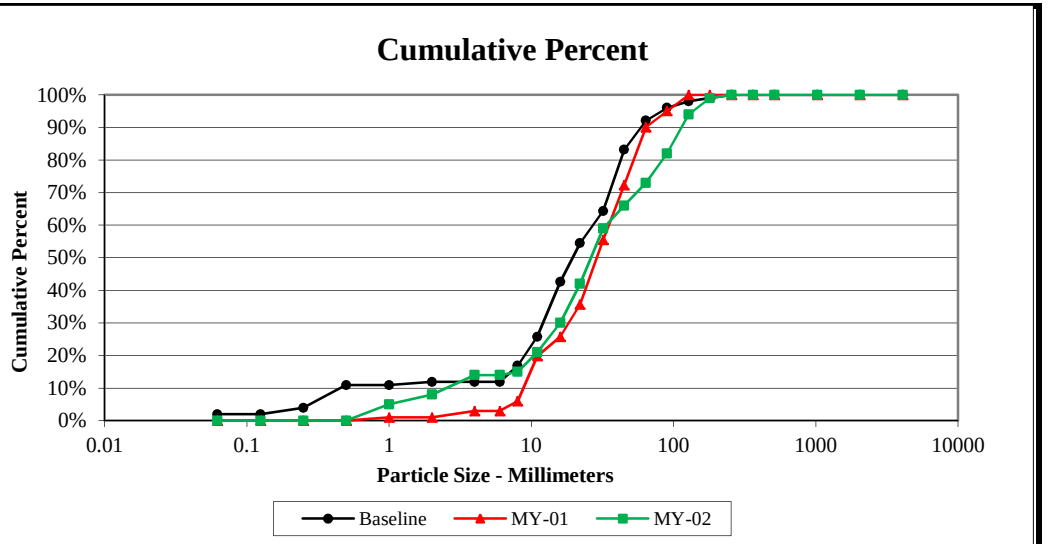


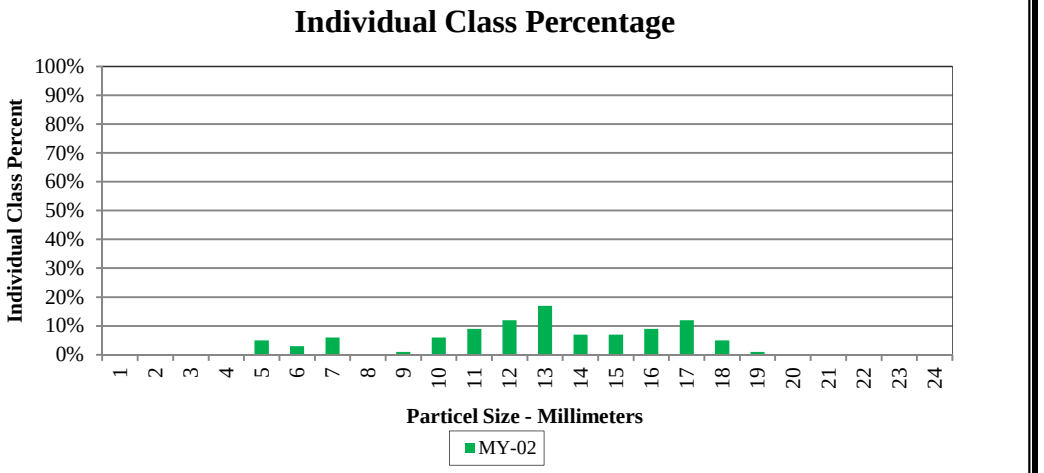
Longitudinal Profile
UT1 to Little Troublesome Creek
EEP Project Number - 749
Station 50+00 - 58+50



Cross-Section 1 Riffle - LTC MY-02					
Particle	Millimeter	Material	Count	Item %	Cum %
Silt/Clay	< 0.062	S/C		0%	0%
Very Fine	.062 - .125	S		0%	0%
Fine	.125 - .25	A		0%	0%
Medium	.25 - .50	N		0%	0%
Coarse	.50 - 1	D	5	5%	5%
Very Coarse	1 - 2	S	3	3%	8%
Very Fine	2 - 4		6	6%	14%
Fine	4 - 5.7	G		0%	14%
Fine	5.7 - 8	R	1	1%	15%
Medium	8 - 11.3	A	6	6%	21%
Medium	11.3 - 16	V	9	9%	30%
Coarse	16 - 22.6	E	12	12%	42%
Coarse	22.6 - 32	L	17	17%	59%
Very Coarse	32 - 45	S	7	7%	66%
Very Coarse	45 - 64		7	7%	73%
Small	64 - 90	C	9	9%	82%
Small	90 - 128	O	12	12%	94%
Large	128 - 180	B	5	5%	99%
Large	180 - 256	L	1	1%	100%
Small	256 - 362	B		0%	100%
Small	362 - 512	L		0%	100%
Medium	512 - 1024	D		0%	100%
Lrg- Very Lrg	1024 - 2048	R		0%	100%
Bedrock	>2048	BDRK		0%	100%
		Total	100	100%	100%

