

**East Tarboro Canal Stream Restoration Project**  
**Edgecombe County**  
**North Carolina**  
**EEP Project No. 123**  
**CU: 03020103**  
**SCO# 030603101**

**Year 4 of 5 Monitoring Report**  
**Data Collection: May through October 2011**  
**Submission Date: October 26, 2011**



Prepared for:



North Carolina Department of Environment and Natural Resources  
Ecosystem Enhancement Program  
2728 Capital Boulevard, Suite 1H-103  
Raleigh, NC 27606

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Prepared by:



Rummel, Klepper & Kahl, LLP  
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Raleigh, NC 27609

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### 3.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

Project goals and objectives for the East Tarboro Canal stream restoration project included:

Project goals are:

- Provide a stable stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load.
- Improve water quality and reduce erosion.
- Improve aquatic habitat with the use of natural material stabilization structures such as root wads, rock vanes, woody debris, and a riparian buffer.
- Provide a native stream buffer that will increase bank stability, improve wildlife habitat, and eliminate or reduce exotic invasive plant infestations and increase the aesthetic value by transforming the unvegetated ditch into a functioning stream buffer.

While project objectives included:

- Restore approximately 2,900 linear feet of East Tarboro Canal.
- Restore the natural riparian buffer.
- Construct a new floodplain at a lower elevation.

Thirteen (13) permanent vegetation plots were established and used in annual vegetation monitoring. The vegetative success criteria are based on the US Army Corps of Engineers Stream Mitigation Guidelines (USACE, 2003) that require 260 stems per acre after five (5) years for stream restoration and 320 stems per acre after five (5) years for buffer restoration. Planted areas on Reach 2 are being monitored for Riparian Buffer Restoration (RBR) assets. This site was instituted prior to October 2007 and, therefore, will generate RBR credit within the conservation easement where planted hardwood stem density requirements are met and a minimum of 50' and a maximum of 200' from top of bank. There are 9.6 acres that are eligible for RBR credit if density requirements are met. Currently, the site is meeting the minimum success requirements for the stream restoration planting and buffer restoration planting accruing 463 stems per acre for SMU and 366 stems per acre for BMU. Although the project received supplemental planting in February 2011 and the site has higher stem counts than 2010 MY3, some areas (VP2-4, 8 and 9) are still below BMU crediting criteria. VP1 along with Reach 1 have been removed from the project. The conservation easement, on this portion, has been lifted, and the property has been returned to the Town of Tarboro. Areas along Reach 2 have been subject to beaver impacts resulting in the loss of planted stems. The beaver infestation has caused damage to riparian vegetation along the restored stream channel and dams have caused flooding that could potentially drown planted stems. Vegetation plot locations are identified in Figure 2 along with locations of beaver activity. East Tarboro Canal Stream Restoration Project received supplemental planting during February 2011 resulting in stem counts higher than 2010 MY3.

The restored stream is functioning well and holding grade while maintaining bedform features. Overall the project is performing adequately. However, the stream has two areas of concern that require immediate repair. Channel dimension and pattern are similar to as-built conditions with the exception of bank erosion at station 21+50 and a section of stream that has been rerouted between Station 11+00 and 13+00 both identified on Figure 2. The section of stream that has been rerouted is due to beaver activity and sediment accumulation in the constructed channel. The rerouted section now flows through the pre-restoration channel alignment east of VP 2 (Figure 2). The problems associated with beaver infestation have been reported to EEP and remedial action is underway. The damaged stormwater outfall entering Reach 2 between Wilson and St. James streets has been repaired and is functioning properly. Bankfull



events have been recorded onsite during 2011 and can be viewed in Appendix E. (Reach 1 has been removed from the monitoring plan).

Wetland restoration or enhancement was not a part of the East Tarboro Canal Stream Restoration Site. Therefore, no wetland monitoring is required.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

#### **4.0 METHODOLOGY**

Stream monitoring was completed by utilizing total station survey along with Rosgen Level II techniques to determine stream stability and performance. The annual cross-sectional survey included points surveyed at breaks in slope, bankfull, inner berm, edge of water, and thalweg, if the features were present. Longitudinal profile survey was conducted for the entire length of the restored channel for Reach 2. Measurements included thalweg, water surface, and bankfull. All surveys were complete using existing onsite benchmarks.

Vegetative sample plots were quantitatively monitored during the first growing season. Twelve (12) 100m<sup>2</sup> plots are used for monitoring. For Monitoring Year 4, 2011, Reach 2 (VP2- VP 13) were sampled. Species composition, density, vigor and survival were monitored. Each plot corner is permanently located with rebar. Year 4 vegetation monitoring was completed in June 2011 utilizing the Carolina Vegetation Survey (CVS) – EEP protocol Level 2 (version 4.1). Baseline data provided was not completed utilizing the CVS-EEP protocol, therefore some data will be skewed.

Photo monitoring was conducted by walking each stream reach and taking photos at each predetermined photo point location using a digital camera.

#### **5.0 References**

USACOE (2003). *Stream Mitigation Guidelines*. USACOE, USEPA, NCWRC, NCDENR-DWQ.

USACOE (1987). *Corps of Engineers Wetlands Delineation Manual*. Tech report Y-87-1. AD/A176.

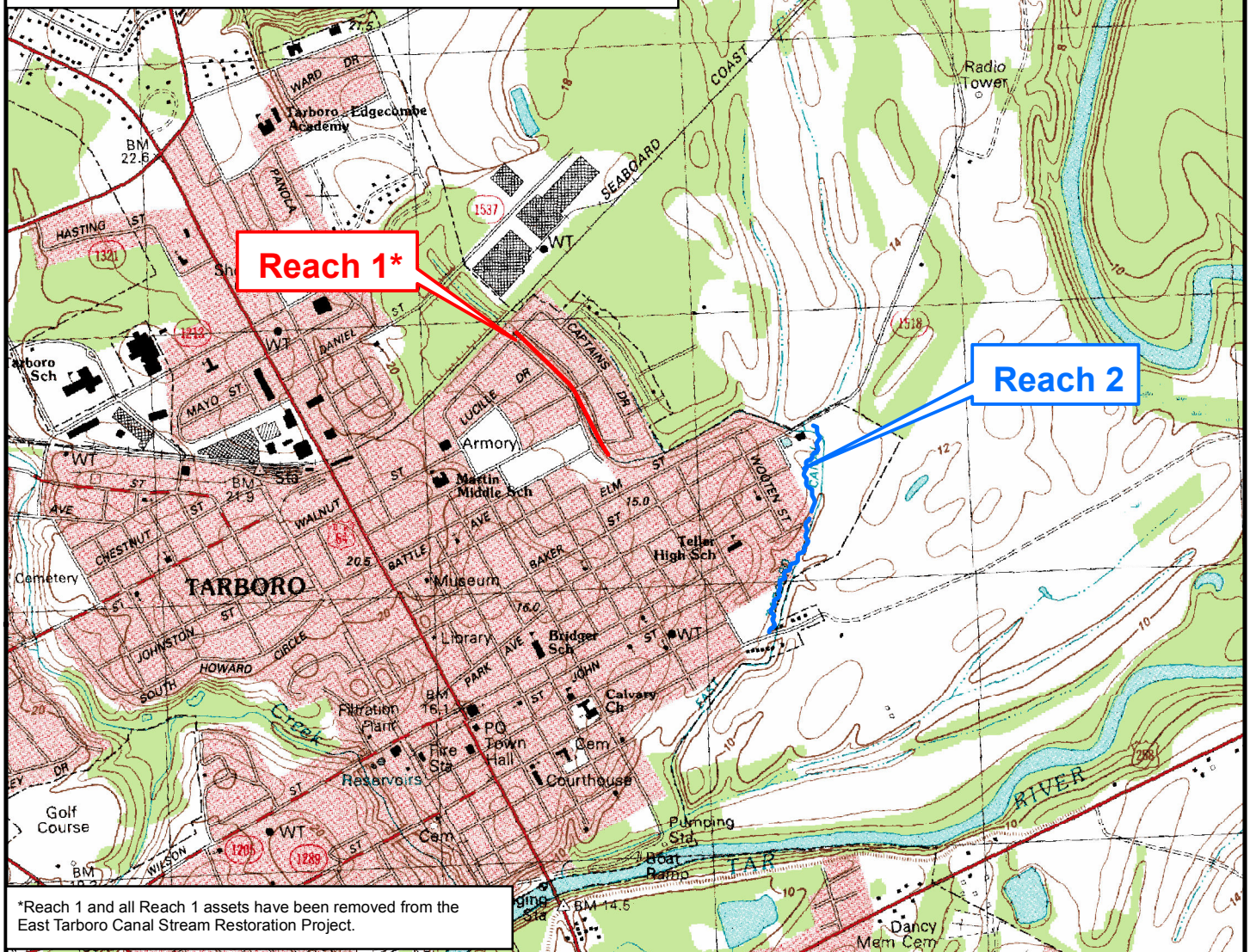
Rosgen, D.L. (1996) *Applied River Morphology*. Wildland Hydrology books, Pagosa Springs, CO.

Lee, M.T., R.K. Peet, S.D. Roberts, T.R. Wentworth. (2006). CVS-EEP Protocol for Recording Vegetation Version 4.0

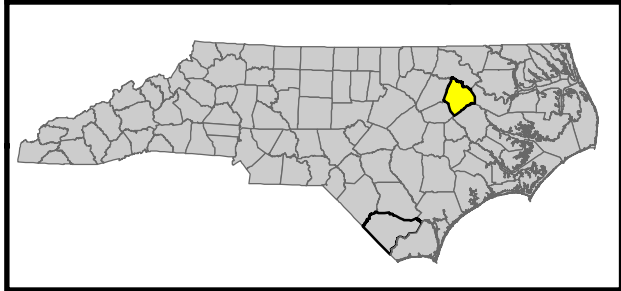
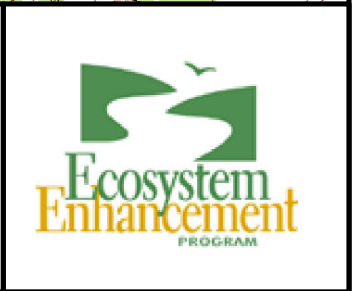
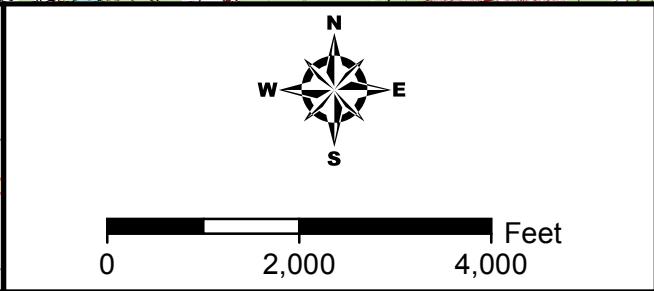
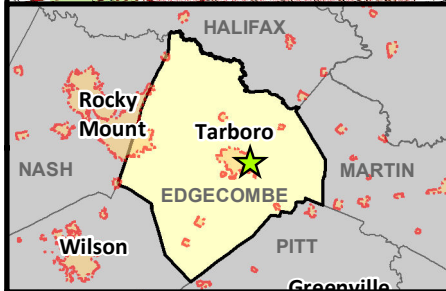
#### **6.0 Project Condition and Monitoring Data Appendices**

# ***APPENDIX A***

Directions to site: From Raleigh take US 64 east to exit 486 (Hwy 258). Take to intersection with S. Main St and turn left. Take S. Main St north across the Tar River and to the intersection with Martin Luther King Jr. Drive. Turn right on Battle Ave and take to dead end. Reach 1 of project occurs at dead end. If travelling to Reach 2, cross the Tar River on S. Main St to intersection with E. St. James St. Turn right on E. St. James St and take to intersection with E. Tarboro Canal (immediately past intersection with Oakland St.)



\*Reach 1 and all Reach 1 assets have been removed from the East Tarboro Canal Stream Restoration Project.



**FIGURE 1**  
 Site Location Map  
 East Tarboro Canal Stream Restoration Project  
 EEP No. 123  
 Edgecombe County, North Carolina  
 October 2011

**Table 1. Project Components and Mitigation Credits  
East Tarboro Canal, EEP No. 123**

<b>Mitigation Credits</b>									
	Stream (LF)		Riparian Wetland (acres)		Non-Riparian Wetland (acres)		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	2,989						418,176 sq. ft.		
<b>Project Components</b>									
Project Component	Stationing/Location		Existing Footage/Acreage		Approach	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio	
Reach 2	10+00 to 39+89				Priority 2		2989 LF	1:1	
<b>Component Summation</b>									
Restoration Level	Stream (Linear Feet)		Riparian Wetland (acres)		Non-riparian Wetland (acres)		Buffer (acres)	Upland (acres)	
Restoration	2,989						418,176 sq. ft		

**Table 2. Project Activity and Reporting History  
East Tarboro Canal Stream Restoration - EEP Project No. 123**

<b>Activity or Report</b>	<b>Data Collection Complete</b>	<b>Actual Completion or Delivery</b>
Restoration Plan	NA	January 2005
Final Design - 90%	NA	May 2005
Construction	Jan 2007	February 2007
Temporary S&E mix applied to entire project area	Jan 2007	Jan 2007
Permanent seed mix applied to entire project area	Jan 2007	Jan 2007
Containerized and B&B plantings	Jan 2007	Jan 2007
Mitigation Plan / As-built (Year 0 Monitoring - baseline)	April 2007	June 2007
Year 1 Monitoring	Nov 2008	Jan 2009
Year 2 Monitoring	Oct 2009	Nov 2009
Year 3 Monitoring	Oct 2010	Nov 2010
Supplemental Planting		February 2011
Year 4 Monitoring	October 2011	November 2011
Year 5 Monitoring	NA	NA

**Table 3. Project Contacts Table  
East Tarboro Canal Stream Restoration - EEP Project No. 123**

<b>Designer</b>	Earth Tech 701 Corporate Center Drive Suite 475 Raleigh, NC 27607
Primary project design POC	
<b>Construction Contractor</b>	Shamrock Environmental Corporation P.O. Box 14987 Greensboro, NC 27415 Mike Granson (336)-375-1989
Construction contractor POC	
<b>Planting Contractor</b>	Shamrock Environmental Corporation P.O. Box 14987 Greensboro, NC 27415 Mike Granson (336)-375-1989
Planting Contractor POC	
<b>Seeding Contractor</b>	Shamrock Environmental Corporation P.O. Box 14987 Greensboro, NC 27415 Mike Granson (336)-375-1989
Seeding Contractor POC	
Seed Mix Sources	contact Shamrock Environmental Corporation
Nursery Stock Suppliers	Mellow Marsh Farm 1312 Woody Store Road Siler City, NC 27344 (919) 742-1200
<b>Monitoring Performers</b> (MY1, MY2, MY3, MY4)	Rummel, Klepper, and Kahl, LLP 900 Ridgefield Drive Suite 250 Raleigh, NC 27609
Stream Monitoring POC	Pete Stafford (919)878-9560
Vegetation Monitoring POC	Pete Stafford (919)878-9560
Wetland Monitoring POC	NA

**Table 4. Project Baseline Information and Attributes  
East Tarboro Canal Restoration Site - EEP Project No. 123**

<b>Project Information</b>			
Project Name	East Tarboro Canal		
Project County	Edgecombe		
Project Area	N/A		
Project Coordinates (Lat and Long)	35.907617,-77.5217		
<b>Project Watershed Summary Information</b>			
Physiographic Region	Coastal Plain		
River Basin	Tar		
USGS HUC 8 Digit 03020103	USGS HUC 14 Digit 03020103010010		
NCDWQ Subbasin	030303		
Project Drainage Area	2.78 sq mi		
Project Drainage impervious cover estimate (%)	10 percent		
CGIA Land Use Classification			
<b>Reach Summary Information</b>			
Parameters	Reach 2		
Length of Reach	2,989 LF		
Valley Classification	N/A		
Drainage Area	2.78 sq mi		
NCDWQ Stream Identification Score			
NCDWQ Water Quality Classification	East Tarboro Canal (C, NSW)		
Morphological Description (stream type)	C5		
Evolutionary Trend	N/A		
Underlying Mapped Soils	Roanoke (Ro)		
Drainage Class	Poorly Drained		
Soil Hydric Status	Hydric A		
Slope	.00179		
FEMA Classification	Zone AE		
Native Vegetation Community	N/A		
Percent Composition Exotic Invasive Vegetation	N/A		
<b>Wetland Summary Information</b>			
There are no delineated or restored wetlands as part of this project.			
<b>Regulatory Considerations</b>			
<b>Regulation</b>	<b>Applicable?</b>	<b>Resolved?</b>	<b>Supporting Documentation</b>
Waters of the United States – Section 404	Yes	Yes	Upon Request
Waters of the United States – Section 401	Yes	Yes	Upon Request
Endangered Species Act	Yes	Yes	Upon Request
Historic Preservation Act	Yes	Yes	Upon Request
Coastal Zone Management Act (CZMA) Coastal Area Management Act (CAMA)	No		
FEMA Floodplain Compliance	Yes	Yes	Upon Request
Essential Fisheries Habitat	No		

## ***APPENDIX B***





**FIGURE 2**



Current Conditions Plan View  
Reach 2

East Tarboro Canal  
Stream Restoration Project  
EEP No. 123  
Edgecombe County, North Carolina

