East Tarboro Canal Stream Restoration Project
Edgecombe County
North Carolina

CU: 03020103
SCO# 030603101
EEP Project No. 123

Year 1 Monitoring Report
January 22, 2009

Prepared for:

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

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Prepared by:

Rummel, Klepper & Kahl, LLP
900 Ridgefield Drive
Suite 350
Raleigh, NC 27609

EXECUTIVE SUMMARY

The project site consists of two reaches along East Tarboro Canal which is located in Tarboro, North Carolina in Edgecombe County (**Figure 1**). This stream is a tributary of the Tar River. Reach 1 begins downstream of Forest Acres Drive and flows for approximately 1,900 feet. Reach 2 begins downstream of Martin Luther King Jr. Drive and continues downstream for approximately 2,900 linear feet to St. James St. The project is located primarily on town of Tarboro and the Edgecombe County Board of Education properties.

Prior to restoration East Tarboro Canal was a relatively straight stream with high banks and areas of severe bank erosion. There was a lack of streambank vegetation due to the fact that the Town of Tarboro routinely maintained the channel to provide flood control. Both reaches of the channel were classified as G5c before restoration.

Reach 1 was modified to improve the bedform and increase the vegetation on the streambanks. Two roads present on either side of the stream restricted pattern adjustment. However, bankfull benches and grading of the slope were performed to improve the stream's dimensional characteristics. Reach 1 is classified as Enhancement Level 1 because the profile and dimension were modified in addition to planting a narrow riparian buffer. Vegetation was used to provide stability and provide habitat along the streambanks and in the riparian area. Vegetation planted consisted of low growing shrubs and herbaceous vegetation because of the limited width of the buffer, adjacent landowner concerns, and sight constraints for traffic. Reach 2 was modified to produce a C-type channel by reintroducing meanders and providing a floodplain at a lower level than the original floodplain. Reach 2 was classified as a Priority 2 restoration because the stream was not raised sufficiently to access its original floodplain. Rock vanes and sills were used to control grade and provide enhanced bedform features. Vegetation was used to provide stability and provide habitat along the streambanks and in the floodplain area. Vegetation planted consisted of trees, shrubs and herbaceous vegetation.

Year 1 monitoring site visits were completed on October 13, 2008, October 14, 2008, and November 10, 2008. Year 1 vegetation monitoring was completed using the Carolina Vegetation Survey (CVS) – EEP protocol Level 1 (Version 4.1). Nine (9) of the thirteen (13) vegetation plots met vegetative success and the site is currently exceeding the criteria of 320 stems per acre. Even though the site has met success criteria, a number of trees across the site have died. North Carolina sustained a prolonged period of drought that continues to cause stress to vegetation.

During the geomorphic assessment, some parts of Reach 1 were dry. There also has been mowing activity within riparian area destroying many of the planted seedlings. Reach 2 is overgrown with vegetation in many areas suggesting that there is not a consistent flow of water. The lack of flow is likely due to the drought. Overall the stream reaches at East Tarboro Canal are stable and are showing few signs of instability. Reach 2 has a structure failure that requires immediate attention. The amount of structure in failure is fifty (50) linear feet.

2008 represents the first of a five year monitoring plan for the East Tarboro Stream Restoration Site. Overall, the site is performing adequately and meets or exceeds the minimum success requirements for monitoring.

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1.0 Project Background

1.1 PROJECT OBJECTIVES

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

The project had the following objectives:

- Enhance over 1,800 linear feet of stream on East Tarboro Canal along Reach 1 and restore approximately 2,900 linear feet of East Tarboro Canal along Reach 2.
- Create a limited floodplain for East Tarboro Canal below its natural floodplain to allow access during flood events (Reach 1).
- Construct a new floodplain at a lower elevation (Reach 2).

While project goals included:

- 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 function stream buffer.

1.2 PROJECT STRUCTURE

The East Tarboro Canal is a Federal Emergency Management Agency (FEMA) regulated stream with a detailed study. Stream restoration areas are located within a zone AE flood hazard area. Zone AE indicates areas inundated by the 100-year recurrence storm event. Stream restoration lowered the floodplain and will lower flood elevations throughout the reach. During Hurricane Floyd, most of the structures located in the floodplain received substantial damage and were raised. The majority of these properties were purchased by FEMA and as a result, the property in the 100-year floodplain is generally structure-free and town-owned. Currently 49% of the watershed remains agricultural or undeveloped. This land has the potential for development due to its proximity to the main Town of Tarboro. Prior to restoration the channel was incised and areas of severe bank erosion were located throughout both project reaches due to the high in-stream shear stress and lack of streambank vegetation.

East Tarboro Canal enters Reach 1 as a first-order stream and remains first order the entire reach. One additional stream enters East Tarboro Canal upstream of Reach 2 and a second tributary empties into Reach 2 near the start of the reach. Reach 2 begins as a 2nd order stream and becomes a third-order stream immediately downstream from the beginning of the reach. It remains a third order stream before emptying into the Tar River.

The Enhancement of Reach 1 and Priority 2 stream restoration of the Reach 2 of the main channel involved adjusting the dimension, pattern, and profile to allow the stream to more fully transport its water and sediment load. In addition In addition to planting, dimension and profile were altered on Reach 1. Dimensional alterations consisted of cutting a left bench to increase flood storage area and allow for sediment aggradation. Structures were installed on the bed of the channel to prevent further incision. A

combination of bedform transformations, channel dimension adjustments, pattern alterations, and structure installations were used to accomplish a Priority 2 stream restoration of Reach 2. The natural meander patterns were restored and rock grade control vanes and rootwads were incorporated for aquatic habitat enhancement and bed and bank stability. A riparian buffer was planted along both reaches in February 2007.