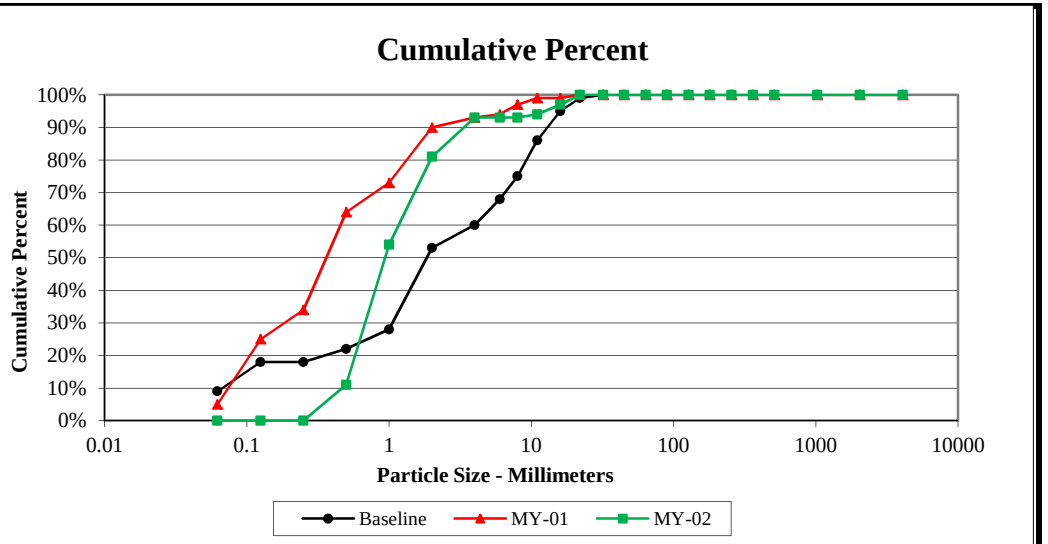
Summary Data	
D50	26
D84	95
D95	140

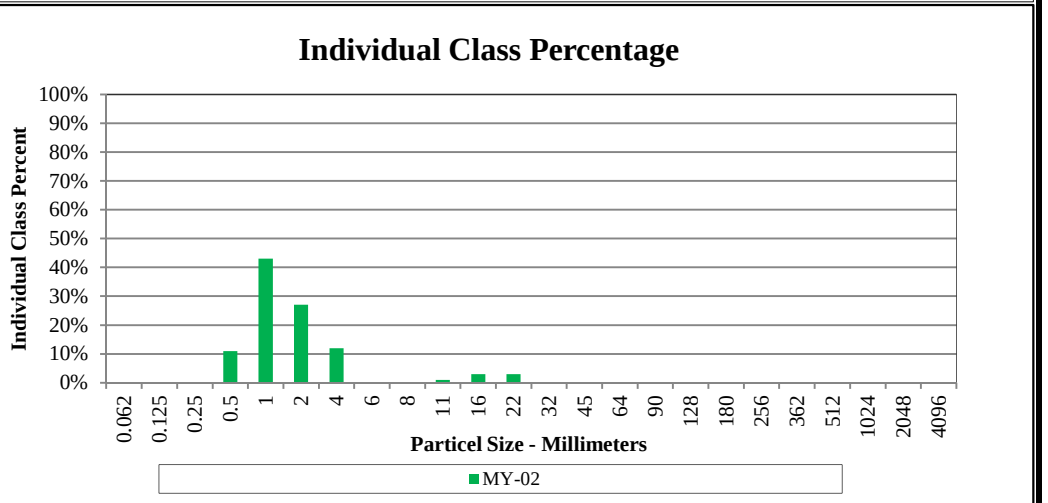




Cross-Section 2 Pool - LTC MY-02					
Particle	Millimeter	Material	Count	Item %	Cum %
Silt/Clay	< 0.062	S/C		0%	0%
Very Fine	.062 - .125	S		0%	0%
Fine	.125 - .25	A		0%	0%
Medium	.25 - .50	N	11	11%	11%
Coarse	.50 - 1	D	43	43%	54%
Very Coarse	1 - 2	S	27	27%	81%
Very Fine	2 - 4		12	12%	93%
Fine	4 - 5.7	G		0%	93%
Fine	5.7 - 8	R		0%	93%
Medium	8 - 11.3	A	1	1%	94%
Medium	11.3 - 16	V	3	3%	97%
Coarse	16 - 22.6	E	3	3%	100%
Coarse	22.6 - 32	L		0%	100%
Very Coarse	32 - 45	S		0%	100%
Very Coarse	45 - 64			0%	100%
Small	64 - 90	C		0%	100%
Small	90 - 128	O		0%	100%
Large	128 - 180	B		0%	100%
Large	180 - 256	L		0%	100%
Small	256 - 362	B		0%	100%
Small	362 - 512	L		0%	100%
Medium	512 - 1024	D		0%	100%
Lrg- Very Lrg	1024 - 2048	R		0%	100%
Bedrock	>2048	BDRK		0%	100%
		Total	100	100%	100%