**Legend**

-  Stream Thalweg
-  Cross Section
-  Beaver Activity
-  Photo Point
-  Stream Areas of Concern

**Vegetation Monitoring Counts**

-  Less Than 290 Stems per Acre
-  More Than 290 Stems per Acre





**Table 5 - Visual Stream Morphological Stability Assessment**  
**Reach ID - Reach 2**  
**Assessed Length – 2989 LF**

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	% Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
<b>1. Bed</b>	1. Vertical Stability (Riffle and Run Units)	1. Aggradation			1	350	88 %			
		2. Degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate	42	44		95%				
	3. Meander Pool Condition	1. Depth	42	42		100%				
		2. Length	41	42		97%				
	4. Thalweg Condition	1. Thalweg at upstream of meander bend	NA	NA		NA				
2. Thalweg centering at downstream of meander		NA	NA	NA						
<b>2. Bank</b>	1. Scoured/Eroding	Bank lacking vegetative cover from pour growth and/or scour and erosion				1	100	97%	NA	NA
	2. Undercut	Banks undercut/overhanging			0	0	100%	NA	NA	98%
	3. Mass Wasting	Bank slumping, caving, or collapse			1	100	97%	NA	NA	98%
				<b>Totals</b>	2	200	93%	NA	NA	98%
<b>3. Engineered Structures</b>	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	17	19			89%			
	2. Grade Control	Grade Control exhibiting maintenance of grade across the ill	8	8			100%			
	2a. Piping	Structures Lacking any substantial flow underneath sills or arms	10	11			91%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	10	11			91%			
	4. Habitat	Pool forming structures maintaining – Max Pool Depth: Mean Bankfull Depth Ratio $\geq$ 1.6 Rootwads/logs providing some cover at base flow.	40	42			95%			

**Table 6 – Vegetation Condition Assessment  
Planted Acreage - NA**

<b>Vegetation Category</b>	<b>Definitions</b>	<b>Mapping Threshold</b>	<b>CCPV Depiction</b>	<b>Number of Polygons</b>	<b>Combined Acreage</b>	<b>% of Planted Acreage</b>
<b>1. Bare Areas</b>	Very Limited Cover of both woody and herbaceous material	No bare areas located onsite	NA	NA	NA	No bare areas located onsite
<b>2. Low Stem Density Areas</b>	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria	100 m <sup>2</sup> 0.0247 acre	RED	1	0.0247 acre	N/A
<b>3. Areas of Poor Growth Rates or Vigor</b>	Areas with woody stems of a size class that are obviously small given the monitoring year	100 m <sup>2</sup> 0.0247 acre	RED	1	0.0247 acre	N/A

## Appendix D – Stream Problem Areas Inventory Table

Stream Problem Areas East Tarboro Canal Stream Restoration Site EEP Project No. 123				
Feature Issue	Reach	Station Number	Suspected Cause	Photo Number
Stream has been re-routed through the adjacent wetland depression	Reach 2	34+00	Beavers	SP1
Bank Scour/Erosion	Reach 2	21+50	Rock vain failed	SP2
Beavers	Reach 2	Throughout – See figure 2	Beavers	SP3

**B.4 Stream Photo Station Photos (all photos recorded on October 13, 2011)**



Photo Station 5. Beginning of Reach 2 Downstream



Photo Station 6. Beginning of Reach 2 Downstream





Photo Station 7. Wilson Street Crossing Upstream



Photo Station 8. Wilson Street Crossing – Downstream





Photo Station 9. Culvert entry downstream



Photo Station 10. Pool Culvert Downstream





Photo Station 11. Reach 2 End of Project

**Stream Problem Area Photos** (all photos recorded on October 13, 2011)



SP1 – Area of stream reroute and aggradation - Station 34+00 – Reach 2



SP2 – Bank Erosion - Sta. 21+50 - Reach 2





SP3 – Beaver Ponding – Locations depicted in CCPV – Reach 2

All photos recorded on June 16, 2011

**Vegetation Plot Photos (all photos recorded on June 16, 2011)**



Vegetation Plot 2



Vegetation Plot 3



All photos recorded on June 16, 2011



Vegetation Plot 4



Vegetation Plot 5

All photos recorded on June 16, 2011



Vegetation Plot 6



Vegetation Plot 7



All photos recorded on June 16, 2011



Vegetation Plot 8



Vegetation Plot 9



All photos recorded on June 16, 2011



Vegetation Plot 10



Vegetation Plot 11

All photos recorded on June 16, 2011



Vegetation Plot 12



Vegetation Plot 13



## Appendix C - Vegetation Problem Areas Photos



VPA1 – Beaver Harvest – Adjacent to Cross Section 10 – Reach 2



VPA2 – Cattails – Station 34+00 – Reach 2

(Photos Recorded on October 13, 2011)



## *APPENDIX C*

<b>Table 7. Vegetation Plot Criteria Attainment Stream Criteria</b>			
<b>Tract</b>	<b>Vegetation Plot ID</b>	<b>Vegetation Survival Threshold Met?</b>	<b>Tract Mean</b>
Reach 1*	VP1*	Did not Monitor for 2011*	NA
Reach 2**	VP2	Y	92%
Reach 2**	VP3	Y	
Reach 2**	VP4	N	
Reach 2**	VP5	Y	
Reach 2**	VP6	Y	
Reach 2**	VP7	Y	
Reach 2**	VP8	Y	
Reach 2**	VP9	Y	
Reach 2**	VP10	Y	
Reach 2**	VP11	Y	
Reach 2**	VP12	Y	
Reach 2**	VP13	Y	

\*Reach 1 and all Reach 1 assets have been removed from the East Tarboro Canal Stream Restoration Project

\*\* The East Tarboro Canal Stream Restoration Project received supplemental planting in February 2011

<b>Table 7a. Vegetation Plot Criteria Attainment Buffer Criteria</b>			
<b>Tract</b>	<b>Vegetation Plot ID</b>	<b>Vegetation Survival Threshold Met?</b>	<b>Tract Mean</b>
Reach 1*	VP1*	Did not Monitor for 2011*	NA
Reach 2**	VP2	Y	92%
Reach 2**	VP3	Y	
Reach 2**	VP4	N	
Reach 2**	VP5	Y	
Reach 2**	VP6	Y	
Reach 2**	VP7	Y	
Reach 2**	VP8	Y	
Reach 2**	VP9	Y	
Reach 2**	VP10	Y	
Reach 2**	VP11	Y	
Reach 2**	VP12	Y	
Reach 2**	VP13	Y	

\*Reach 1 and all Reach 1 assets have been removed from the East Tarboro Canal Stream Restoration Project

\*\* The East Tarboro Canal Stream Restoration Project received supplemental planting in February 2011

**Table 8. CVS Vegetation Plot Metadata  
East Tarboro Canal EEP No: 123**

Report Prepared By	William (Pete) Stafford
Date Prepared	10/11/2011 10:33
Database Name	EastTarboroCanal.mdb
Database Location	C:\Documents and Settings\pstafford\Desktop\CVS Veg Data
Computer Name	STAFFORDP
<b>Description Worksheets In This Document</b>	
<b>Metadata</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Proj, total stems</b>	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.
<b>Plots</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>Planted Stems by Plot and Spp</b>	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
<b>Project Summary</b>	
<b>Project Code</b>	123
<b>Project Name</b>	East Tarboro Canal
<b>Description</b>	Stream Restoration Project
<b>River Basin</b>	Tar-Pamlico
<b>Length(ft)</b>	2989 LF
<b>Stream-to-edge width (ft)</b>	
<b>Area (sq m)</b>	
<b>Required Plots (calculated)</b>	

**Table 9 - Planted and Total Counts (Species by Plot with Annual Means)**

		CURRENT DATA (MY4 2011)																								ANNUAL MEANS										
		Plot 1**		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12		Plot 13		Current Mean***		MY3 (2010)		MY2 (2009)		MY1 (2008)		
Scientific Name	Common Name	Type	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T		
<i>Alnus serrulata</i>	Tag Alder	Shrub																1	1							1	1	2	2	2	3	2	2			
<b><i>Betula nigra</i></b>	<b>River Birch</b>	Tree			4	4							3	3	1	1	1	1			2	2	3	3	2	2	3	3	19	19	2	1	2	2	2	34
<b><i>Cornus amomum</i></b>	<b>Silky Dogwood</b>	Tree																1	1							1	1	2	2	5	1	5	5	5	4	
<b><i>Cornus florida</i></b>	<b>Dogwood</b>	Tree										1	1							1	1							2	2	1	2	1	1	1	4	
<b><i>Fraxinus pennsylvanica</i></b>	<b>Green Ash</b>	Tree			1	1	2	2			2	2	1	1	4	4	2	2	1	1	6	6			5	5			24	24	3	10	3	3	3	47
<i>Hamamelis</i>	Witch Hazel	Shrub																						1	1			1	1	1	1	1	1	1	2	
<i>Itea virginica</i>	Sweetspire	Shrub								1	1			1	1											1	1	3	3	5	3	5	12	5	6	
<i>Liriodendron tulipifera</i>	Poplar	Tree					2	2					2	2										3	3			7	7	N/A	N/A	N/A	N/A	N/A	N/A	
<i>Myrica sp.</i>	Wax Myrtle	Shrub			2	2			1	1			1	1							2	2	2	2	2	2	2	2	12	12	21	13	21	1	21	22
<b><i>Nyssa biflora</i></b>	<b>Black Gum</b>	Tree								2	2									2	2							4	4	10	6	10	13	10	8	
<i>Platanus occidentalis</i>	Sycamore	Tree						5	5			3	3			1	1					7	7			4	4	20	20	N/A	N/A	N/A	N/A	N/A	N/A	
<b><i>Quercus laurifolia</i></b>	<b>Laurel Oak</b>	Tree																										0	0	3	1	3	1	3	0	
<b><i>Quercus lyrata</i></b>	<b>Overcup Oak</b>	Tree					1	1						2	2													3	3	1	3	1	4	1	6	
<b><i>Quercus pagoda</i></b>	<b>Cherrybark Oak</b>	Tree					2	2						2	2					4	4							8	8	7	7	7	8	7	16	
<b><i>Quercus palustris</i></b>	<b>Pin Oak</b>	Tree										1	1															1	1	2	2	2	1	2	2	
<b><i>Quercus phellos</i></b>	<b>Willow Oak</b>	Tree							1	1	4	4			2	2			2	2	3	3	2	2				14	14	4	2	4	2	4	28	
<i>Rosa palustris</i>	Swamp Rose	Shrub					1	1						1	1	1	1			1	1	1	1					5	5	7	6	7	4	7	10	
<b><i>Salix caroliniana</i></b>	<b>Willow</b>	Tree								4	4																	4	4	4	4	4	4	4	8	
<b><i>Taxodium distichum</i></b>	<b>Bald Cypress</b>	Tree																				2	2					2	2	1	1	1	1	1	4	
<i>Unknown</i>					1	1	1	1								1	1											3	3	47	6	47	14	47	5	
<i>Viburnumsp.</i>	Viburnum	Shrub						1	1			2	2	1	1													4	4		4					
	Plot Area (acres)		0.025		0.025		0.03		0.03		0.025		0.025		0.025		0.03		0.03		0.025		0.025		0.025		0.025									
Stream Restoration Criteria	Species Count		0	4	2	4	5	5	2	5	3	4	4	4	7	3	2	4	4	5	5	5	4	1	6	2	5	21	21	18	19	18	18	18	18	
	Stem Count		0	8	8	9	9	7	7	10	10	18	18	12	12	9	9	8	8	14	14	18	18	15	15	11	11	139	139	113	75	113	80	113	113	
	Stems/Acre		0	320	320	360	360	280	280	400	400	720	720	480	480	360	360	320	320	560	560	720	720	600	600	440	440	463.3	463	363	250	363	320	230	363.3	
Buffer Restoration Criteria	Species Count		0	2	2	4	4	1	1	4	4	7	7	4	4	5	5	3	3	4	4	4	4	4	4	3	3	13	13	12	12	12	10	12	12	
	Stem Count		0	5	5	7	7	5	5	9	9	15	15	9	9	7	7	7	7	11	11	15	15	12	12	8	8	110	110	33	40	33	39	32	33	
	Stems/Acre		0	200	200	280	280	200	200	360	360	600	600	360	360	280	280	280	280	440	440	600	600	480	480	320	320	366.7	367	110	133	110	172	107	110	

\*Bolded tree species are counted toward riparian buffer success criteria

\*\*Reach 1 and all Reach 1 assets have been removed from the East Tarboro Canal Stream Restoration Project

\*\*\*East Tarboro Canal was replanted in February 2011, the 2011 MY4 (Current Mean) data will be used as baseline to account for the new planted stems

## ***APPENDIX D***



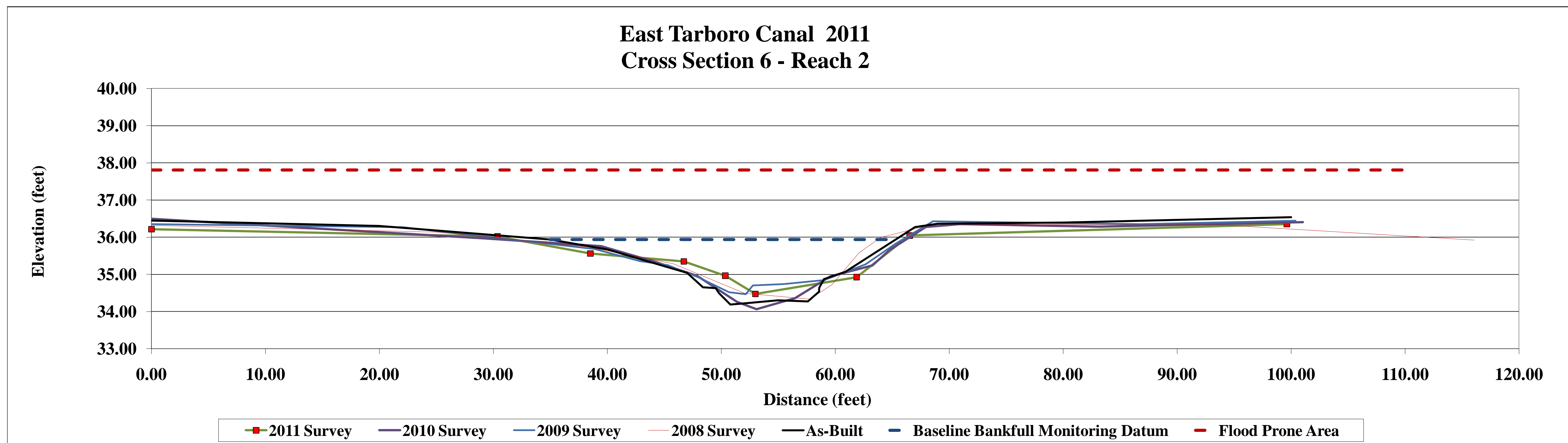
**Project Name** East Tarboro Canal  
**Watershed** Mill Creek, MY4  
**Cross Section** 6  
**Drainage Area** NA  
**Date** Mar-11  
**Crew** Tutt, Stafford

**Photo of Cross-Section #6 - Looking Downstream**

Picture Taken October 13 2011

As-Built Survey			2008 Survey			2009 Survey			2010 Survey			2011 Survey			2012 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	36.45	LPIN	0.00	36.32		0.00	36.35		0.00	36.50		0.00	36.22				
20.00	36.30		25.08	36.14		22.07	36.27		29.01	35.97		30.36	36.02				
35.00	35.94	BKF	38.26	35.74		38.88	35.68		39.47	35.76		38.52	35.56				
40.00	35.67		45.82	35.29		42.86	35.35		44.32	35.32		46.71	35.35				
47.00	35.04		52.03	34.49		45.30	35.25		47.88	34.96		50.35	34.96				
48.40	34.65		57.78	34.33		48.03	34.92		51.39	34.26		52.99	34.47				
49.50	34.63	LEW	59.72	34.73		50.69	34.52		52.41	34.14		61.88	34.92				
49.80	34.49		62.08	35.58		52.16	34.46		53.08	34.07		66.53	36.05				
50.80	34.19	TW	63.97	35.99		52.77	34.70		56.47	34.36		99.63	36.35				
52.00	34.22		68.53	36.35		55.50	34.74		59.56	34.95							
55.00	34.30		94.15	36.33		59.02	34.84		63.27	35.25							
57.60	34.27		116.05	35.92		62.67	35.27		64.78	35.66							
58.60	34.54					65.29	35.83		67.95	36.28							
58.60	34.64	REW				68.58	36.43		70.94	36.35							
59.00	34.87					86.79	36.35		83.20	36.28							
60.90	35.07					100.38	36.44		101.03	36.40							
67.00	36.27																
69.00	36.36																
80.00	36.39																
100.00	36.54	RPIN															

Summary Data	
Bankfull Elev.	35.94
BF Area	18.7
BF Width	34.3
Flood Prone Elev.	37
Flood Prone Width	99.6
Max Depth	1
Mean Depth	0.55
W/D Ratio	62.8
ER	2.9
Bank Height Ratio	
Stream Type	C5