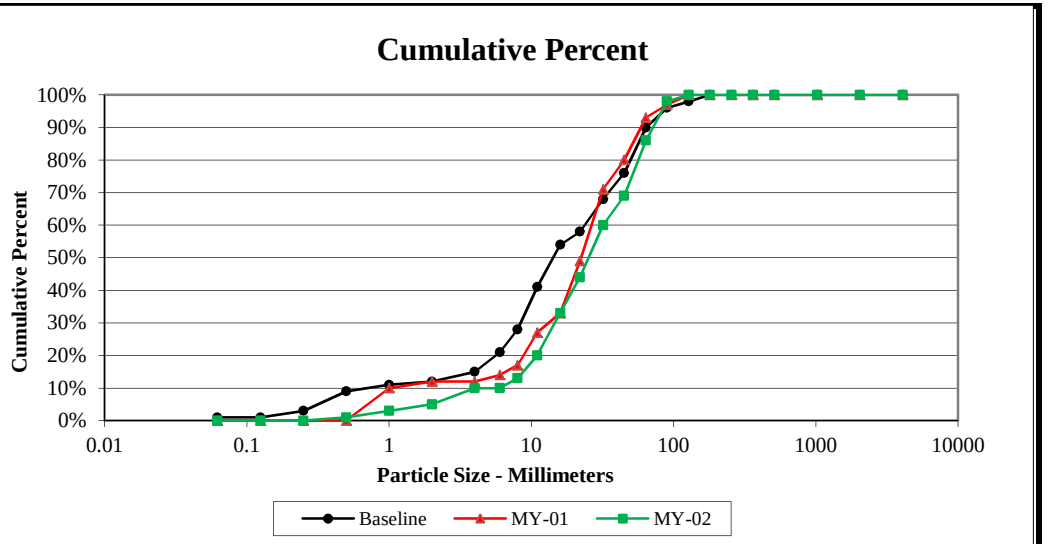
Summary Data	
D50	0.94
D84	2.4
D95	12

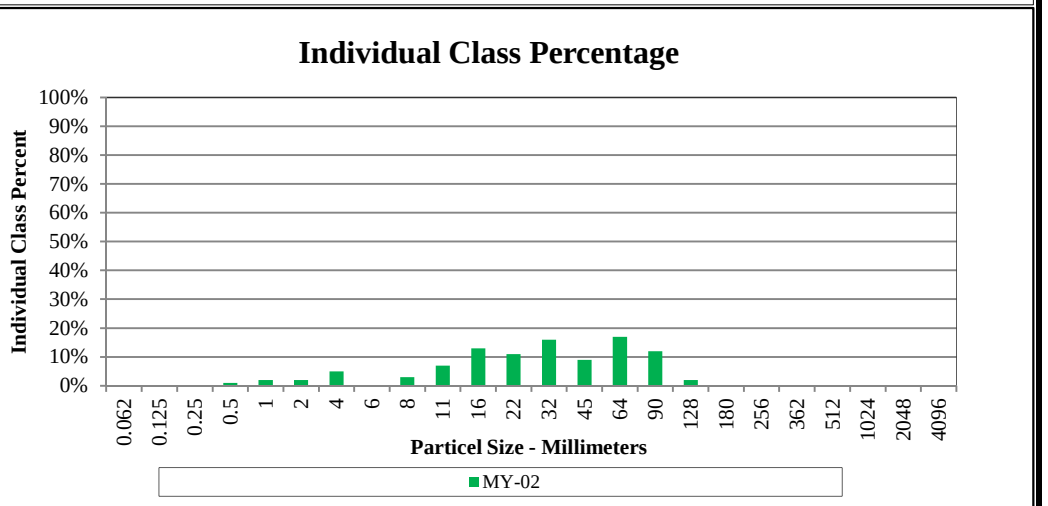




Cross-Section 3 Riffle - LTC MY-02					
Particle	Millimeter	Material	Count	Item %	Cum %
Silt/Clay	< 0.062	S/C		0%	0%
Very Fine	.062 - .125	S		0%	0%
Fine	.125 - .25	A		0%	0%
Medium	.25 - .50	N	1	1%	1%
Coarse	.50 - 1	D	2	2%	3%
Very Coarse	1 - 2	S	2	2%	5%
Very Fine	2 - 4		5	5%	10%
Fine	4 - 5.7	G		0%	10%
Fine	5.7 - 8	R	3	3%	13%
Medium	8 - 11.3	A	7	7%	20%
Medium	11.3 - 16	V	13	13%	33%
Coarse	16 - 22.6	E	11	11%	44%
Coarse	22.6 - 32	L	16	16%	60%
Very Coarse	32 - 45	S	9	9%	69%
Very Coarse	45 - 64		17	17%	86%
Small	64 - 90	C	12	12%	98%
Small	90 - 128	O	2	2%	100%
Large	128 - 180	B		0%	100%
Large	180 - 256	L		0%	100%
Small	256 - 362	B		0%	100%
Small	362 - 512	L		0%	100%
Medium	512 - 1024	D		0%	100%
Lrg- Very Lrg	1024 - 2048	R		0%	100%
Bedrock	>2048	BDRK		0%	100%
		Total	100	100%	100%

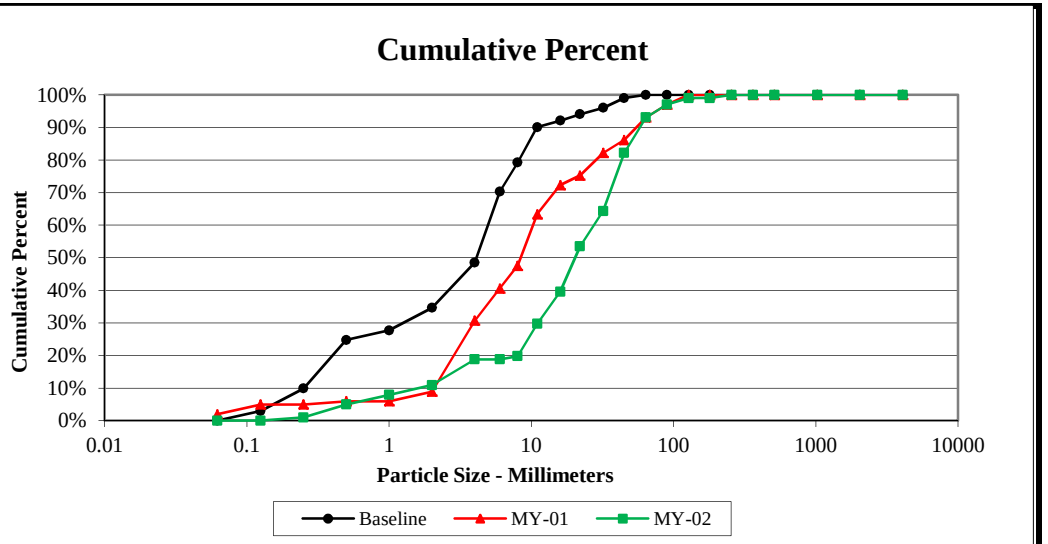
Summary Data	
D50	25
D84	61
D95	83

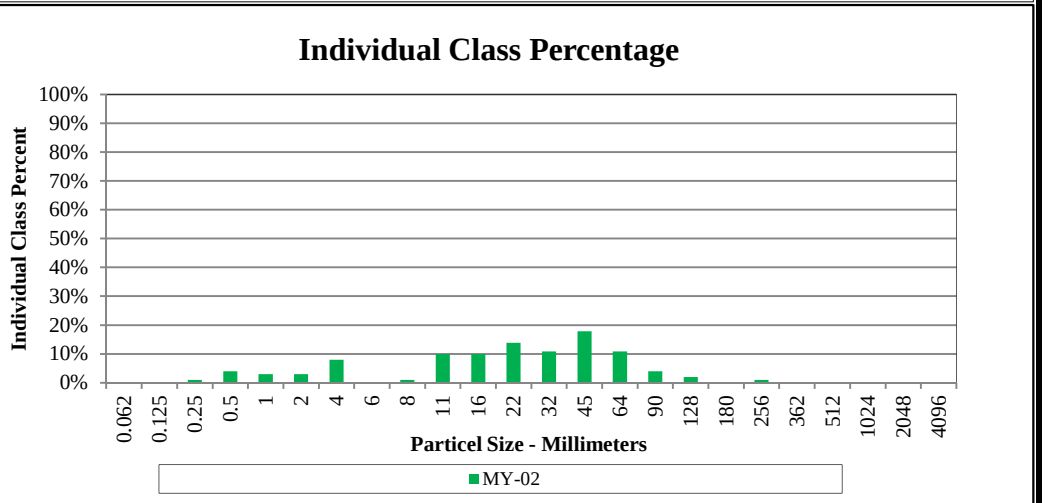




Cross-Section 4 Riffle - LTC MY-02					
Particle	Millimeter	Material	Count	Item %	Cum %
Silt/Clay	< 0.062	S/C		0%	0%
Very Fine	.062 - .125	S		0%	0%
Fine	.125 - .25	A	1	1%	1%
Medium	.25 - .50	N	4	4%	5%
Coarse	.50 - 1	D	3	3%	8%
Very Coarse	1 - 2	S	3	3%	11%
Very Fine	2 - 4		8	8%	19%
Fine	4 - 5.7	G		0%	19%
Fine	5.7 - 8	R	1	1%	20%
Medium	8 - 11.3	A	10	10%	30%
Medium	11.3 - 16	V	10	10%	40%
Coarse	16 - 22.6	E	14	14%	53%
Coarse	22.6 - 32	L	11	11%	64%
Very Coarse	32 - 45	S	18	18%	82%
Very Coarse	45 - 64		11	11%	93%
Small	64 - 90	C	4	4%	97%
Small	90 - 128	O	2	2%	99%
Large	128 - 180	B		0%	99%
Large	180 - 256	L	1	1%	100%
Small	256 - 362	B		0%	100%
Small	362 - 512	L		0%	100%
Medium	512 - 1024	D		0%	100%
Lrg- Very Lrg	1024 - 2048	R		0%	100%
Bedrock	>2048	BDRK		0%	100%
		Total	101	100%	100%

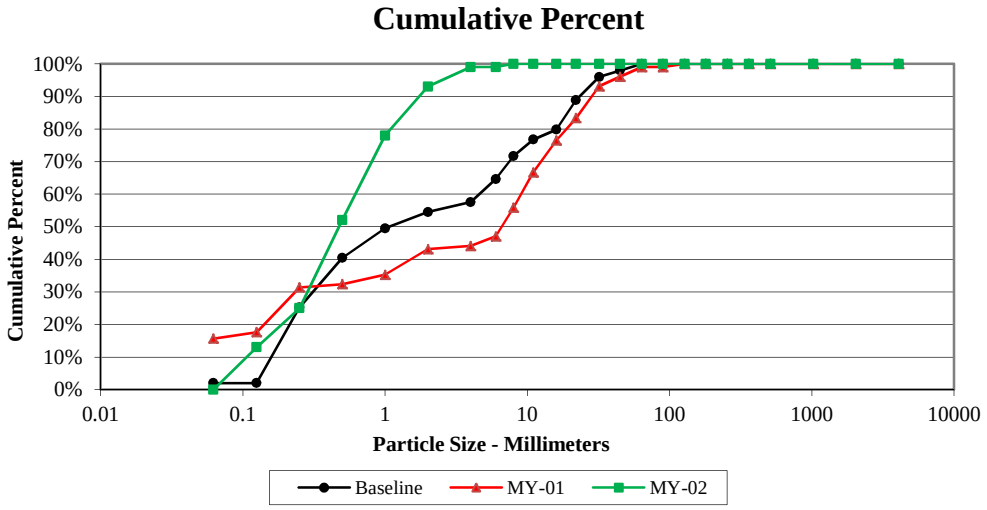
Summary Data	
D50	20
D84	48
D95	76

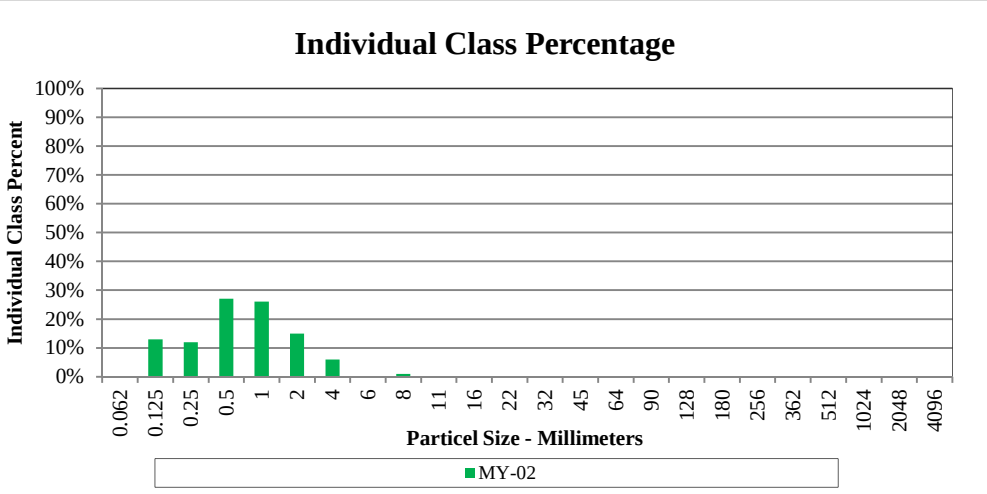




Cross-Section 5 Riffle - UT1 MY-02					
Particle	Millimeter	Material	Count	Item %	Cum %
Silt/Clay	< 0.062	S/C		0%	0%
Very Fine	.062 - .125	S	13	13%	13%
Fine	.125 - .25	A	12	12%	25%
Medium	.25 - .50	N	27	27%	52%
Coarse	.50 - 1	D	26	26%	78%
Very Coarse	1 - 2	S	15	15%	93%
Very Fine	2 - 4		6	6%	99%
Fine	4 - 5.7	G		0%	99%
Fine	5.7 - 8	R	1	1%	100%
Medium	8 - 11.3	A		0%	100%
Medium	11.3 - 16	V		0%	100%
Coarse	16 - 22.6	E		0%	100%
Coarse	22.6 - 32	L		0%	100%
Very Coarse	32 - 45	S		0%	100%
Very Coarse	45 - 64			0%	100%
Small	64 - 90	C		0%	100%
Small	90 - 128	O		0%	100%
Large	128 - 180	B		0%	100%
Large	180 - 256	L		0%	100%
Small	256 - 362	B		0%	100%
Small	362 - 512	L		0%	100%
Medium	512 - 1024	D		0%	100%
Lrg- Very Lrg	1024 - 2048	R		0%	100%
Bedrock	>2048	BDRK		0%	100%
		Total	100	100%	100%