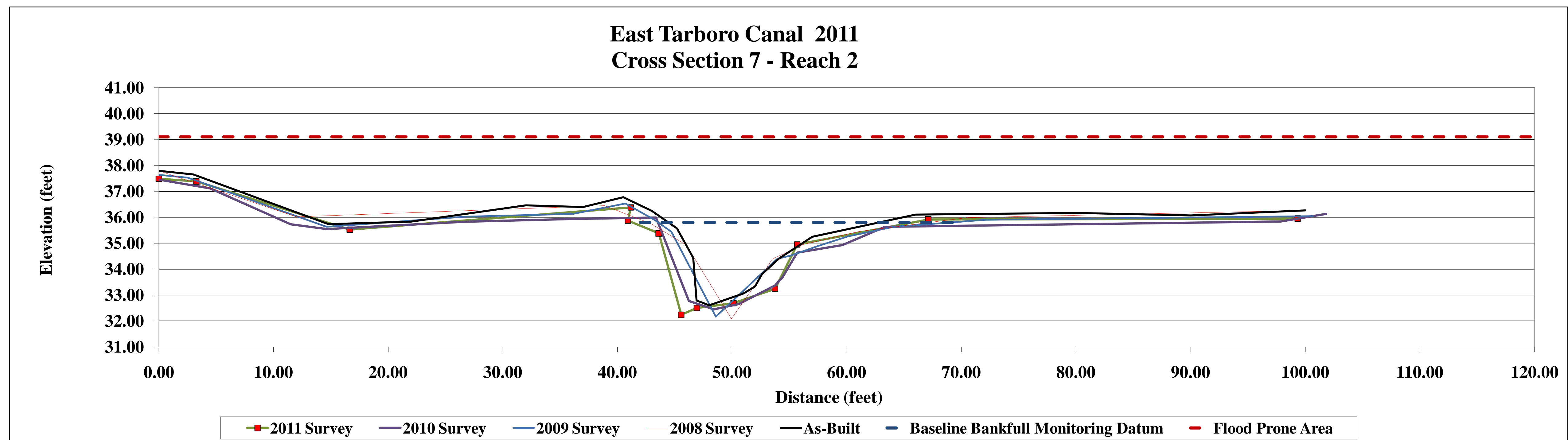


**Project Name** East Tarboro Canal  
**Watershed** Mill Creek, MY4  
**Cross Section** 7  
**Drainage Area** NA  
**Date** Mar-11  
**Crew** Tutt, Stafford

Photo of Cross-Section #7 - Looking Upstream

Picture Taken October 13 2011

As-Built Survey			2008 Survey		2009 Survey		2010 Survey		2011 Survey			2012 Survey		Summary Data		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes		
0.00	37.79	LPIN	0.00	37.79		0.00	37.63		0.00	37.49		0.00	37.49		Bankfull Elv.	35.8
3.00	37.65		12.00	36.02		2.53	37.53		4.47	37.11		3.26	37.38		BF Area	38.6
14.80	35.73		38.87	36.45		14.64	35.63		11.49	35.72		16.65	35.52		BF Width	34.3
22.00	35.83		42.91	35.76		26.68	36.02		14.66	35.54		41.16	36.38		Flood Prone Elv.	39.36
32.00	36.46		46.03	34.92		36.11	36.13		26.67	35.83		40.91	35.87		Flood Prone Width	99.3
37.00	36.39		49.94	32.08		40.69	36.53		36.11	35.94		43.60	35.38		Max Depth	3.6
40.50	36.77		52.84	33.91		43.26	35.89		43.36	35.99		45.56	32.24		Mean Depth	1.13
43.00	36.24		53.48	34.38		44.70	35.44		46.24	32.77		46.93	32.50		W/D Ratio	30.6
45.20	35.57		56.17	34.94		48.57	32.17		48.41	32.45		50.13	32.69		ER	2.9
46.60	34.43	LEW	61.09	35.45		53.95	34.40		50.59	32.66		53.74	33.24		Bank Height Ratio	
46.90	32.79		70.47	35.99		55.15	34.52		53.74	33.37		55.69	34.95		Stream Type	C5
48.00	32.60	TW	100.00	36.26		57.45	34.88		54.40	33.69		67.11	35.92			
49.00	32.75					60.11	35.27		55.69	34.64		99.33	35.95			
51.00	33.06					64.10	35.63		59.63	34.92						
52.00	33.33					72.13	35.90		63.34	35.63						
52.60	33.81					100.66	36.04		97.87	35.84						
54.10	34.41	REW							101.81	36.13						
57.00	35.25															
66.00	36.10	BKF														
80.00	36.17															
90.00	36.07															
100.00	36.26	RPIN														





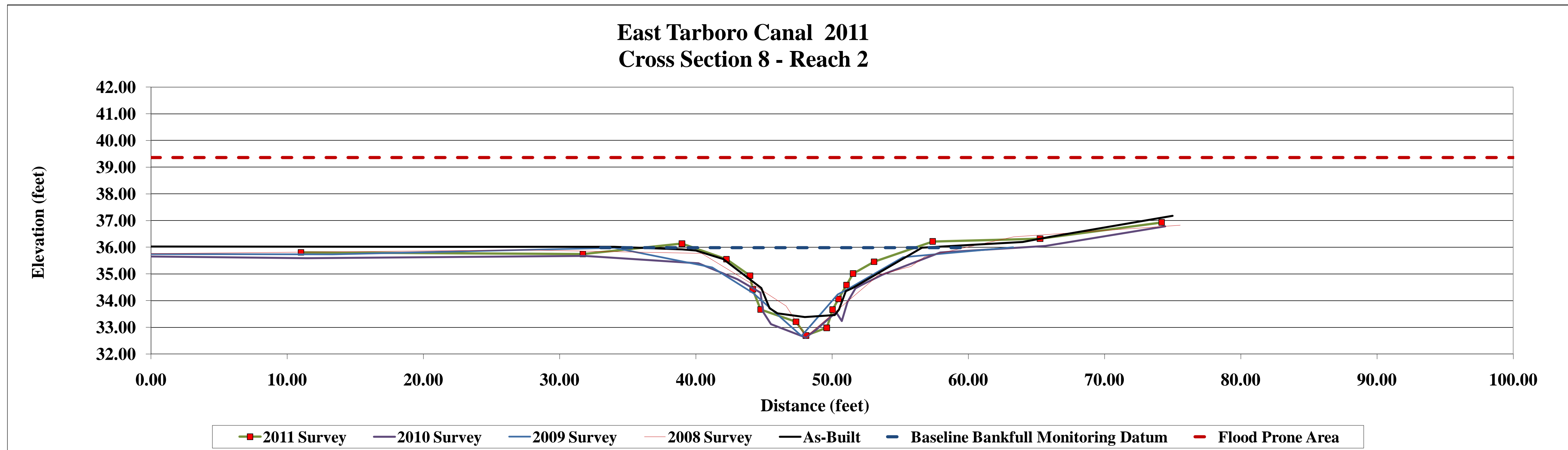
<b>Project Name</b>	East Tarboro Canal
<b>Watershed</b>	Mill Creek, MY4
<b>Cross Section</b>	8
<b>Drainage Area</b>	NA
<b>Date</b>	Mar-11
<b>Crew</b>	Tutt, Stafford

Photo of Cross-Section #8 - Looking Upstream

Picture Taken October 13 2011

As-Built Survey			2008 Survey		2009 Survey		2010 Survey		2011 Survey			2012 Survey		
12.00	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
	0.00	36.03 LPIN	0.00	35.76		0.00	35.74		0	35.7				
	20.00	36.02	27.39	35.90		13.34	35.73		11.01	35.81				
	34.00	36.02	40.41	35.77		34.02	35.98		31.70	35.74				
	39.00	35.92	44.41	34.53		41.21	35.24		40.20	36.13				
	40.00	35.88	46.63	33.80		44.22	34.27		43.06	35.55				
	42.00	35.56	48.09	32.65		47.75	32.68		44.75	34.93				
	44.80	34.47 LEW	52.77	34.69		50.42	34.23		44.95	33.56		44.18	34.42	
	45.40	33.71	53.36	34.95		51.31	34.48		45.52	33.12		44.76	33.67	
	46.00	33.52	55.78	35.28		55.22	35.63		48.07	32.62		47.35	33.21	
	48.00	33.38 TW	56.84	35.66		63.30	36.00		48.79	32.90		48.08	32.69	
	50.20	33.46	63.32	36.38		74.01	36.86		50.29	33.56		49.61	32.98	
	50.50	33.66	75.55	36.82					50.71	33.23		50.04	33.66	
	51.00	34.35							51.14	33.95		50.47	34.06	
	51.50	34.47 REW							51.71	34.46		51.05	34.58	
	56.60	35.98 BKF							52.18	34.58		51.53	35.01	
	64.00	36.20							53.70	34.97		53.08	35.46	
	66.00	36.39							57.93	35.80		57.38	36.22	
	75.00	37.18 RPIN							65.67	36.05		65.26	36.32	
									74.45	36.78		74.20	36.93	

Summary Data	
Bankfull Elev.	35.98
BF Area	29.6
BF Width	52.4
Flood Prone Elev.	39.27
Flood Prone Width	74.2
Max Depth	3.3
Mean Depth	0.6
W/D Ratio	92.8
ER	1.4
Bank Height Ratio	
Stream Type	C5



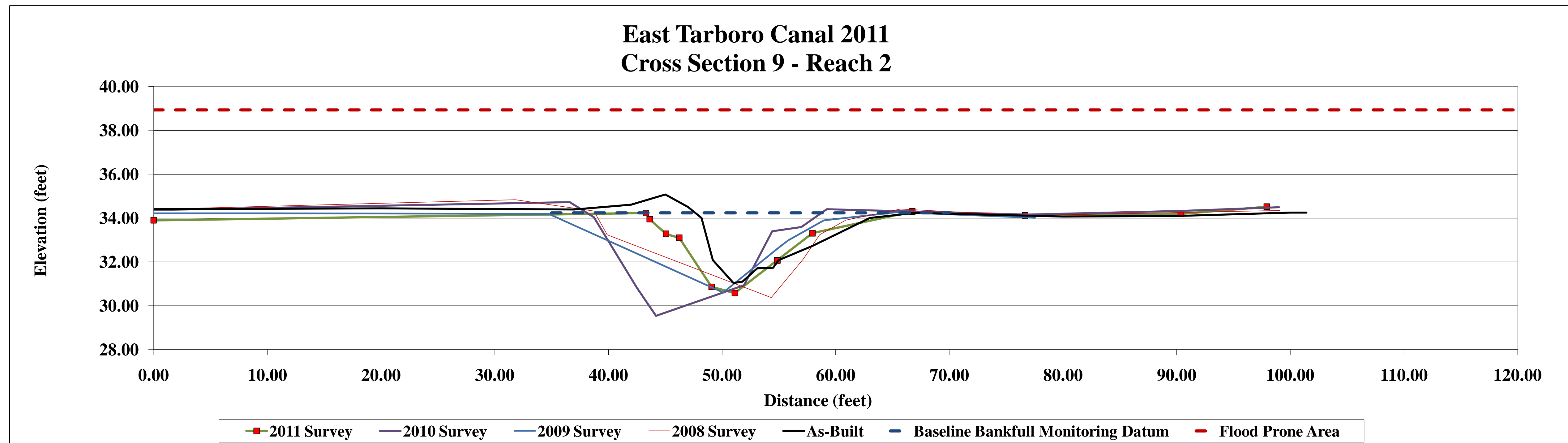


<b>Project Name</b>	East Tarboro Canal
<b>Watershed</b>	Mill Creek, MY4
<b>Cross Section</b>	9
<b>Drainage Area</b>	NA
<b>Date</b>	Mar-11
<b>Crew</b>	Tutt, Stafford

Photo of Cross-Section #9 - Looking Downstream

Picture Taken October 13 2011

As-Built Survey			2008 Survey			2009 Survey			2010 Survey			2011 Survey			2012 Survey			Summary Data	
Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Bankfull Elv.	BF Area
0.00	34.41	LPIN	0.00	34.40		0.00	34.22		0.00	34.37		0.00	33.90					34.24	44.5
20.00	34.44		31.81	34.84		10.00	34.22		36.60	34.72		43.31	34.23					20.02	
37.00	34.39		38.72	34.32		34.76	34.19		38.71	34.04		43.64	33.95					37.9	97.9
42.00	34.61		39.90	33.24		50.10	30.60		42.51	30.83		45.08	33.28					3.7	2.2
45.00	35.08		54.34	30.37		54.90	32.61		44.18	29.53		46.24	33.10					9	4.9
47.00	34.51		57.17	32.15		55.85	32.99		51.94	30.94		49.09	30.86						
48.20	34.00		58.59	33.23		58.96	33.90		54.41	33.40		51.13	30.58						
49.20	32.08	LEW	60.90	33.91		65.41	34.26		56.98	33.59		54.86	32.07						
51.00	31.03	TW	65.70	34.41		77.54	34.01		59.22	34.40		57.96	33.31						
51.80	31.10		76.79	34.12		97.90	34.21		76.82	34.16		66.74	34.30						
53.10	31.71		99.09	34.35					90.46	34.32		76.67	34.12						
54.50	31.73								98.99	34.49		90.36	34.19						
55.00	32.08	REW										97.92	34.52						
58.00	32.74																		
63.00	34.00																		
67.00	34.24	BKF																	
80.00	34.07																		
90.00	34.10																		
100.00	34.25																		
101.40	34.25	RPIN																	





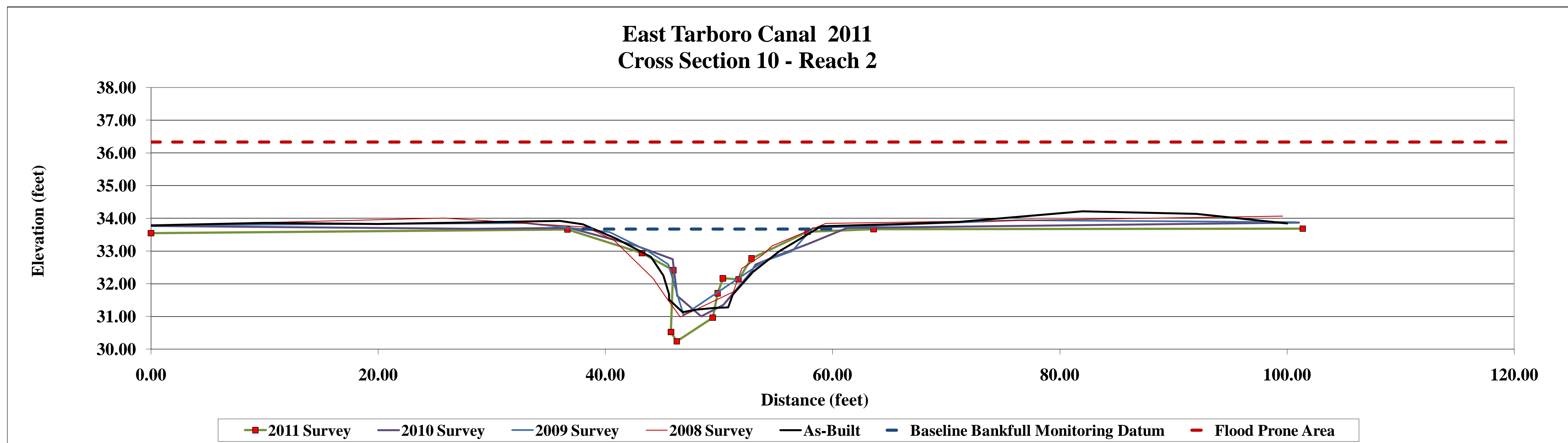
<b>Project Name</b>	East Tarboro Canal
<b>Watershed</b>	Mill Creek, MY4
<b>Cross Section</b>	10
<b>Drainage Area</b>	NA
<b>Date</b>	Mar-11
<b>Crew</b>	Tutt, Stafford

Photo of Cross-Section #10 - Unable to stretch tape across stream due to beaver flooding

Picture Taken October 13 2011

As-Built Survey			2008 Survey			2009 Survey			2010 Survey			2011 Survey			2012 Survey		
Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes
0.00	33.78	LPIN	0.00	33.78		0.00	33.79		0.00	33.76		0.00	33.55				
10.00	33.86		25.81	34.00		32.90	33.86		28.37	33.68		36.66	33.66				
20.00	33.83		38.28	33.73		40.35	33.58		36.85	33.71		43.22	32.94				
36.00	33.92		40.74	33.33		43.73	33.01		42.70	33.17		45.97	32.41				
38.00	33.82		44.20	32.16		45.54	32.59		45.92	32.75		45.77	30.53				
41.00	33.37		45.45	31.53		46.89	31.04		46.32	31.64		46.28	30.24				
44.00	32.82		46.60	30.99		53.95	32.69		48.42	31.00		49.45	30.97				
45.10	32.25		51.25	31.75		56.42	33.00		50.40	31.36		49.88	31.71				
45.60	31.68	LEW	51.99	32.46		58.23	33.70		52.83	32.36		50.34	32.17				
45.60	31.52		52.72	32.62		76.34	33.94		53.21	32.58		51.71	32.13				
46.80	31.13	TW	53.86	32.89		100.78	33.88		55.07	32.85		52.86	32.77				
48.00	31.21		54.66	33.16					57.84	33.22		57.80	33.59				
49.60	31.26		59.39	33.85					61.29	33.71		63.61	33.67				
50.80	31.28		99.61	34.07					101.06	33.87		101.39	33.69				
51.20	31.67	REW															
53.00	32.36																
55.30	32.99																
59.00	33.76	BKF															
66.00	33.83																
71.00	33.89																
82.00	34.21																
92.00	34.14																
100.00	33.84	RPIN															