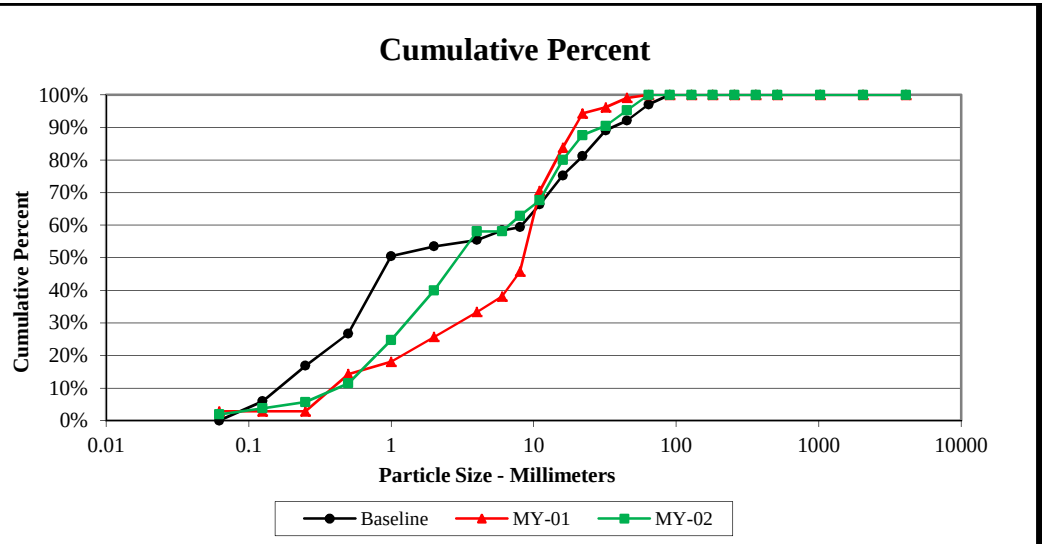
Summary Data	
D50	0.47
D84	1.3
D95	2.5

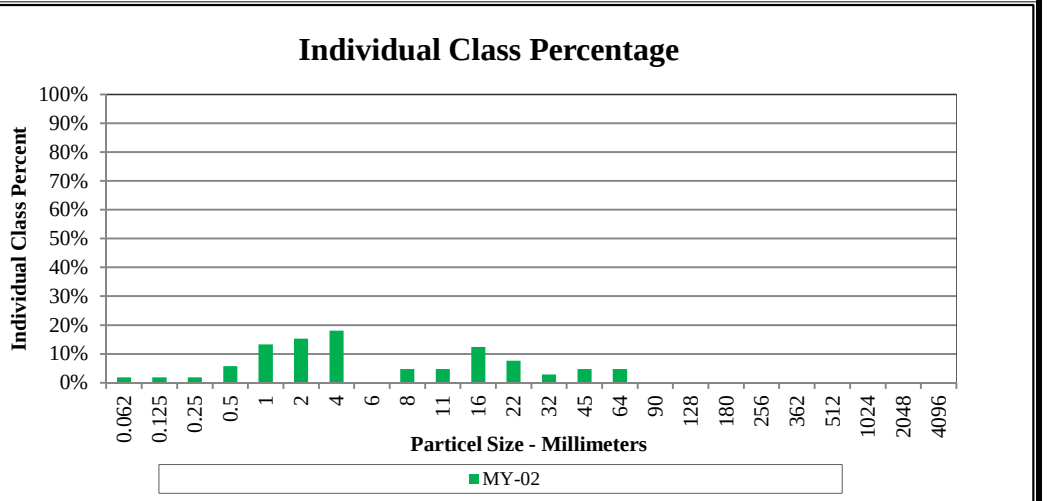




Cross-Section 6 Pool - UT1 MY-02					
Particle	Millimeter	Material	Count	Item %	Cum %
Silt/Clay	< 0.062	S/C	2	2%	2%
Very Fine	.062 - .125	S	2	2%	4%
Fine	.125 - .25	A	2	2%	6%
Medium	.25 - .50	N	6	6%	11%
Coarse	.50 - 1	D	14	13%	25%
Very Coarse	1 - 2	S	16	15%	40%
Very Fine	2 - 4		19	18%	58%
Fine	4 - 5.7	G		0%	58%
Fine	5.7 - 8	R	5	5%	63%
Medium	8 - 11.3	A	5	5%	68%
Medium	11.3 - 16	V	13	12%	80%
Coarse	16 - 22.6	E	8	8%	88%
Coarse	22.6 - 32	L	3	3%	90%
Very Coarse	32 - 45	S	5	5%	95%
Very Coarse	45 - 64		5	5%	100%
Small	64 - 90	C		0%	100%
Small	90 - 128	O		0%	100%
Large	128 - 180	B		0%	100%
Large	180 - 256	L		0%	100%
Small	256 - 362	B		0%	100%
Small	362 - 512	L		0%	100%
Medium	512 - 1024	D		0%	100%
Lrg- Very Lrg	1024 - 2048	R		0%	100%
Bedrock	>2048	BDRK		0%	100%
		Total	105	100%	100%

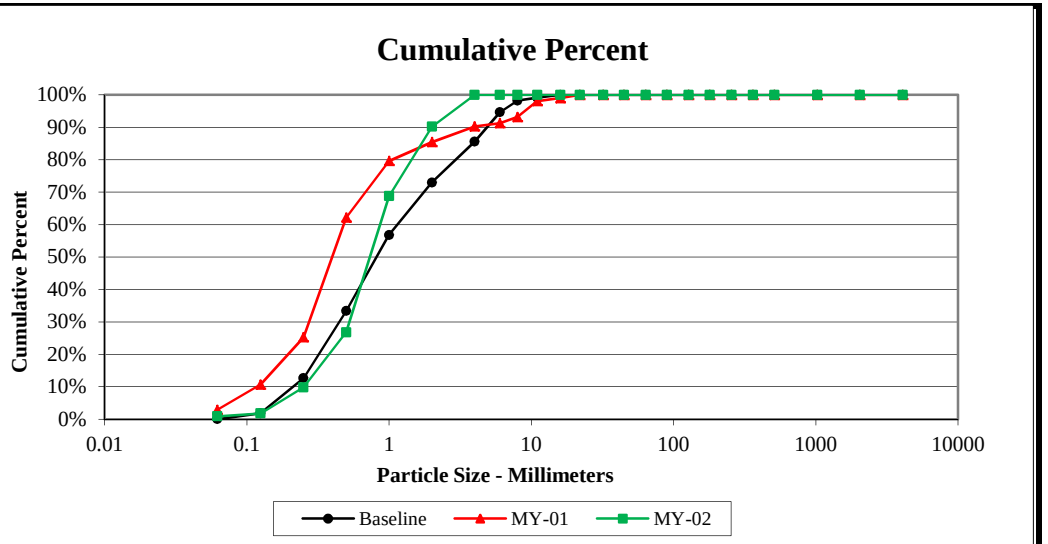
Summary Data	
D50	2.9
D84	19
D95	44





Cross-Section 7 Riffle - UT1 MY-02					
Particle	Millimeter	Material	Count	Item %	Cum %
Silt/Clay	< 0.062	S/C	1	1%	1%
Very Fine	.062 - .125	S	1	1%	2%
Fine	.125 - .25	A	9	8%	10%
Medium	.25 - .50	N	19	17%	27%
Coarse	.50 - 1	D	47	42%	69%
Very Coarse	1 - 2	S	24	21%	90%
Very Fine	2 - 4		11	10%	100%
Fine	4 - 5.7	G		0%	100%
Fine	5.7 - 8	R		0%	100%
Medium	8 - 11.3	A		0%	100%
Medium	11.3 - 16	V		0%	100%
Coarse	16 - 22.6	E		0%	100%
Coarse	22.6 - 32	L		0%	100%
Very Coarse	32 - 45	S		0%	100%
Very Coarse	45 - 64			0%	100%
Small	64 - 90	C		0%	100%
Small	90 - 128	O		0%	100%
Large	128 - 180	B		0%	100%
Large	180 - 256	L		0%	100%
Small	256 - 362	B		0%	100%
Small	362 - 512	L		0%	100%
Medium	512 - 1024	D		0%	100%
Lrg- Very Lrg	1024 - 2048	R		0%	100%
Bedrock	>2048	BDRK		0%	100%
		Total	112	100%	100%

Summary Data	
D50	0.73
D84	1.6
D95	2.8



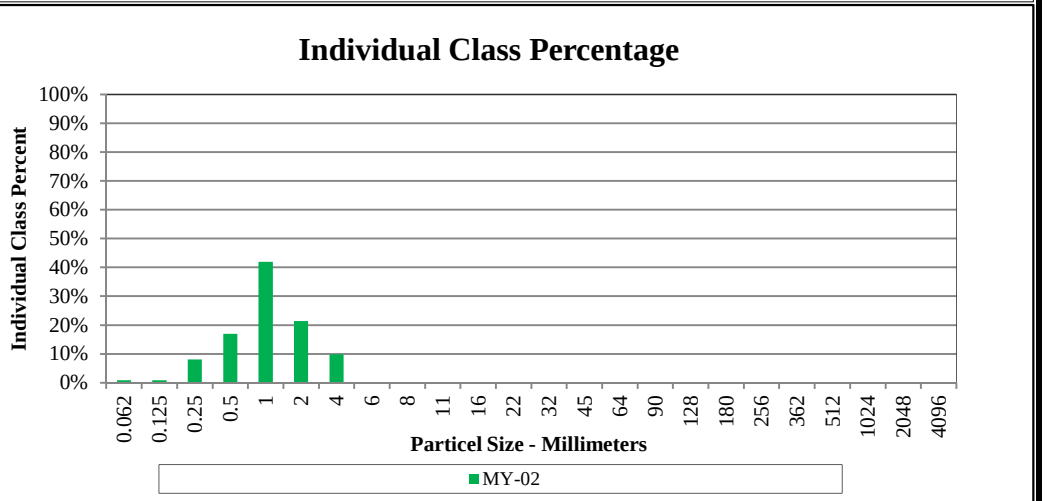


Table 10 Baseline Stream Data Summary Table: Little Troublesome Creek - 1,375 lf

Little Troublesome / Project No. 749

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			As-built					
Dimension and Substrate - Riffle	LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)				21.3	24.2	23.3	29.0	3.4	4	11.9			20.1		2		31.6		32.1	32.7	32.6	33.3	0.6	3
Floodprone Width (ft)					>65				3		>60				2		>60			>200				3
Bankfull Mean Depth (ft)				4.4	4.7	4.8	5.0	0.2	4	1.7			2.7		2		3.7		3.6	3.7	3.7	3.7	0.1	3
Bankfull Max Depth (ft)				6.2	6.6	6.7	6.9	0.3	4	3.3			4.2		2		4.9		4.7	4.8	4.8	4.9	0.1	3
Bankfull Cross-Sectional Area (ft^2)				106.1	114.3	107.6	135.8	14.4	4	32.4			33.4		2		118.0		118.6	118.8	118.6	119.2	0.3	3
Width/Depth Ratio				4.2	5.0	4.7	6.2	1.0	3	4.4			12.1		2		8.5		8.7	9.0	8.9	9.3	0.3	3
Entrenchment Ratio				2.0	2.6	2.7	3.0	0.5	3	2.0			3.0		2		>3.0			>6.0				3
Bank Height Ratio				1.0	1.1	1.1	1.2	0.1	3	1.0			1.1		2		1.0		1.0	1.0	1.0	1.0	0.0	3
d50 (mm)				4.5	6.8	6.8	9.1	3.3	2	1.9			3.4		2				4.1	12.7	14.0	20.0	8.0	3
Profile																								
Riffle Length (ft)																	58		60	90	89	121	21	6
Riffle Slope (ft/ft)										0.0010			0.0070			0.002		0.004	0.0008	0.0022	0.0018	0.0039	0.0013	6
Pool Length (ft)										13			21			20		56	11	60	42	144	42	7
Pool Max Depth										1.5			2.5				7.5		4.9	5.7	5.8	6.2	0.5	7
Pool Spacing (ft)										32			80			50		212	169	199	180	285	44	6
Pool Volume (ft^3)																								
Pattern																								
Channel Beltwidth (ft)										50			60				125		51	63	55	85	15	6
Radius of Curvature (ft)										24			31			72		126	59	87	90	120	24	7
Rc:Bankfull width (ft/ft)										1.2			2.6			2.3		4.0	1.8	2.7	2.8	3.7		
Meander Wavelength (ft)										77			138			158		358	293	328	318	385	35	5
Meander Width Ratio										2.5			5.0				3.9		1.6	1.9	1.7	2.6		
Substrate, bed and transport parameters																								
Ri%/Ru%/P%/G%/S%																								
SC% / Sa% / G% / C% / B% / Be%				3% / 54% / 40% / 3% / 0% / 0%						0% / 52% / 48% / 0% / 0% / 0%									1% / 19% / 75% / 6% / 0% / 0%				
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)				0.26 / 0.56 / 1.4 / 8.1 / 15 / - / -						0.7 / 1.2 / 1.9 / 16 / 26 / - / -									0.79 / 6.1 / 10 / 18 / 42 / 71 / - / -				
Reach Shear Stress (competency) lb/ft^2																	0.38			0.28				
Max part size (mm) mobilized at bankfull																	28			20				
Stream Power (transport capacity) W/m^2																								
Additional Reach Parameters																								
Drainage Area (SM)				12.09						1.68						12.09			12.09					
Impervious cover estimate				21%												21%			21%					
Rosgen Classification				E4						E4						E4/C4			E4/C4					
Bankfull Velocity (fps)				4.1 - 5.3						3.4 - 4.4						4.3								
Bankfull Discharge (cfs)				553 - 564						115 - 150						510 - 550								
Valley length (ft)				1,273												1,273			1,273					
Channel thalweg length (ft)				1,329												1,379			1,401					
Sinuosity				1.06												1.10			1.10					
Water Surface Slope (Channel) (ft/ft)				0.0020						0.0030						0.0020			0.0015					
BF slope (ft/ft)				0.0020												0.0020			0.0018					
Bankfull Floodplain Area (acres)																								
Proportion over wide (%)																								
Entrenchment Class (ER Range)																								
Incision Class (BHR Range)																								
BEHI VL% / L% / M% / H% / VH% / E%																								
Channel Stability or Habitat Metric																								
Biological or Other																								