Summary Data	
Bankfull Elv.	33.67
BF Area	26.5
BF Width	63.5
Flood Prone Elv.	37
Flood Prone Width	103.4
Max Depth	3.4
Mean Depth	0.4
W/D Ratio	152.2
ER	1.6
Bank Height Ratio	
Stream Type	C5





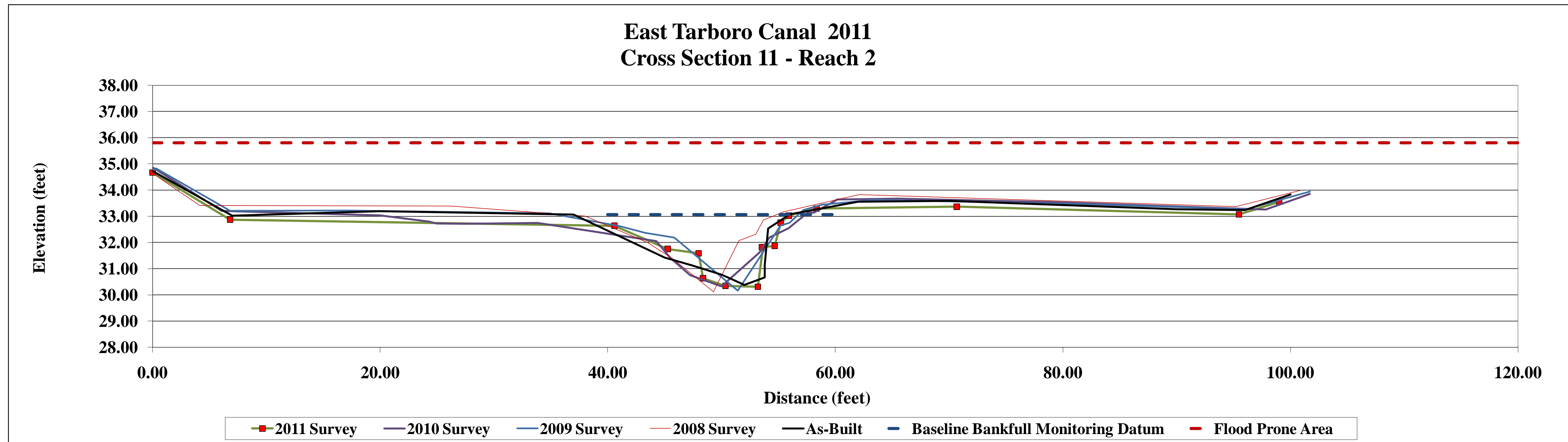
<b>Project Name</b>	East Tarboro Canal
<b>Watershed</b>	Mill Creek, MY4
<b>Cross Section</b>	11
<b>Drainage Area</b>	NA
<b>Date</b>	Mar-11
<b>Crew</b>	Tutt, Stafford

Photo of Cross-Section #11 - Looking Downstream - Beaver Dam located on cross section

As-Built Survey			2008 Survey			2009 Survey			2010 Survey			2011 Survey			2012 Survey		
Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes
0.00	34.73	LPIN	100.86	33.99		0.00	34.72		0.00	34.87		0.00	34.67				
7.00	33.02		95.21	33.37		0.31	34.83		6.10	33.21		6.82	32.87				
20.00	33.19		62.08	33.82		6.82	33.21		19.99	33.03		40.59	32.64				
37.00	33.06	BKF	55.44	33.17		17.23	33.22		24.28	32.79		45.27	31.75				
45.00	31.42		53.68	32.85		34.84	33.11		24.95	32.73		47.99	31.59				
47.40	31.13	LEOW	52.99	32.31		40.96	32.63		27.45	32.71		48.37	30.63				
50.00	30.77		51.53	32.06		43.29	32.37		33.86	32.75		50.35	30.34				
51.00	30.58		49.29	30.12		45.86	32.19		44.26	32.05		53.20	30.31				
52.00	30.38	TW	45.72	31.37		51.42	30.16		45.49	31.41		53.63	31.82				
53.80	30.67		43.52	32.00		55.18	32.64		47.23	30.75		53.54	31.82				
53.80	31.15	REOW	38.01	33.01		55.96	32.75		49.99	30.33		54.67	31.87				
54.10	32.53		26.25	33.39		57.21	33.24		53.30	31.60		55.20	32.75				
56.00	33.08		4.14	33.41		58.84	33.44		54.22	32.19		55.91	33.02				
62.00	33.56		0.00	34.63		63.32	33.62		55.89	32.54		58.35	33.29				
70.00	33.59					80.80	33.48		57.58	33.13		70.68	33.36				
90.00	33.27					96.16	33.27		58.12	33.14		95.47	33.07				
96.00	33.24					101.71	33.94		60.18	33.64		99.01	33.55				
100.00	33.83	RPIN							65.60	33.67							
									78.69	33.55							
									97.81	33.26							
									101.71	33.85							

Summary Data	
Bankfull Elv.	33.06
BF Area	33.8
BF Width	47.2
Flood Prone Elv.	35.8
Flood Prone Width	90
Max Depth	2.8
Mean Depth	0.7
W/D Ratio	66.1
ER	1.9
Bank Height Ratio	
Stream Type	C5

Picture Taken October 13 2011



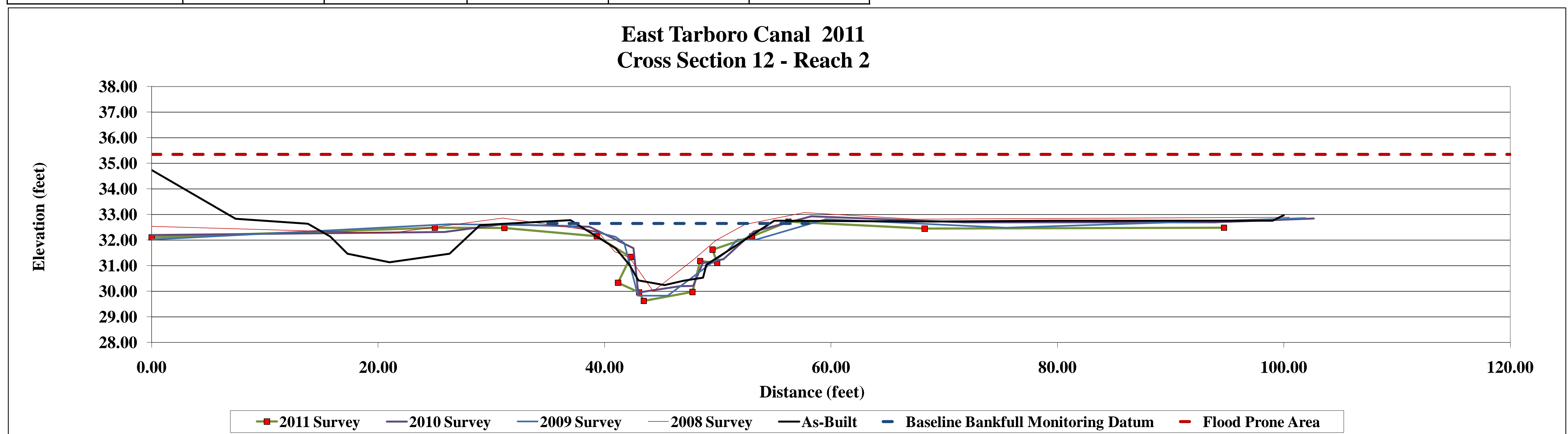


<b>Project Name</b>	East Tarboro Canal
<b>Watershed</b>	Mill Creek, MY4
<b>Cross Section</b>	12
<b>Drainage Area</b>	NA
<b>Date</b>	Mar-11
<b>Crew</b>	Tutt, Stafford

Photo of Cross-Section #12 - Looking Downstream

Picture Taken October 13 2011

As-Built Survey			2008 Survey			2009 Survey			2010 Survey			2011 Survey			2012 Survey			Summary Data	
Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes	Station	Elv	Notes		
0.00	34.74	LPIN	0.00	32.54		0.00	32.02		0.00	32.20		0.00	32.11					Bankfull Elv.	32.65
7.40	32.83		21.01	32.26		26.33	32.62		25.88	32.31		25.00	32.49					BF Area	27.4
13.80	32.64		31.01	32.86		36.95	32.55		30.97	32.62		31.15	32.47					BF Width	31.9
15.80	32.13		39.38	32.34		40.97	32.13		38.66	32.52		39.31	32.15					Flood Prone Elv.	35.27
17.30	31.47		40.89	31.55		41.73	31.88		42.56	31.68		42.30	31.34					Flood Prone Width	69.7
21.00	31.13		42.18	31.32		42.96	29.83		42.96	29.95		41.19	30.33					Max Depth	2.8
26.30	31.47		42.76	30.97		45.59	29.83		46.67	30.20		43.05	29.96					Mean Depth	0.7
29.00	32.58		44.28	30.00		50.82	31.56		47.83	30.20		43.46	29.62					W/D Ratio	37.3
37.00	32.78		48.01	31.29		51.74	32.02		48.68	31.10		47.76	29.97					ER	2.2
41.00	31.67		49.82	31.98		53.33	32.00		50.49	31.25		48.45	31.18					Bank Height Ratio	
42.20	31.04	LEW	52.41	32.61		59.54	32.82		53.19	32.33		49.95	31.11					Stream Type	C5
43.00	30.42		57.65	33.07		75.48	32.48		58.27	32.93		49.54	31.63						
45.30	30.24	TW	67.42	32.81		101.87	32.86		71.75	32.69		53.04	32.15						
47.00	30.41		100.49	32.90					93.85	32.69		56.24	32.72						
48.70	30.53								102.65	32.85		68.28	32.45						
49.00	31.04	REW										94.72	32.48						
55.00	32.76	BKF																	
69.00	32.72																		
80.00	32.76																		
99.00	32.76																		
100.00	32.97	RPIN																	



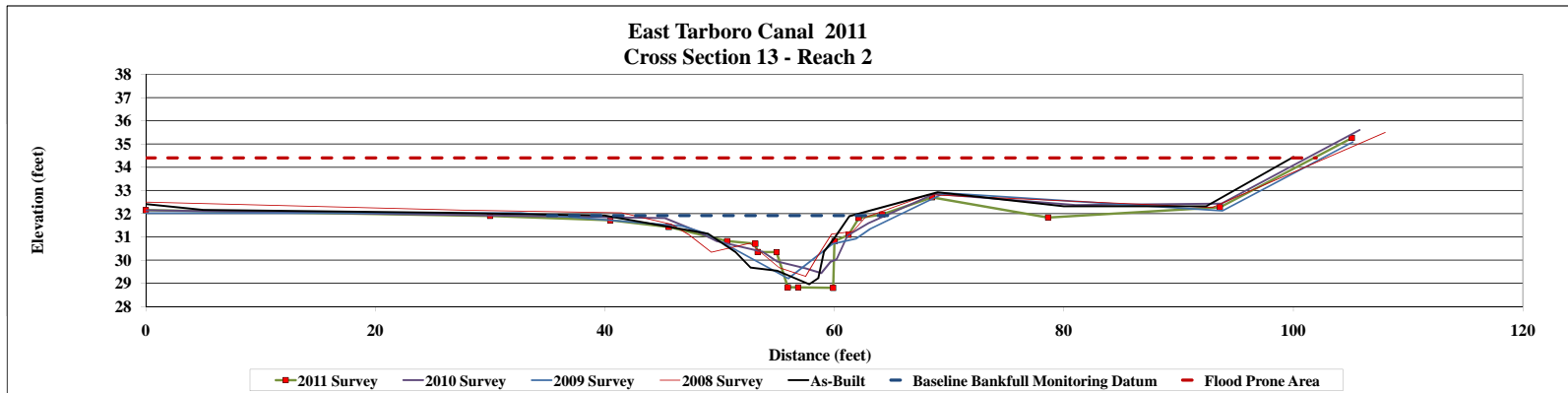


Project Name	East Tarboro Canal
Watershed	Mill Creek, MY4
Cross Section	#13
Drainage Area	NA
Date	Mar-11
Crew	Tutt, Stafford

Photo of Cross-Section #13 - Looking Upstream

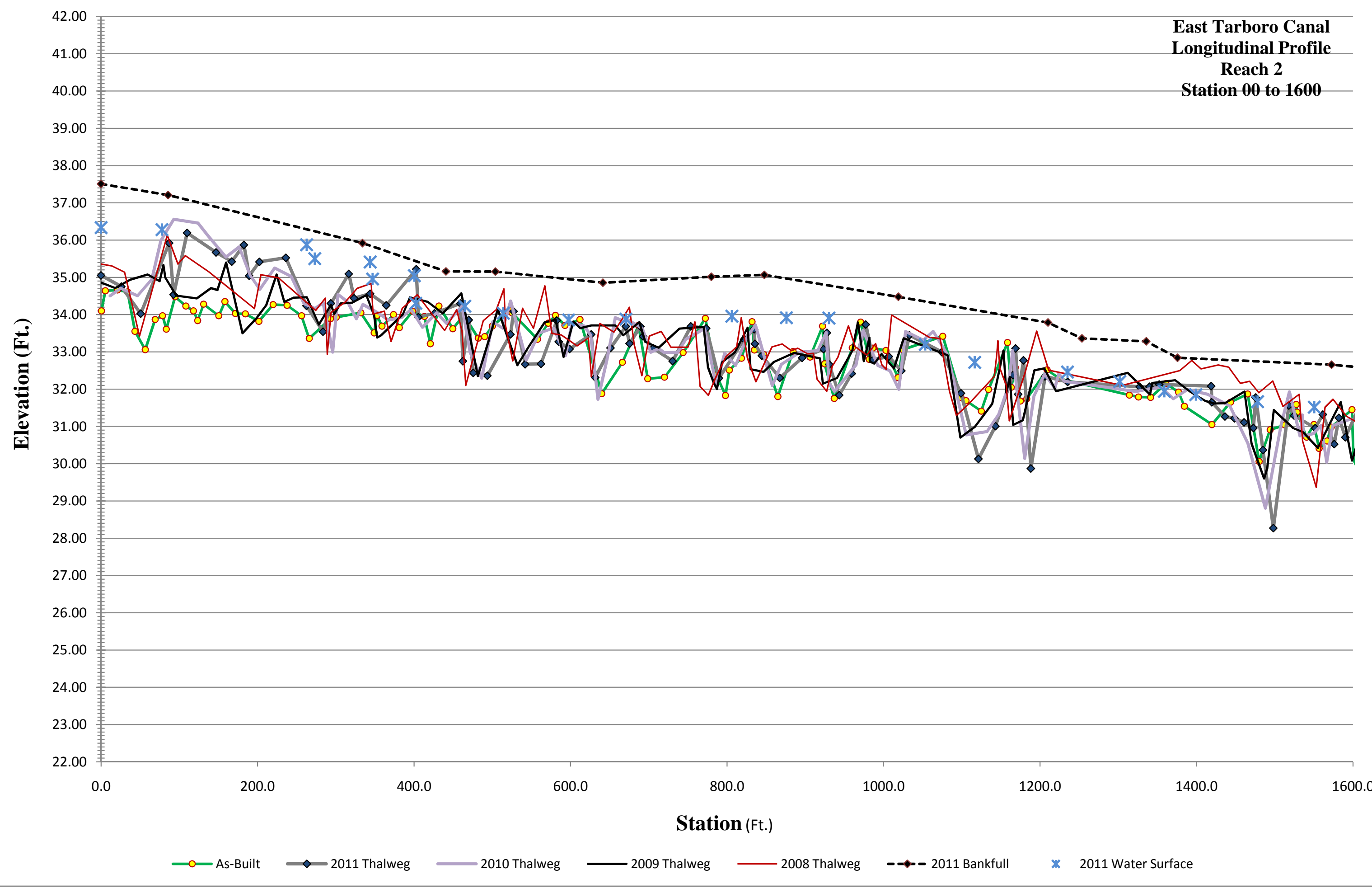
Picture Taken October 13 2011

As-Built Survey			2008 Survey			2009 Survey			2010 Survey			2011 Survey			2012 Survey			Summary Data	
Station	Elev	Notes	Station	Elev	Notes	Station	Elev	Notes	Station	Elev	Notes	Station	Elev	Notes	Station	Elev	Notes		
0	32.41	LPIN	0.00	32.50		0.00	32.02		0	32.1491		0	32.15		0	32.15		Bankfull Elev.	31.92
5	32.16		27.52	32.15		32.66	32.03		45.2	31.8066		30	31.9		30	31.9		BF Area	29.3
26	32.04		41.46	32.04		46.73	31.47		47.9	31.2745		40.5	31.72		40.5	31.72		BF Width	36.4
40	31.92	BKF	45.78	31.55		48.77	31.15		49.74	30.8204		45.58	31.42		45.58	31.42		Flood Prone Elev.	35
49	31.14		47.33	31.09		55.98	29.21		53.8	30.3593		50.65	30.82		50.65	30.82		Flood Prone Width	100
51.4	30.34	LEW	49.27	30.34		59.84	30.70		55	29.9394		53.1	30.7		53.1	30.7		Max Depth	3.1
52.7	29.68		52.64	30.73		61.89	30.92		57.45	29.6481		53.31	30.35		53.31	30.35		Mean Depth	0.8
55	29.54		55.19	29.67		63.12	31.35		58.9	29.4379		54.96	30.34		54.96	30.34		W/D Ratio	45.1
57.8	28.96	TW	57.49	29.30		69.6	32.89		59.7	29.9288		56.0	28.83		56.0	28.83		ER	1.8
58.6	29.22		58.70	30.30		93.82	32.12		60.2	30.0276		56.9	28.8		56.9	28.8		Bank Height Ratio	
59.1	30.36	REW	59.76	31.12		105.18	35.08		61.2	31.0628		59.9	28.8		59.9	28.8		Stream Type	C5
60	30.95		61.62	31.24					63.0	31.5896		60.0	30.8		60.0	30.8			
61.3	31.89		62.70	31.84					68.7	32.8511		61.2	31.1		61.2	31.1			
69	32.92		68.18	32.82					81.0	32.3745		62.1	31.8		62.1	31.8			
80	32.32		92.94	32.27					93.7	32.4328		64.2	32.0		64.2	32.0			
92.4	32.32		108.00	35.50					105.8	35.6026		68.5	32.7		68.5	32.7			
100	34.44	RPIN										78.6	31.8		78.6	31.8			
												93.6	32.3		93.6	32.3			
												105.1	35.3		105.1	35.3			