Table 10 Baseline Stream Data Summary Table: UT1 - 813 lf

Little Troublesome / Project No. 749

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			As-built					
Dimension and Substrate - Riffle	LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)				4.0	5.4	5.1	7.7	1.4	5	7.7			10.8				6.3		7.2	7.6		7.9	0.5	2
Floodprone Width (ft)				5	6	6	7	0.9	3	13			16				12		13	13		14	0.6	2
Bankfull Mean Depth (ft)				0.7	0.9	0.9	1.1	0.2	5	0.7			0.9				0.6		0.6	0.6		0.6	0	2
Bankfull Max Depth (ft)				1.0	1.3	1.1	1.9	0.4	5	1.1			1.4				1.0		1.1	1.1		1.1	0	2
Bankfull Cross-Sectional Area (ft^2)				3.6	4.6	4.3	5.8	1.0	5	6.1			8.8				3.5		4.5	4.7		4.8	0.2	2
Width/Depth Ratio				4.4	5.7	5.6	7.0	1.3	3	8.5			11.4				11.4		11.5	12.3		13.0	1.1	2
Entrenchment Ratio				1.0	1.3	1.4	1.5	0.3	3	1.6			2.1				1.9		1.6	1.8		1.9	0.2	2
Bank Height Ratio				5.3	6.1	6.4	6.5	0.7	3								1.0		1.0	1.0		1.0	0	2
d50 (mm)				2.2	11.2	12.3	19.2	8.6	3										0.8	1.0		1.1	0.2	2
Profile																								
Riffle Length (ft)																			3	11	8	32	9	11
Riffle Slope (ft/ft)										0.0120			0.0280			0.0180		0.0400	0.0077	0.0378	0.0318	0.1022	0.0283	11
Pool Length (ft)										5			9			3		11	5	13	12	36	8	14
Pool Max Depth										0.8			0.9				1.4		1.7	2.3	2.2	3.0	0.5	12
Pool Spacing (ft)																			21	44	41	81	22	13
Pool Volume (ft^2)																								
Pattern																								
Channel Beltwidth (ft)											22						13		6	9	9	14	2.1	19
Radius of Curvature (ft)										11			23			13		32	14	18	18	27	4.5	27
Rc:Bankfull width (ft/ft)										1.0			3.0			2.0		5.0	1.8	2.4	2.4	3.6		
Meander Wavelength (ft)										45			59			32		63	40	51	49	69	7.6	25
Meander Width Ratio										2.0			2.9			2.0		2.9	0.8	1.2	1.2	1.9		
Substrate, bed and transport parameters																								
Ri%/Ru%/P%/G%/S%																								
SC% / Sa% / G% / C% / B% / Be%				0% / 27% / 73% / 0% / 0%						6% / 45% / 42% / 7% / 0%									1% / 63% / 36% / 0% / 0% / 0%					
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)				1.4 / 3.2 / 7.3 / 15 / 20						0.14 / 0.38 / 1.8 / 18 / 139									0.22 / 0.47 / 0.87 / 2.1 / 7.3 / 23					
Reach Shear Stress (competency) lb/ft^2																0.42			0.60					
Max part size (mm) mobilized at bankfull																32			35					
Stream Power (transport capacity) W/m^2																								
Additional Reach Parameters																								
Drainage Area (SM)				0.10						0.15						0.10			0.10					
Impervious cover estimate																								
Rosgen Classification				G4c						B4c						B4c			B4c					
Bankfull Velocity (fps)				4.3 - 4.7						5.1 - 5.8						3.7			3.7					
Bankfull Discharge (cfs)				16 - 20						31 - 49						13 - 20			17					
Valley length (ft)				769												769			769					
Channel thalweg length (ft)				873												813			824					
Sinuosity				1.02						1.20						1.10			1.10					
Water Surface Slope (Channel) (ft/ft)				0.019						0.012						0.018			0.017					
BF slope (ft/ft)				0.021						0.017						0.021			0.016					
Bankfull Floodplain Area (acres)																								
Proportion over wide (%)																								
Entrenchment Class (ER Range)																								
Incision Class (BHR Range)																								
BEHI VL% / L% / M% / H% / VH% / E%																								
Channel Stability or Habitat Metric																								
Biological or Other																								

Table 11a. Cross-Section Morphology Data Tables
Little Troublesome / Project No. 749

Dimension and Substrate	Cross-Section 1 (LTC, Riffle) Station 13+08							Cross-Section 2 (LTC, Pool) Station 13+90							Cross-Section 3 (LTC, Riffle) Station 16+30							Cross-Section 4 (LTC, Riffle) Station 19+42							Cross-Section 5 (UT1, Riffle) Station 51+56						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	32.6	33.0	33.2					36.0	39.1	37.5					32.1	32.3	32.2					33.3	33.5	33.1					7.9	7.7	6.9				
Floodprone Width (ft)	>200	>200	>200					-	-	-					>200	>200	>200					>200	>200	>200					13	13	11				
Bankfull Mean Depth (ft)	3.7	3.6	3.5					3.4	3.4	3.6					3.7	3.6	3.6					3.6	3.6	3.5					0.6	0.5	0.3				
Bankfull Max Depth (ft)	4.8	4.8	4.9					6.0	7.3	7.7					4.9	4.9	4.9					4.7	4.9	5.0					1.1	0.9	0.5				
Bankfull Cross-Sectional Area (ft^2)	119.2	118.4	117.4					123.1	134.3	135.0					118.6	117.5	114.8					118.6	120.0	115.9					4.8	4.1	2.0				
Bankfull Width/Depth Ratio	8.9	9.2	9.4					-	-	-					8.7	8.9	9					9.3	9.4	9.5					13.0	14.5	23.3				
Bankfull Entrenchment Ratio	>6.0	>6.0	>6.0					-	-	-					>6.0	>6.0	>6.0					>6.0	>6.0	>6.0					1.6	1.6	1.5				
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				
Cross-Sectional Area Between End Pins (ft^2)	142.4	147.9	144.2					170.0	171.1	170.2					156.0	160.1	156.7					162.2	165.8	161.2					150.8	156.3	152.5				
d50 (mm)	20.0	29.0	26.0					1.8	0.36	0.94					14.0	22.0	25.0					4.1	8.4	20.0					1.1	8.9	0.47				

	Cross-Section 6 (UT1, Pool) Station 55+08							Cross-Section 7 (UT1, Riffle) Station 56+84						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	4.6	4.8	4.5					7.2	6.9	6.9				
Floodprone Width (ft)	-	-	-					13.6	13.6	12.0				
Bankfull Mean Depth (ft)	0.9	1.0	1.0					0.6	0.6	0.5				
Bankfull Max Depth (ft)	1.4	1.6	1.6					1.1	1.0	0.7				
Bankfull Cross-Sectional Area (ft^2)	4.2	4.8	4.5					4.5	4.3	3.2				
Bankfull Width/Depth Ratio	-	-	-					11.5	11.1	15.0				
Bankfull Entrenchment Ratio	-	-	-					1.9	2.0	1.7				
Bankfull Bank Height Ratio	-	-	-					1.0	1.0	1.0				
Cross-Sectional Area Between End Pins (ft^2)	146.9	149.8	149.9					120.6	123.6	121.4				
d50 (mm)	1.0	8.6	2.9					0.82	0.4	0.73				

Table 11b. Stream Reach Morphology Data Tables
Little Troublesome / Project No. 749
Segment Reach: Little Troublesome Creek (1,375 ft.)