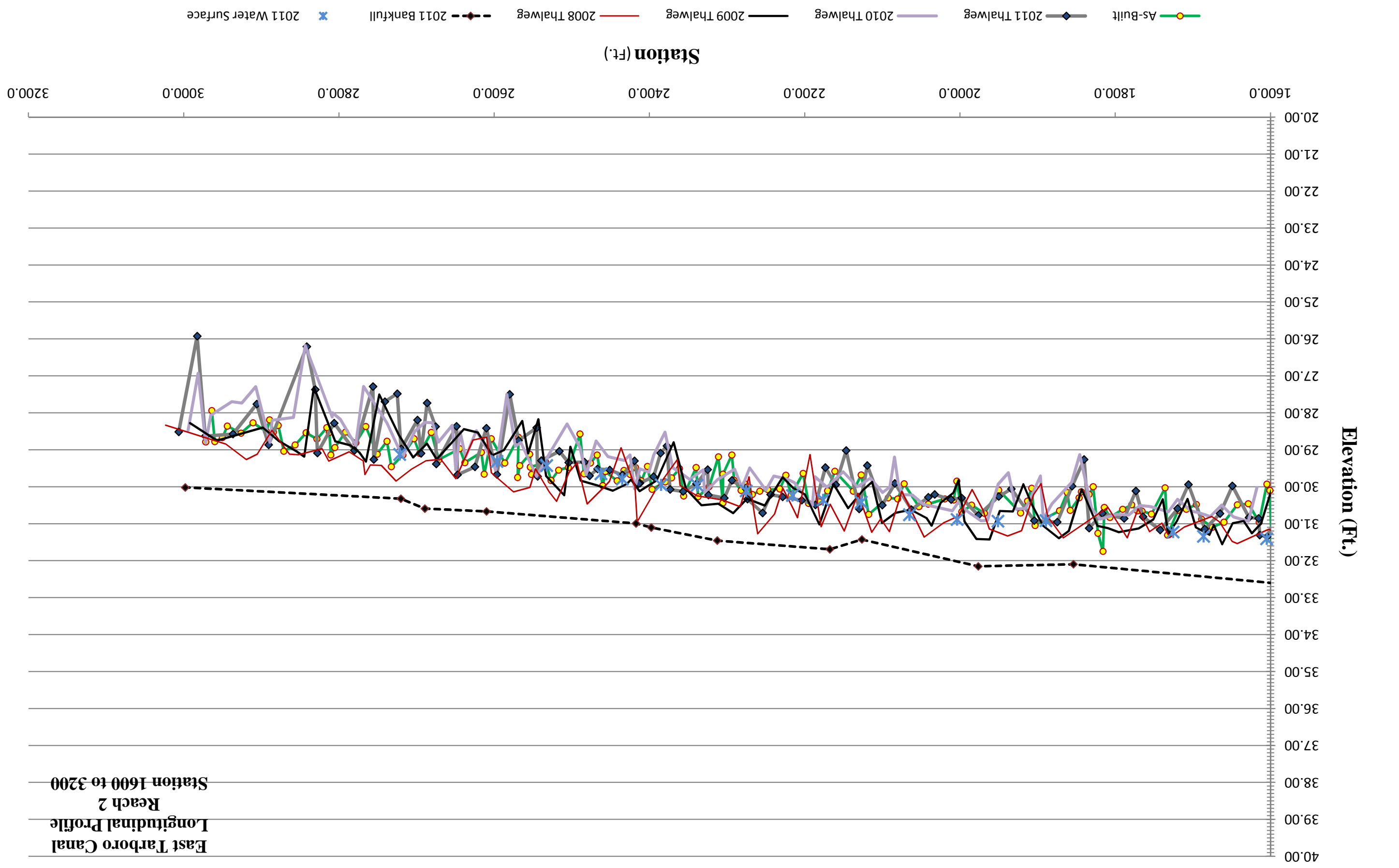


**East Tarboro Canal  
Longitudinal Profile  
Reach 2  
Station 00 to 1600**



- As-Built
- 2011 Thalweg
- 2010 Thalweg
- 2009 Thalweg
- 2008 Thalweg
- 2011 Bankfull
- 2011 Water Surface

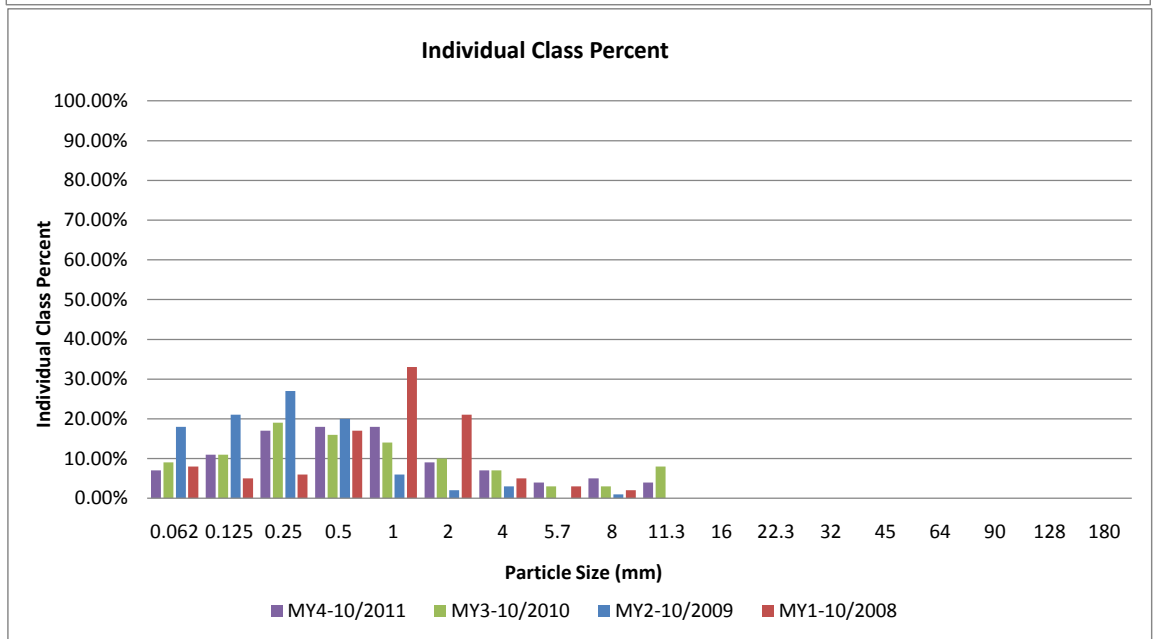
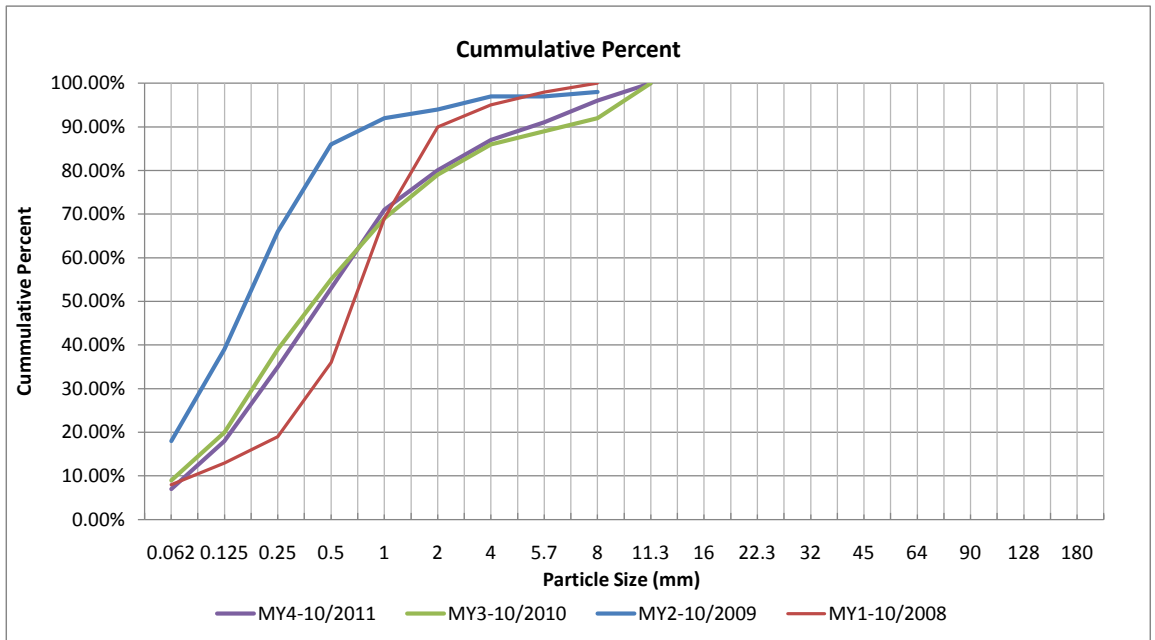
East Tarboro Canal  
Reach 2  
Station 1600 to 3200





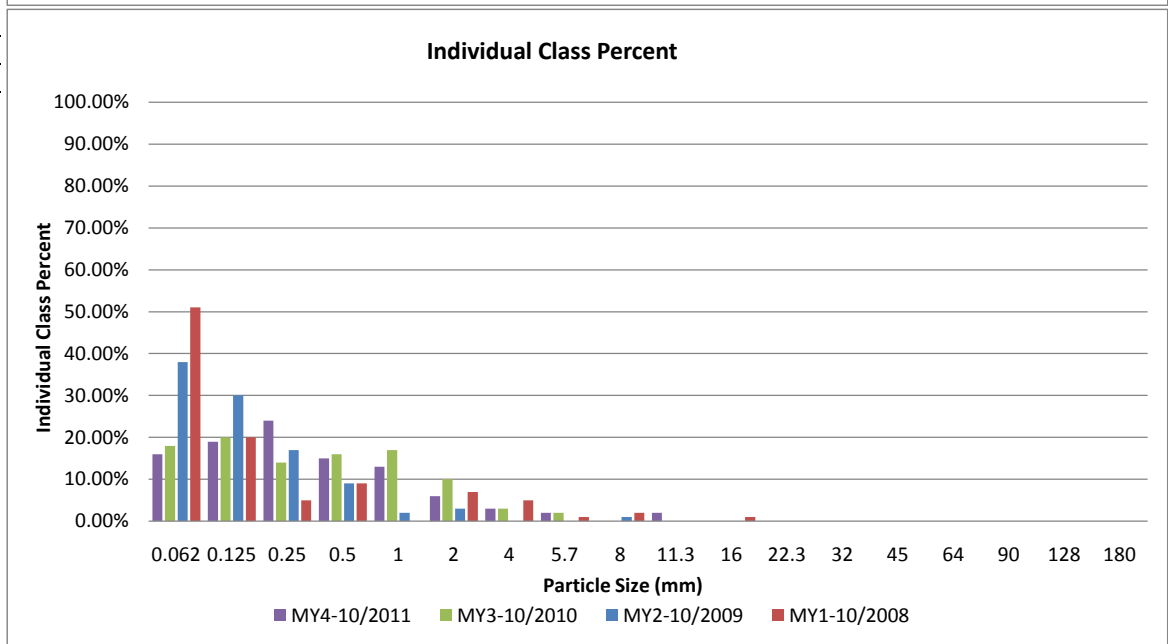
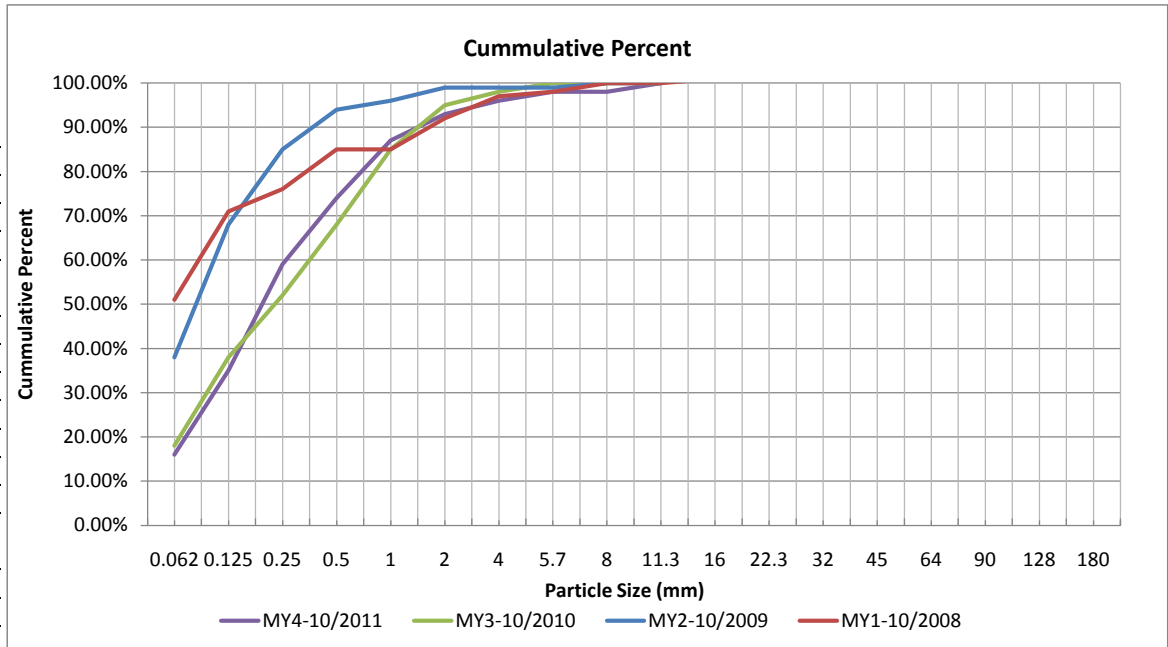
Project Name: East Tarboro Canal Cross Section: 6 Monitoring Year 4 - 2011					
Desc.	Material	Size (MM)	Count	% of Total	Cumulative %
SAND	silt/clay	0.062	7	7.00%	7.00%
	very fine sand	0.125	11	11.00%	18.00%
	fine sand	0.25	17	17.00%	35.00%
	medium sand	0.5	18	18.00%	53.00%
	coarse sand	1	18	18.00%	71.00%
	very coarse sand	2	9	9.00%	80.00%
GRAVEL	very fine gravel	4	7	7.00%	87.00%
	fine gravel	5.7	4	4.00%	91.00%
	fine gravel	8	5	5.00%	96.00%
	medium gravel	11.3	4	4.00%	100.00%
	medium gravel	16			
	coarse gravel	22.3			
	coarse gravel	32			
	very coarse gravel	45			
	very coarse gravel	64			
	very coarse gravel				
COBBLE	small cobble	90			
	medium cobble	128			
	large cobble	180			
	very large cobble	256			
BOULDER	small boulder	362			
	small boulder	512			
	medium boulder	1024			
	large boulder	2048			
<b>TOTAL % of whole count:</b>			<b>100</b>	<b>100%</b>	<b>100%</b>

Sumamry Data	
D50	0.45
D84	3
D95	7.6



Project Name: East Tarboro Canal Cross Section: 7 Monitoring Year 4 - 2011					
Desc.	Material	Size (MM)	Count	% of Total	Cumulative %
SAND	silt/clay	0.062	16	16.00%	16.00%
	very fine sand	0.125	19	19.00%	35.00%
	fine sand	0.25	24	24.00%	59.00%
	medium sand	0.5	15	15.00%	74.00%
	coarse sand	1	13	13.00%	87.00%
	very coarse sand	2	6	6.00%	93.00%
GRAVEL	very fine gravel	4	3	3.00%	96.00%
	fine gravel	5.7	2	2.00%	98.00%
	fine gravel	8	0	0.00%	98.00%
	medium gravel	11.3	2	2.00%	100.00%
	medium gravel	16	0	0.00%	
	coarse gravel	22.3	0	0.00%	
	coarse gravel	32	0	0.00%	
	very coarse gravel	45	0	0.00%	
	very coarse gravel	64	0	0.00%	
COBBLE	small cobble	90	0	0.00%	
	medium cobble	128	0	0.00%	
	large cobble	180	0	0.00%	
	very large cobble	256	0	0.00%	
BOULDER	small boulder	362	0	0.00%	
	small boulder	512	0	0.00%	
	medium boulder	1024	0	0.00%	
<b>TOTAL % of whole count:</b>			<b>100</b>	<b>100%</b>	<b>100%</b>

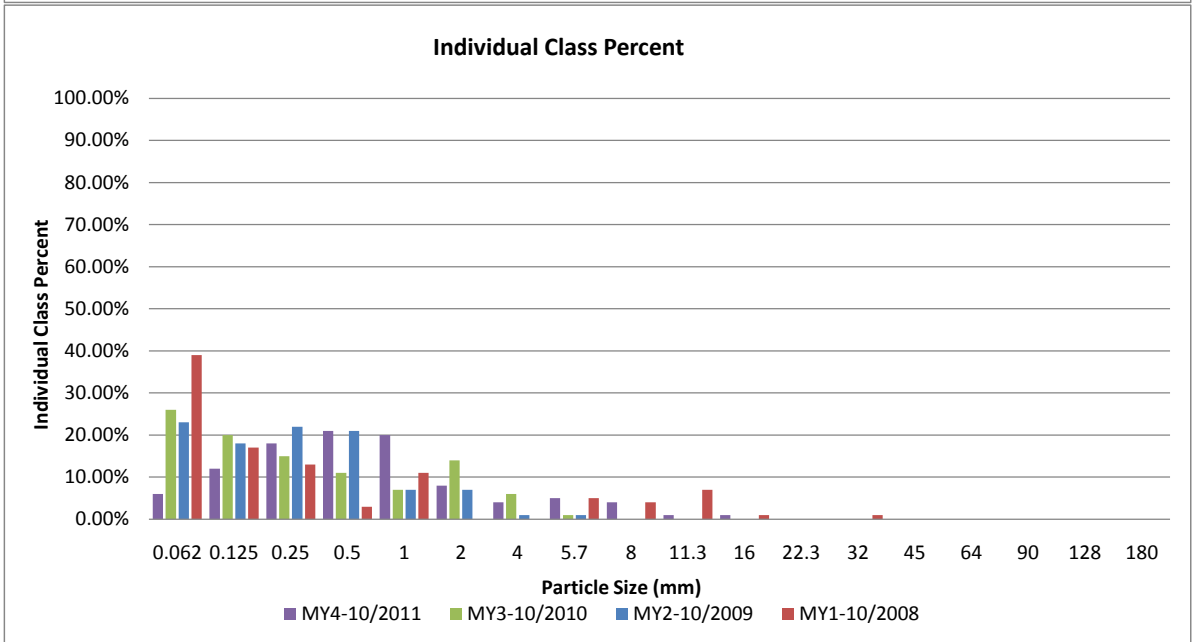
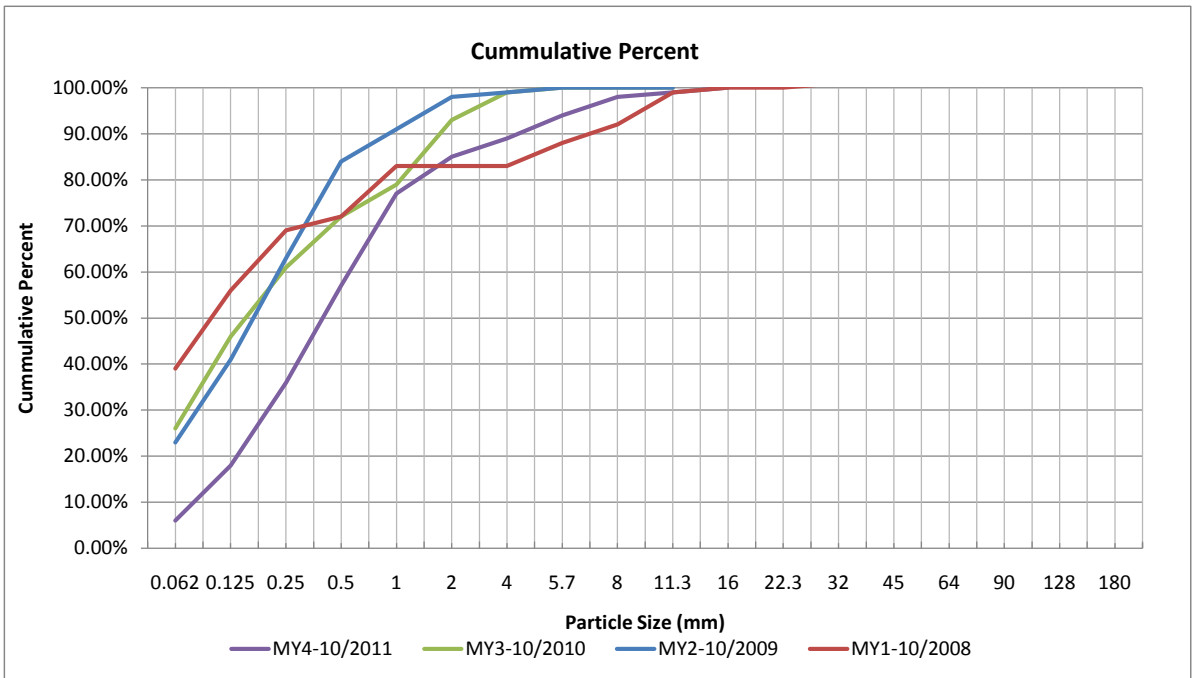
Sumamry Data	
D50	0.19
D84	0.85
D95	3.2





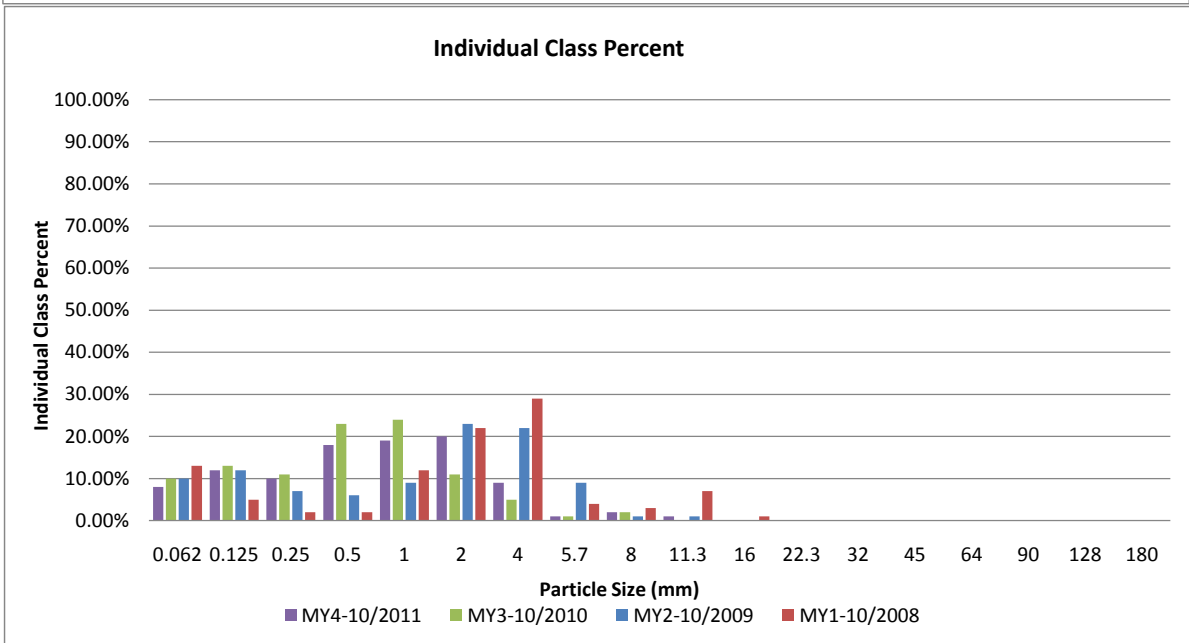
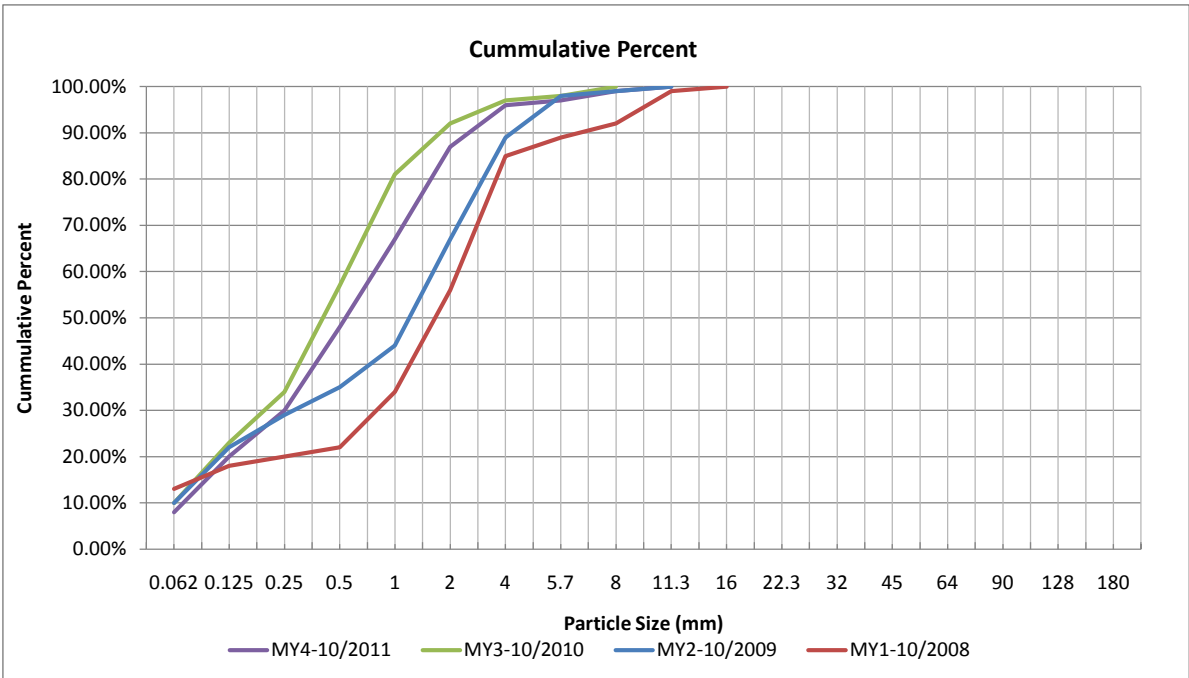
Project Name: East Tarboro Canal Cross Section: 8 Monitoring Year 4 - 2011					
Desc.	Material	Size (MM)	Count	% of Total	Cumulative %
SAND	silt/clay	0.062	6	6.00%	6.00%
	very fine sand	0.125	12	12.00%	18.00%
	fine sand	0.25	18	18.00%	36.00%
	medium sand	0.5	21	21.00%	57.00%
	coarse sand	1	20	20.00%	77.00%
	very coarse sand	2	8	8.00%	85.00%
GRAVEL	very fine gravel	4	4	4.00%	89.00%
	fine gravel	5.7	5	5.00%	94.00%
	fine gravel	8	4	4.00%	98.00%
	medium gravel	11.3	1	1.00%	99.00%
	medium gravel	16	1	1.00%	100.00%
	coarse gravel	22.3	0	0.00%	
	coarse gravel	32	0	0.00%	
	very coarse gravel	45	0	0.00%	
COBBLE	very coarse gravel	64	0	0.00%	
	small cobble	90	0	0.00%	
	medium cobble	128	0	0.00%	
	large cobble	180	0	0.00%	
BOULDER	very large cobble	256	0	0.00%	
	small boulder	362	0	0.00%	
	small boulder	512	0	0.00%	
	medium boulder	1024	0	0.00%	
<b>TOTAL % of whole count:</b>			<b>100</b>	<b>100%</b>	<b>100%</b>

Sumamry Data	
D50	0.4
D84	1.8
D95	6.4



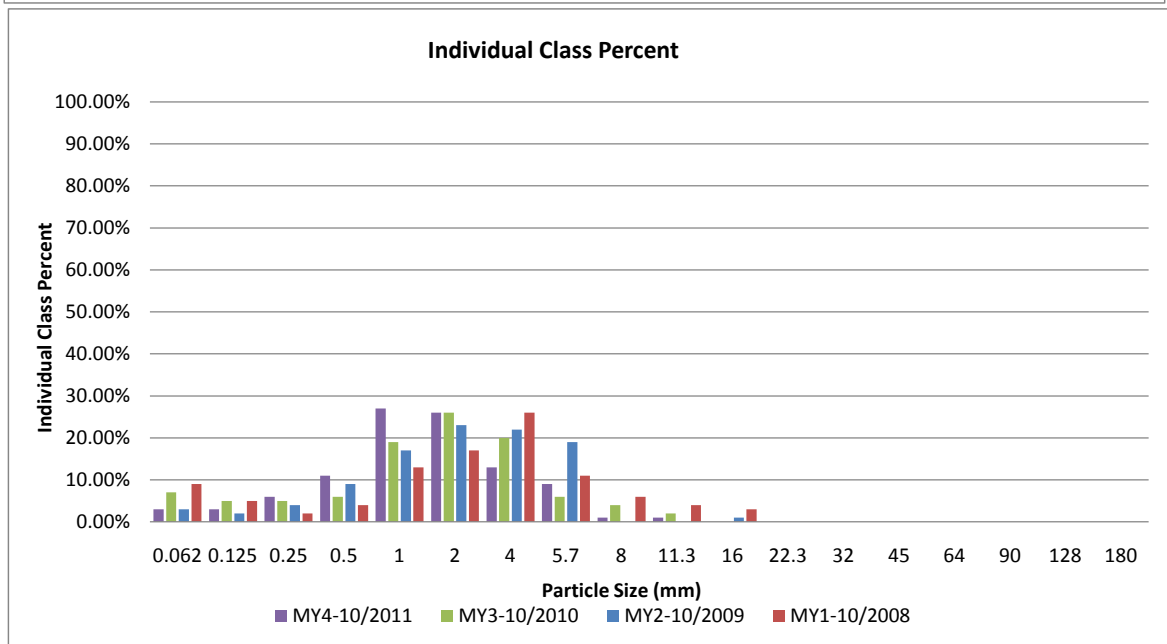
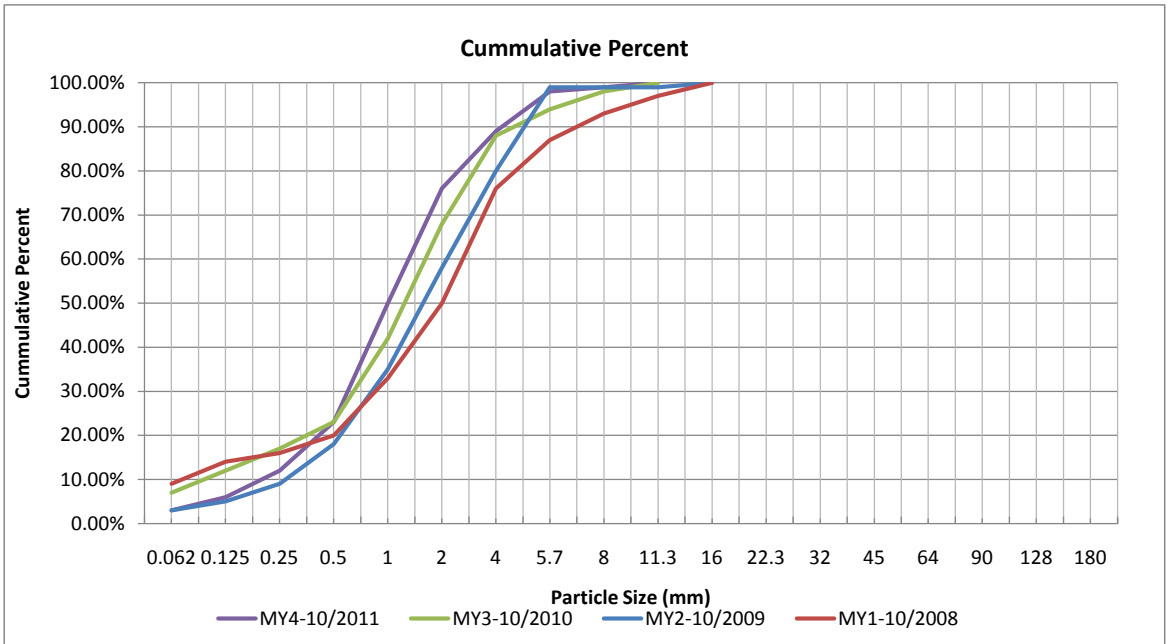
Project Name: East Tarboro Canal Cross Section: 9 Monitoring Year 4 - 2011					
Desc.	Material	Size (MM)	Count	% of Total	Cumulative %
SAND	silt/clay	0.062	8	8.00%	8.00%
	very fine sand	0.125	12	12.00%	20.00%
	fine sand	0.25	10	10.00%	30.00%
	medium sand	0.5	18	18.00%	48.00%
	coarse sand	1	19	19.00%	67.00%
	very coarse sand	2	20	20.00%	87.00%
GRAVEL	very fine gravel	4	9	9.00%	96.00%
	fine gravel	5.7	1	1.00%	97.00%
	fine gravel	8	2	2.00%	99.00%
	medium gravel	11.3	1	1.00%	100.00%
	medium gravel	16	0	0.00%	
	coarse gravel	22.3	0	0.00%	
	coarse gravel	32	0	0.00%	
COBBLE	very coarse gravel	45	0	0.00%	
	very coarse gravel	64	0	0.00%	
	small cobble	90	0	0.00%	
	medium cobble	128	0	0.00%	
BOULDER	large cobble	180	0	0.00%	
	very large cobble	256	0	0.00%	
	small boulder	362	0	0.00%	
	small boulder	512	0	0.00%	
	medium boulder	1024	0	0.00%	
	large boulder	2048	0	0.00%	
<b>TOTAL % of whole count:</b>			<b>100</b>	<b>100%</b>	<b>100%</b>