Parameter	MY01 (2010)						MY02 (2011)						MY03 (2012)						MY04 (2013)						MY05 (2014)					
Dimension	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	32.3	33.0		33.5		3	32.2	32.8		33.2		3																		
Floodprone Width (ft)	200	200		200		3	200	200		200		3																		
Bankfull Mean Depth (ft)	3.6	3.6		3.6		3	3.5	3.5		3.6		3																		
Bankfull Max Depth (ft)	4.8	4.9		4.9		3	4.9	4.9		5.0		3																		
Bankfull Cross-Sectional Area (ft^2)	117.5	118.4		120.0		3	114.8	116.0		117.4		3																		
Width/Depth Ratio	8.9	9.2		9.4		3	9.0	9.3		9.5		3																		
Entrenchment Ratio	6.0	6.0		6.0		3	6.0	6.0		6.0		3																		
Bank Height Ratio	1.0	1.0		1.0		3	1.0	1.0		1.0		3																		
Pattern																														
Channel Beltwidth (ft)	66	89	90	110	18.2	6	66	89	90	110	18.2	6																		
Radius of Curvature (ft)	80	96	80	120	21.9	5	80	96	80	120	21.9	5																		
Rad. of Curv. : Bankfull Width (ft/ft)	2.4	2.9	2.4	3.6			2.5	2.9	2.4	3.6																				
Meander Wavelength (ft)	280	318	314	375	33.2	6	280	318	314	375	33.2	6																		
Meander Width Ratio	2.0	2.7	2.7	3.3			2	2.7	2.7	3.3																				
Profile																														
Riffle Length (ft)	21	65	60	104	26	7	75	86	83	112	14	7																		
Riffle Slope (ft/ft)	0.002	0.005	0.004	0.014	0.004	7	0.001	0.003	0.003	0.005	0.001	7																		
Pool Length (ft)	32	65	48	127	35	7	53	79	68	161	39	7																		
Pool Max Depth (ft)	7.3	7.3		7.3		1	3.3	3.3		3.3		1																		
Pool Spacing (ft)	93	198	179	291	73	6	166	202	179	308	54	6																		
Additional Reach Parameters																														
Valley Length (ft)	1,285						1,285																							
Channel Thalweg Length (ft)	1,402						1,402																							
Sinuosity	1.08						1.08																							
Water Surface Slope (ft/ft)	0.0015						0.0015																							
Bankfull Slope (ft/ft)	0.0018						0.0018																							
Rosgen Classification	C5						C5																							
Ri% / Ru% / P% / G% / S%	25 / 20 / 30 / 25 / 0						25 / 20 / 30 / 25 / 0																							
SC% / Sa% / G% / C% / B% / Be%	0%/12%/81%/7%/0%/0%						0%/26%/62%/12%/0%/0%																							
d16 / d35 / d50 / d84 / d95	7.3/17/22/50/76						5.3/12/18/52/78																							
% of Reach with Eroding Banks	1%						1%																							

Table 11b. Stream Reach Morphology Data Tables
Little Troublesome / Project No. 749
Segment Reach: UT1 (813 ft.)

Parameter	MY01 (2010)						MY02 (2011)						MY03 (2012)						MY04 (2013)						MY05 (2014)					
Dimension	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	6.9	7.3		7.7	0.566	2	6.9	6.9		6.9	0.000	2																		
Floodprone Width (ft)	12.7	13.15		13.6	0.636	2	10.5	11.3		12.0	1.061	2																		
Bankfull Mean Depth (ft)	0.5	0.6		0.6	0.064	2	0.3	0.4		0.5	0.141	2																		
Bankfull Max Depth (ft)	0.9	1.0		1.0	0.064	2	0.5	0.6		0.7	0.141	2																		
Bankfull Cross-Sectional Area (ft^2)	4.1	4.2		4.3	0.141	2	2.0	2.6		3.2	0.849	2																		
Width/Depth Ratio	11.1	12.8		14.5	2.396	2	15.0	19.2		23.3	5.869	2																		
Entrenchment Ratio	1.6	1.8		2.0	0.283	2	1.5	1.6		1.7	0.141	2																		
Bank Height Ratio	1.0	1.0		1.0	0.000	2	1.0	1.0		1.0	0.000	2																		
Pattern																														
Channel Beltwidth (ft)	7	12	12	17	2.91	21																								
Radius of Curvature (ft)	12	18.1	20	25	3.19	26																								
Rad. of Curv. : Bankfull Width (ft/ft)	1.7	2.5	2.7	2.5																										
Meander Wavelength (ft)	45	50.1	50	56	2.79	22																								
Meander Width Ratio	1.0	1.64	1.64	2.33																										
Profile																														
Riffle Length (ft)	2	10	6	42	12	13	8	12	9	22	6	6																		
Riffle Slope (ft/ft)	0.000	0.061	0.049	0.162	0.053	13	0.026	0.045	0.041	0.076	0.020	6																		
Pool Length (ft)	3	9	6	30	7	16	6	14	11	38	10	9																		
Pool Max Depth (ft)	1.6		1.6	1.6		1	1.6		1.6	1.6		1																		
Pool Spacing (ft)	18	39	33	69	18	15	24	55	47	98	27	8																		
Additional Reach Parameters																														
Valley Length (ft)	780						780																							
Channel Thalweg Length (ft)	811						811																							
Sinuosity	1.04						1.04																							
Water Surface Slope (ft/ft)	0.0171						0.0181																							
Bankfull Slope (ft/ft)	0.0164						0.0164																							
Rosgen Classification	B5						B5																							
Ri% / Ru% / P% / G% / S%*																														
SC% / Sa% / G% / C% / B% / Be%	3%/83%/15%/0%/0%/0%						1%/73%/26%/0%/0%/0%																							
d16 / d35 / d50 / d84 / d95	0.16/0.3/0.4/1.7/9						0.37/0.8/1.4/7.3/16.4																							
% of Reach with Eroding Banks	5%						5%																							

*The small size of UT 1 combined with vegetation growing in the channel creates poorly defined features.

Table 12. Verification of Bankfull Events Little Troublesome / Project No. 749			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo Number**
6/14/2009	6/11/2009	Site visit to evaluate indicators of stage after storm event	N/A
11/11/2009	11/11/2009	Site visit to evaluate indicators of stage after storm event	N/A
12/25/2009	12/25/2009	Land owner, eye-witness account	N/A
1/25/2010	1/25/2010	Site visit to evaluate indicators of stage after storm event	N/A
10/7/2010	9/26/2010	Site visit to evaluate indicators of stage after storm event	see MY01 report photo
11/18/2011	unknown	Crest gauge and indicators of storm event	N/A