Sumamry Data	
D50	0.54
D84	1.8
D95	3.7



Project Name: East Tarboro Canal Cross Section: 10 Monitoring Year 4 - 2011					
Desc.	Material	Size (MM)	Count	% of Total	Cumulative %
SAND	silt/clay	0.062	3	3.00%	3.00%
	very fine sand	0.125	3	3.00%	6.00%
	fine sand	0.25	6	6.00%	12.00%
	medium sand	0.5	11	11.00%	23.00%
	coarse sand	1	27	27.00%	50.00%
	very coarse sand	2	26	26.00%	76.00%
GRAVEL	very fine gravel	4	13	13.00%	89.00%
	fine gravel	5.7	9	9.00%	98.00%
	fine gravel	8	1	1.00%	99.00%
	medium gravel	11.3	1	1.00%	100.00%
	medium gravel	16	0	0.00%	
	coarse gravel	22.3	0	0.00%	
	coarse gravel	32	0	0.00%	
	very coarse gravel	45	0	0.00%	
	very coarse gravel	64	0	0.00%	
COBBLE	small cobble	90	0	0.00%	
	medium cobble	128	0	0.00%	
	large cobble	180	0	0.00%	
	very large cobble	256	0	0.00%	
	BOULDER	small boulder	362	0	0.00%
small boulder		512	0	0.00%	
medium boulder		1024	0	0.00%	
large boulder		2048	0	0.00%	
<b>TOTAL % of whole count:</b>			<b>100</b>	<b>100%</b>	<b>100%</b>

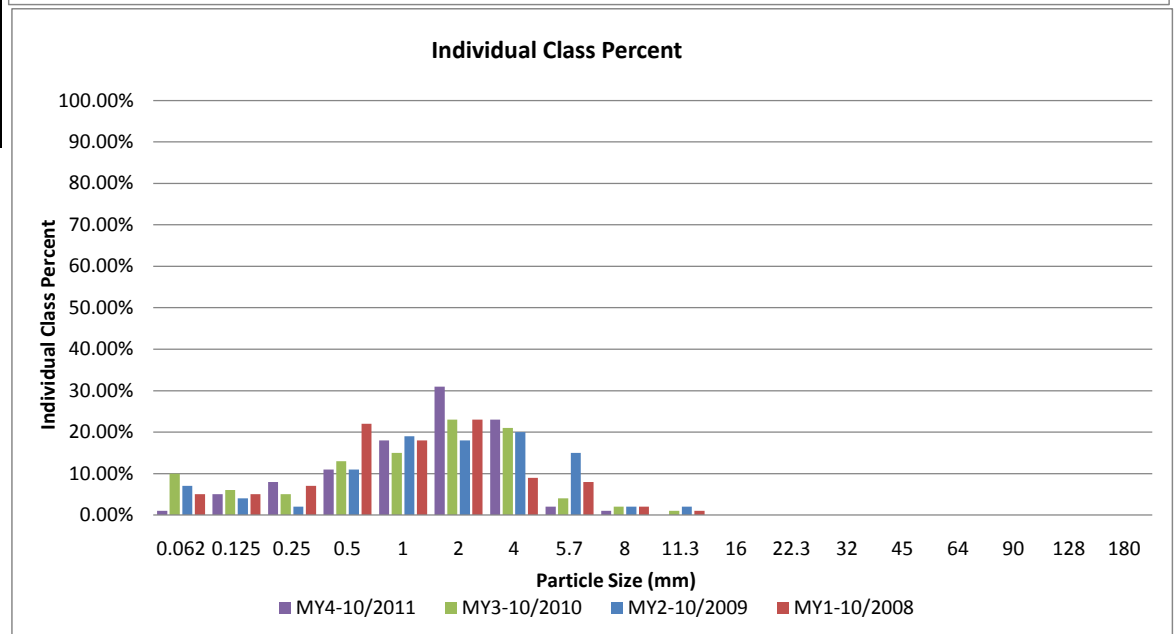
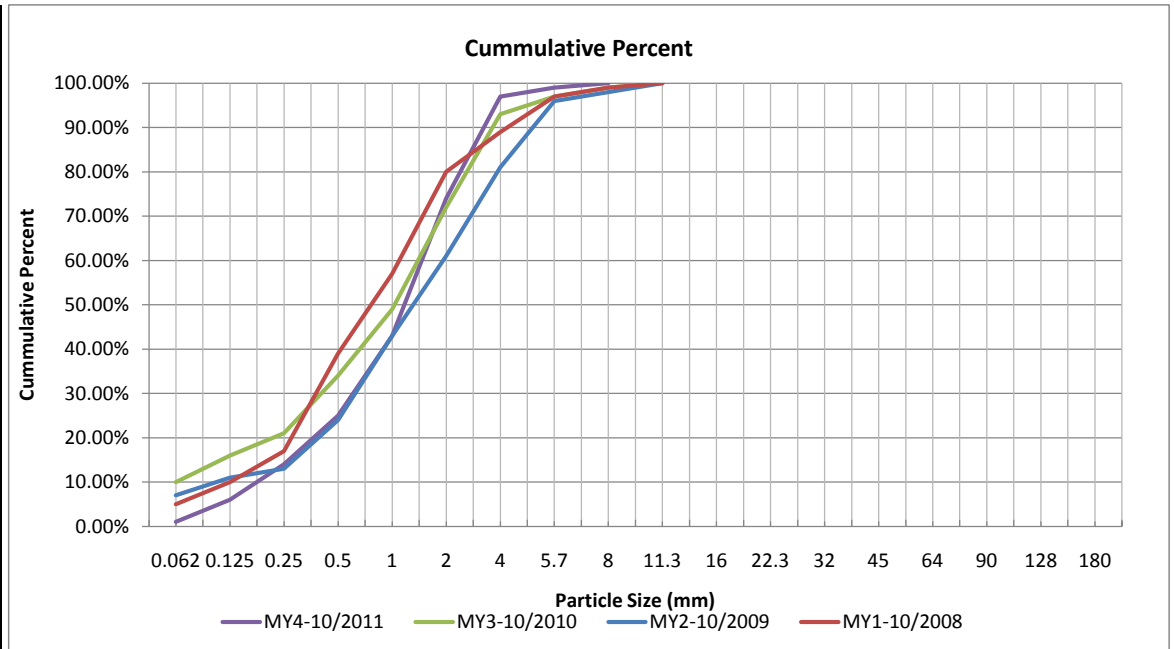
Sumamry Data	
D50	1
D84	3.1
D95	5.2





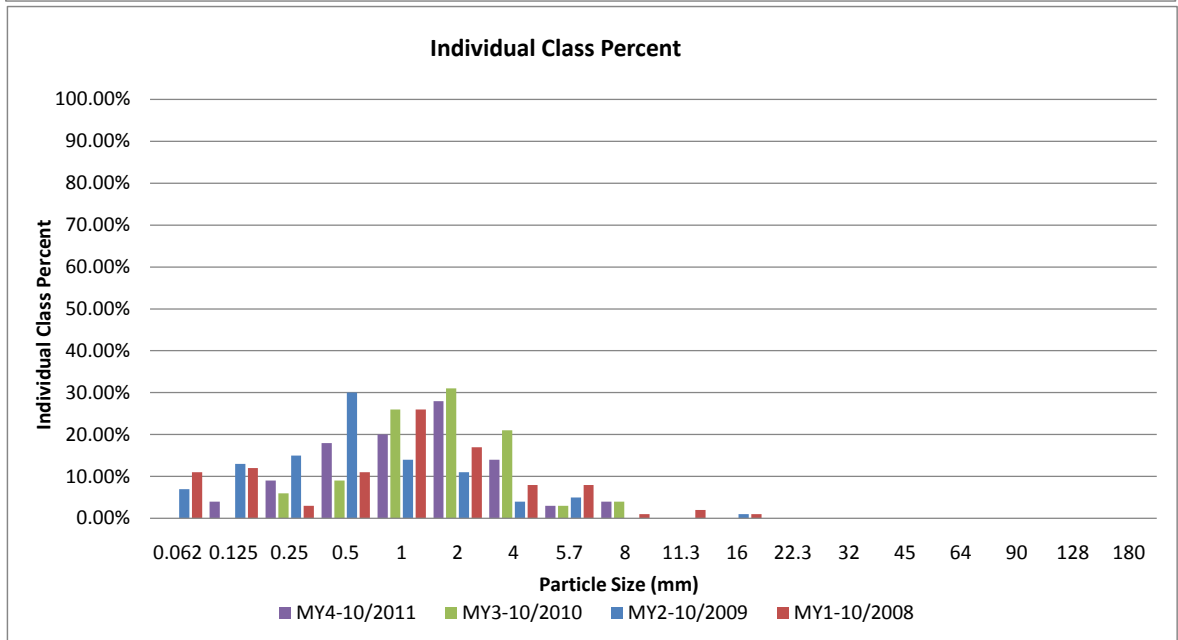
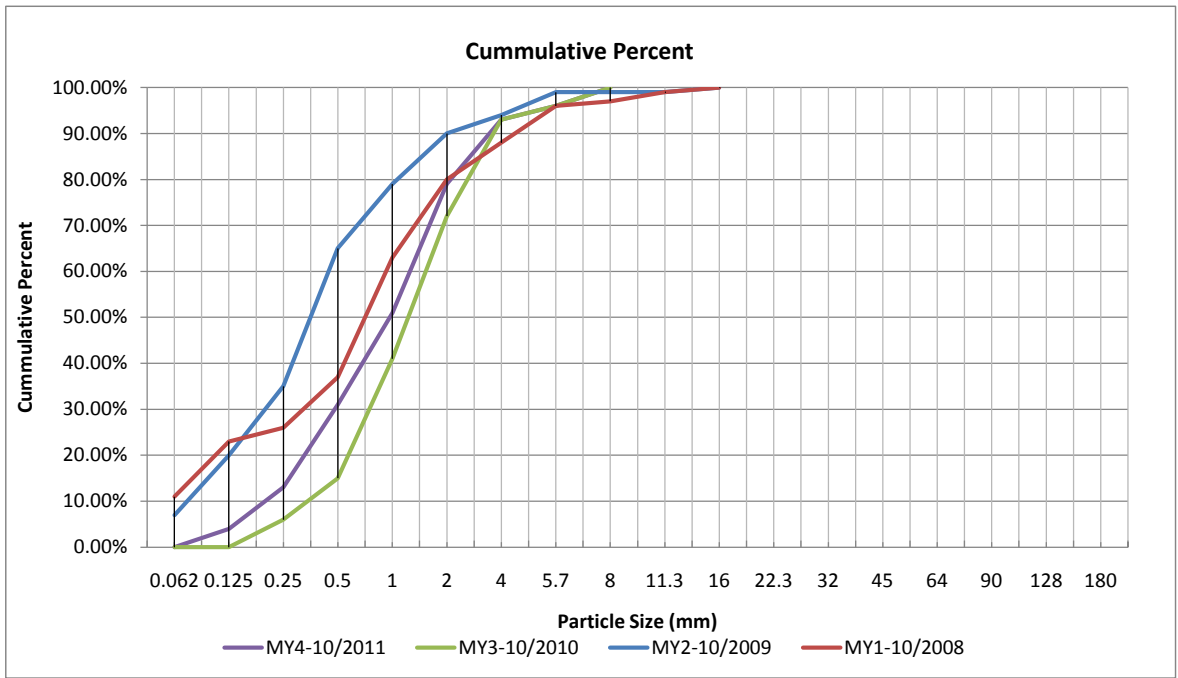
Project Name: East Tarboro Canal Cross Section: 11 Monitoring Year 4 - 2011					
Desc.	Material	Size (MM)	Count	% of Total	Cumulative %
SAND	silt/clay	0.062	1	1.00%	1.00%
	very fine sand	0.125	5	5.00%	6.00%
	fine sand	0.25	8	8.00%	14.00%
	medium sand	0.5	11	11.00%	25.00%
	coarse sand	1	18	18.00%	43.00%
	very coarse sand	2	31	31.00%	74.00%
GRAVEL	very fine gravel	4	23	23.00%	97.00%
	fine gravel	5.7	2	2.00%	99.00%
	fine gravel	8	1	1.00%	100.00%
	medium gravel	11.3	0	0.00%	
	medium gravel	16	0	0.00%	
	coarse gravel	22.3	0	0.00%	
	coarse gravel	32	0	0.00%	
	very coarse gravel	45	0	0.00%	
	very coarse gravel	64	0	0.00%	
	COBBLE	small cobble	90	0	0.00%
medium cobble		128	0	0.00%	
large cobble		180	0	0.00%	
very large cobble		256	0	0.00%	
BOULDER	small boulder	362	0	0.00%	
	small boulder	512	0	0.00%	
	medium boulder	1024	0	0.00%	
	large boulder	2048	0	0.00%	
<b>TOTAL % of whole count:</b>			<b>100</b>	<b>100%</b>	<b>100%</b>

Sumamry Data	
D50	1
D84	3
D95	4.9



Project Name: East Tarboro Canal Cross Section: 12 Monitoring Year 4 - 2011					
Desc.	Material	Size (MM)	Count	% of Total	Cumulative %
SAND	silt/clay	0.062	0	0.00%	0.00%
	very fine sand	0.125	4	4.00%	4.00%
	fine sand	0.25	9	9.00%	13.00%
	medium sand	0.5	18	18.00%	31.00%
	coarse sand	1	20	20.00%	51.00%
	very coarse sand	2	28	28.00%	79.00%
GRAVEL	very fine gravel	4	14	14.00%	93.00%
	fine gravel	5.7	3	3.00%	96.00%
	fine gravel	8	4	4.00%	100.00%
	medium gravel	11.3	0	0.00%	
	medium gravel	16	0	0.00%	
	coarse gravel	22.3	0	0.00%	
	coarse gravel	32	0	0.00%	
	very coarse gravel	45	0	0.00%	
COBBLE	very coarse gravel	64	0	0.00%	
	small cobble	90	0	0.00%	
	medium cobble	128	0	0.00%	
	large cobble	180	0	0.00%	
BOULDER	very large cobble	256	0	0.00%	
	small boulder	362	0	0.00%	
	small boulder	512	0	0.00%	
	medium boulder	1024	0	0.00%	
<b>TOTAL % of whole count:</b>			<b>100</b>	<b>100%</b>	<b>100%</b>

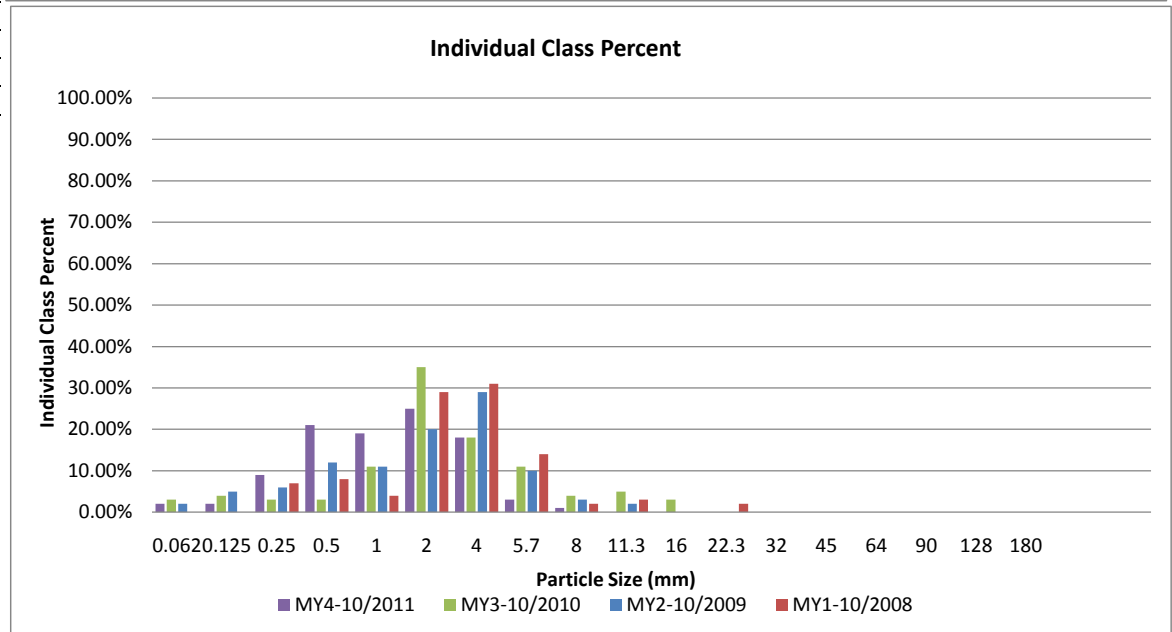
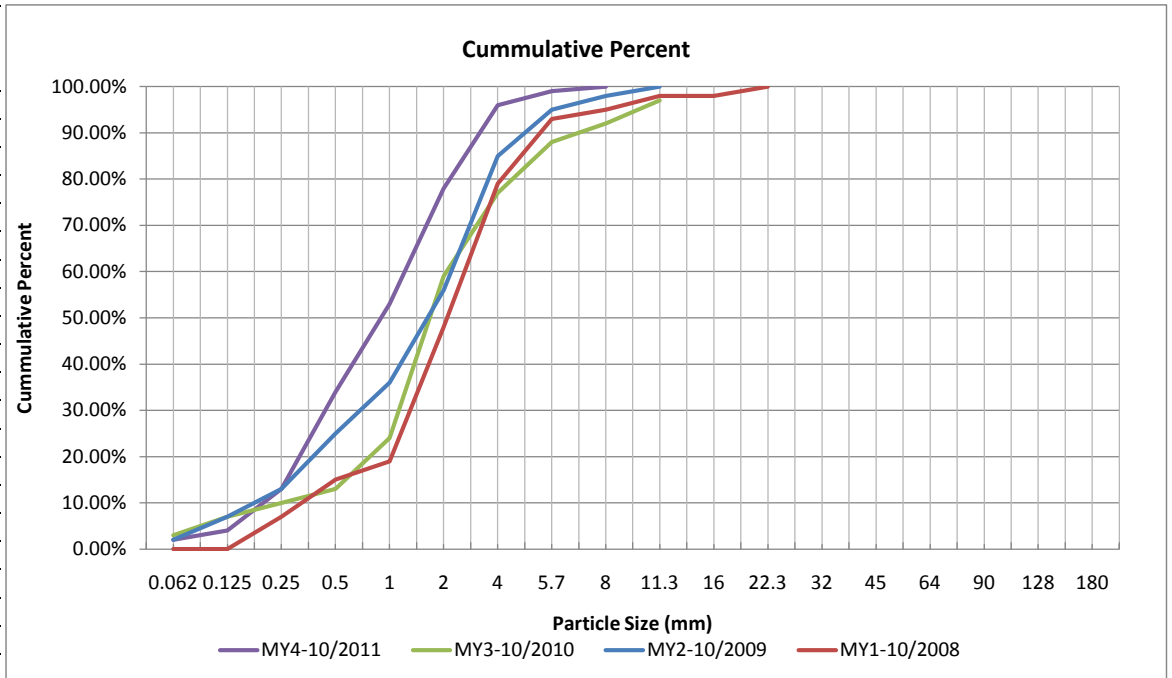
Sumamry Data	
D50	0.97
D84	2.6
D95	5.2



**Project Name: East Tarboro Canal  
Cross Section: 13  
Monitoring Year 4 - 2011**

Desc.	Material	Size (MM)	Count	% of Total	Cumulative %
SAND	silt/clay	0.062	2	2.00%	2.00%
	very fine sand	0.125	2	2.00%	4.00%
	fine sand	0.25	9	9.00%	13.00%
	medium sand	0.5	21	21.00%	34.00%
	coarse sand	1	19	19.00%	53.00%
	very coarse sand	2	25	25.00%	78.00%
GRAVEL	very fine gravel	4	18	18.00%	96.00%
	fine gravel	5.7	3	3.00%	99.00%
	fine gravel	8	1	1.00%	100.00%
	medium gravel	11.3	0	0.00%	
	medium gravel	16	0	0.00%	
	coarse gravel	22.3	0	0.00%	
	coarse gravel	32	0	0.00%	
	very coarse gravel	45	0	0.00%	
	very coarse gravel	64	0	0.00%	
COBBLE	small cobble	90	0	0.00%	
	medium cobble	128	0	0.00%	
	large cobble	180	0	0.00%	
	very large cobble	256	0	0.00%	
BOULDER	small boulder	362	0	0.00%	
	small boulder	512	0	0.00%	
	medium boulder	1024	0	0.00%	
<b>TOTAL % of whole count:</b>			<b>100</b>	<b>100%</b>	<b>100%</b>

Sumamry Data	
D50	0.9
D84	2.5
D95	3.8





**Table 10a. Baseline Stream Data Summary**  
**East Tarboro Canal Stream Restoration Site - EEP Project No. 123**  
**Reach 2 (2989 feet)**

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Stream Reference			Design			As-Built		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)						14.55	14	17	15	10.8	11	10.9	Na	Na	20	17.66	30.32	20.6
Flood Prone Width (ft)						24.34	22.8	25.4	24.1	8.3	9.6	9	Na	Na	29.25	20.52	31.22	26.73
BF Cross Sectional Area (SF)						1.63	1.5	1.72	1.61	0.77	0.87	0.82	Na	Na	1.46	.89	1.41	1.25
BF Mean Depth (ft)							2.2	2.37	2.32	1.24	1.45	1.34	Na	Na	2.5	1.75	3.5	2.69
BF Max Depth (ft)							8.2	11.4	9.4	12.6	14.1	13.4	Na	Na	13.7	13.23	34.07	16.22
Width/Depth Ratio							1.5	1.7	NA	9.1	9.3	Na	2.2	6	Na	1.75	5.52	4.65
Entrenchment Ratio							17.6	31.1	21.75	Na	Na	Na	Na	Na	Na	19.2	30.78	21.88
Bank Height Ratio							.87	1.36	1.14	Na	Na	Na	Na	Na	Na	0.88	1.29	1.19
Wetted Perimeter (ft)																		
Hydraulic Radius (ft)																		
<b>Pattern</b>																		
Channel Beltwidth (ft)							29	47	39	12.5	25	18.8	22	46	34	20.58	52.64	36.53
Radius of Curvature (ft)							75	560	220	14.4	39.8	23.3	40	72	56	22.99	71.49	37.54
Meander Wavelength (ft)							154	226	190	39	64	50.4	72	170	Na	100.91	147.43	129.22
Meander Width ratio							10.3	15.1	12.7	3.6	5.9	4.6	1.1	2.3	1.7	0.374	0.956	0.663
<b>Profile</b>																		
Riffle Length							Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	Na	64.25
Riffle Slope							.002	.0044	.0002	0	.0055	.0022	0	.0036	Na	Na	Na	.00543
Pool Length							Na	Na	23.3	Na	Na	13	Na	Na	24	49.66	113.74	70.29
Pool Spacing							44	133	90	16	45	32.3	32	86	59	72.09	416.51	206.2
<b>Substrate</b>																		
d50 (mm)																.05	2	1.14
d84 (mm)																1.88	18.06	4.49
<b>Additional Reach Parameters</b>																		
Valley Length (ft)									2722						2722			2722
Channel Length (ft)									2946			280			2946			2946
Sinuosity									1.03			1.3	1.2	1.4	1.1			1.19
Water Surface Slope									.0007	0	.0055	.003	0	.0036				.00185
BF Slope							0	.0044	Na			Na			Na			.00179
Rosgen Classification									G5c			C5			C5			C5
*Habitat Index																		
*Macrobenthos																		

**Table 11a. Morphology and Hydraulic Monitoring Summary\*\*  
East Tarboro Canal Stream Restoration Site - EEP Project No. 123  
Reach 2 (2989 LF)**

Parameter	Cross Section 6					Cross Section 7					Cross Section 8					Cross Section 9					Cross Section 10				
<b>Based on fixed baseline bankfull elv.</b>	MY0	MY1	MY2	MY3	MY4	MY0	MY1	MY2	MY3	MY4	MY0	MY1	MY2	MY3	MY4	MY0	MY1	MY2	MY3	MY4	MY0	MY1	MY2	MY3	MY4
Record elevation (datum) used	35.94	35.98	35.9	35.94	35.94	36.1	35.9	35.8	36.1	36.1	35.98	35.7	36	35.98	35.98	34.24	34.3	34.3	34.24	34.24	33.76	33.7	33.7	33.76	33.76
Bankfull Width (ft)	30.32	36.6	35.51	35.8	34.3	22.54	26.8	23.54	92.2	34.3	20.6	12.7	15.13	62.6	52.4	19.36	34.7	14.0	29.7	20.02	20.6	22.7	19.52	72	63.5
Floodprone Width (ft)	100	115	99.1	101	99.6	100	85.5	63.4	101.8	99.3	75	51.7	69.5	74.5	74.2	101.4	78.6	87.4	99	97.9	100	92.4	98.8	101.1	103.4
Bankfull Mean Depth (ft)	0.89	.67	0.72	0.8	.55	1.39	1.1	0.83	0.7	1.1	1.12	0.95	0.95	0.7	0.6	1.41	0.5	1.7	1.8	2.2	1.25	0.95	1.02	0.4	0.4
BF Cross Sectional Area(ft)	26.95	24	25.46	27.2	18.7	31.22	30	19.6	66.7	38.6	22.99	12.1	14.30	44.6	29.6	27.34	22.19	23.3	52.6	44.5	25.78	21.6	19.96	27.5	26.5
BF Width/Depth Ratio	34.07	55.7	49.5	47.0	62.8	16.22	23.9	29	127.5	30.6	18.39	13.3	16.0	87.9	92.8	13.73	66.9	8.4	16.8	9	16.48	23.8	19.1	188.7	152.2
BF Entrenchment Ratio	3.3	3.1.1	0.7	2.8	2.9	4.44	3.2	2.6	1.1	2.9	3.64	4.1	4.6	1.2	1.4	5.24	12.3	6.3	3.3	4.9	4.85	4.1	5.1	1.4	1.6
BF Bank Height Ratio (ft)	1.15	1.13	1.2	1	1.03	1.04	1.04	1.04	1.03	1.03	0.97	1.05	1.04	1.03	1.04	0.92	1.03	0.99	1.03	0.98	1.04	1	0.99	1	0.99
Hydraulic radius (ft)	0.9	0.7	0.7	0.8	0.5	0.8	1	0.7	0.7	1	1.1	0.8	0.9	0.7	0.5	0.6	1	1.5	1.6	0.5	1	0.9	1.0	0.4	0.4
Cross Sectional Area between Bank Pins (ft)	40.9	43.7	39.1	43.9	46.4	44.8	45.8	59.4	80.2	69.3	24.4	35	37.4	47.9	32.2	31.2	49.8	51.8	53.2	45.4	26.2	26	23.4	28.9	37.2
D50 (mm)	1.05	0.67	0.16	0.4	0.45	0.05	.062	.082	0.23	0.19	0.05	0.1	.17	0.062	0.4	1.95	1.7	1.2	0.4	0.54	2	2	1.6	1.2	1
Parameter	Cross Section 11					Cross Section 12					Cross Section 13														
<b>Based on fixed baseline bankfull elv.</b>	MY0	MY1	MY2	MY3	MY4	MY0	MY1	MY2	MY3	MY4	MY0	MY1	MY2	MY3	MY4										
Record elevation (datum) used	33.06	33	33.16	33.06	33.06	32.76	32.6	32.61	32.76	32.76	31.92	31.84	31.47	31.92	31.92										
Bankfull Width (ft)	18.93	15.1	18.77	39.9	47.2	18.13	15.6	17.98	55.9	31.9	21.52	9.6	10.99	34.2	36.4										
Floodprone Width (ft)	100	97.3	93.2	101.7	90	100	89.5	82.6	102.7	69.7	100	38	47.1	0.7	66.7										
Bankfull Mean Depth (ft)	1.41	1.2	0.96	0.8	0.7	1.37	0.8	0.79	0.6	0.9	1.24	1.4	1.04	0.7	0.8										
BF Cross Sectional Area(ft)	26.71	18.2	18.01	32.6	33.8	24.83	12.9	14.28	34.2	27.4	26.73	13.5	11.43	25	29.3										
BF Width/Depth Ratio	13.43	12.6	19.5	48.9	66.1	13.23	18.9	22.6	91.4	37.3	17.35	6.9	10.6	46.8	45.1										
BF Entrenchment Ratio	5.28	6.4	5.3	2.5	1.9	5.52	5.7	4.6	1.8	2.2	4.65	3.9	4.3	3.0	1.8										
BF Bank Height Ratio (ft)	1	1.27	1.05	1	0.83	1.05	1.05	0.97	0.86	0.95	0.99	1.05	1.04	0.96	1										
Hydraulic radius (ft)	1.28	1.1	0.9	0.8	0.7	1.29	0.8	0.7	0.6	0.7	1.15	1.1	0.9	0.7	0.7										
Cross Sectional Area between Bank Pins (ft)	81.8	62.1	96.5	97.8	95.8	62.8	45.4	66.3	62.6	73.9	52.5	42.9	58.4	53.9	65.4										
D50 (mm)	N/A	0.76	1.3	1	1	1.14	0.71	.35	1.2	0.97	1.97	2.1	1.6	1.7	0.9										

\*\*Cross Sections 1 through 5 are located on Reach 1. Reach 1 and all Reach 1 assets have been removed from the East Tarboro Canal Stream Restoration Project.

**Exhibit Table 11b. Monitoring Data – Stream and Data Summary  
East Tarboro Canal Stream Restoration Site - EEP Project No. 123  
Reach 2 (2989 LF)**

Parameter	Baseline						MY-01 (2008)						MY-02 (2009)						MY-03 (2010)						MY-04 (2011)						MY-05 (2012)					
	Min	Mean	Med	Max	SD4	N	Min	Mean	Med	Max	SD4	N	Min	Mean	Med	Max	SD4	N	Min	Mean	Med	Max	SD4	N	Min	Mean	Med	Max	SD4	N	Min	Mean	Med	Max	SD4	N
Bankfull Width (ft)	17.66		20.6	30.32			9.6	21.73	19.15	30			10.99	19.43	18.37	25.46			29.7	50.85	50.5	72			20.02	40	35.35	44.5								
Floodprone Width (ft)							38	81	87.5	115			47.1	80.13	85	99.1			74.5	88.6	96.7	102.7			69.7	91.76	98.6	103.4								
BF Mean Depth (ft)	1.46		1.25	1.41			0.5	0.95	0.95	1.4			0.72	1	0.95	1.7			0.4	1.1	0.73	1.8			0.4	0.88	0.7	2.2								
BF Max Depth (ft)	2.5		2.69	3.5			1.6	3.06	2.9	4.9			1.54	2.65	2.63	3.72			1.9	3.3	3.2	4.7			1	2.96	3.2	3.7								
BF Cross Sectional Area (ft2)	20.52		26.73	31.22			12.1	19.31	19.9	30			11.43	18.29	18.80	25.46			29.7	60.95	55.4	92.2			18.7	31.05	29.45	44.5								
Width/Depth Ratio (ft)	13.23		16.22	34.07			6.9	27.75	21.35	66.9			8.4	21.83	19.3	49.5			16.8	102.75	70.4	188.7			9	61.98	53.95	152.2								
Entrenchment Ratio (ft)	1.75		5.52	4.65			3.1	14.04	4.1	12.3			0.7	12.63	4.6	6.3			1.4	3.05	3.2	4.7			1.4	17.73	2.05	4.9								
Bank Height Ratio (ft)							1	1.08	1.05	1.27			0.97	1.04	1.04	1.2			0.86	0.99	1	1.03			0.83	0.98	0.99	1.04								
<b>Profile</b>																																				
Riffle Length (ft)			64.25				71.44						68.91						58.9						96.7											
Riffle Slope (ft)			.00543				.006						.0065						.0062						.0083											
Pool Length (ft)			70.29				135.2						148.7						153.3						133.3											
Pool Max Depth (ft)																																				
Pool Spacing (ft)			206.2				157.8						149.6						148.9						182.9											
Rosgen Classification			C5				C5						C5						C5						C5											
*Habitat Index																																				
<b>Pattern</b>																																				
Channel Beltwidth (ft)	20.58		36.53	52.64																																
Radius of Curvature (ft)	22.99		37.54	71.49																																
Rc: Bankfull width (ft/ft)																																				
Meander Wavelength (ft)	100.91		129.22	147.32																																
Meander Width Ratio	0.374		.663	0.956																																
<b>Additional Reach Parameters</b>																																				
Rosgen Classification			C5				C5						C5						C5						C5											
Channel Thalweg length (ft)			2933				2933						2933						2993						2993											
Sinuosity			1.19				1.19						1.19						1.19						1.19											
Water Surface Slope (Channel) (ft/ft)			.00185				.0116						.0021						.00205						.00239											
BF Slope (ft/ft)			.00179				.0020						.0020						.00187						.00240											
Ri% / Ru% / P% / G% / S%																																				
SC% / Sa% / G% / C% / B% / Be%																																				
D16 / d35 / d50 / d84 / d95																																				
% Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				



# ***APPENDIX E***

## Verification of Bankfull Events

<b>Table 12. Verification of Bankfull Events</b>			
<b>Date of Data Collection</b>	<b>Date of Occurrence</b>	<b>Method</b>	<b>Photo#</b>
10/13/2011	September 2011	Photo of wrack line in center of picture	Photo Station 6 Appendix B