Exhibit Table 1. Project Restoration Components
East Tarboro Canal Stream Mitigation Site
EEP Project No: 123

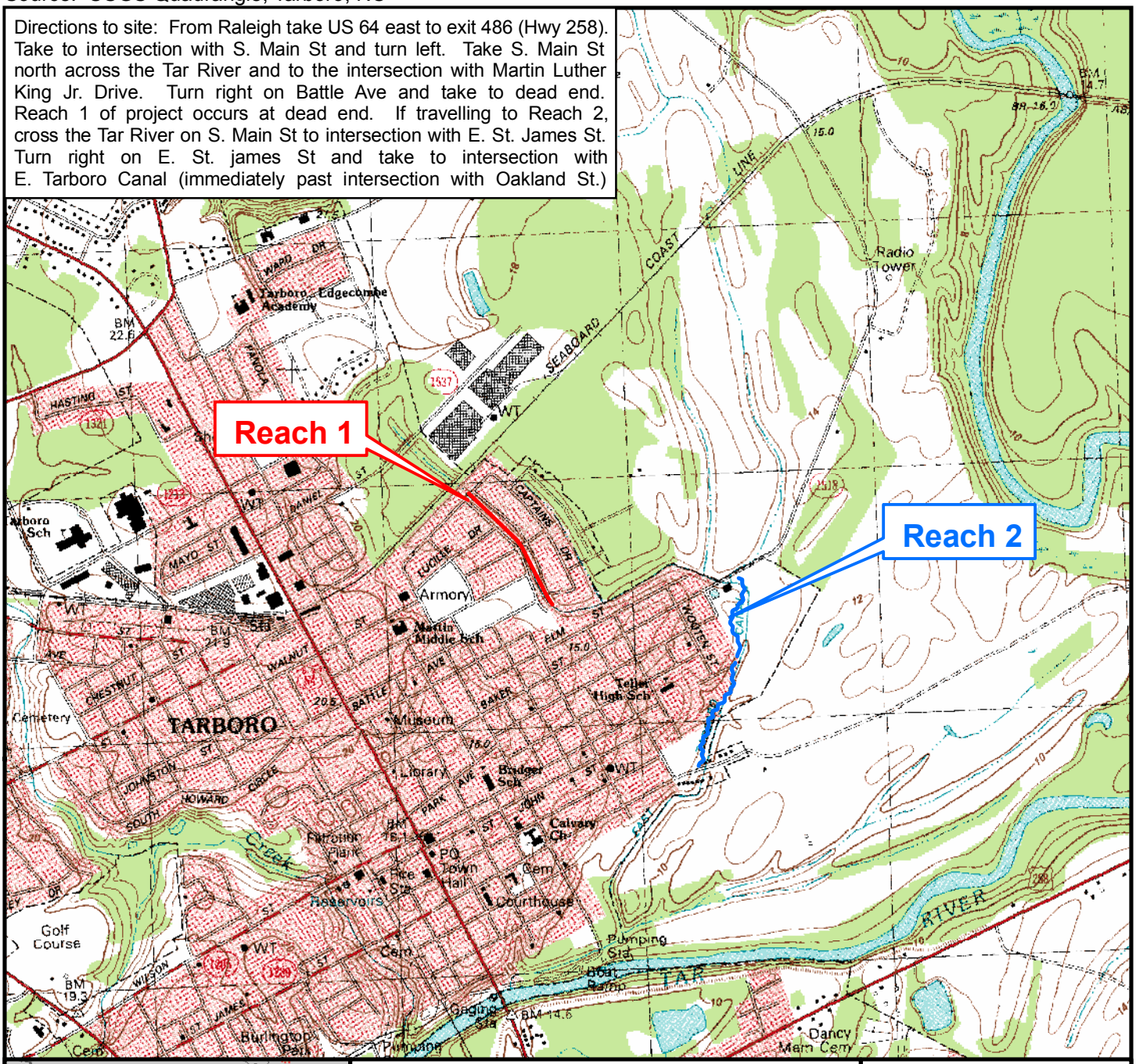
Project Segment/Reach ID	Mitigation Type	Approach	Linear Footage	Stationing	Comment
Reach 1	Enhancement 1	N/A	1,869	10+00 to 28+69	Instream structures and vegetated buffers
Reach 2	Restoration	Priority 2	2,933	10+00 to 39+33	Instream structures and vegetated Buffers

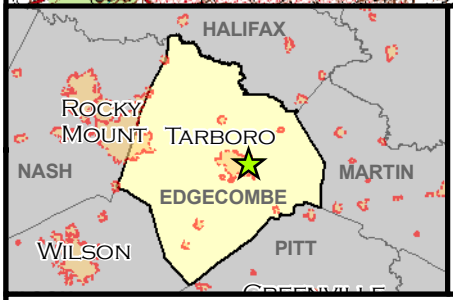
1.3 LOCATION AND SETTING

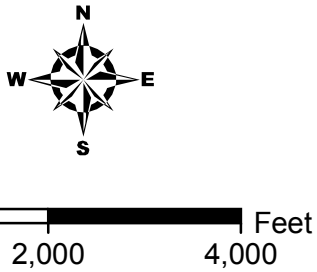
The project site consists of two reaches along East Tarboro Canal which is located in Tarboro, North Carolina in Edgecombe County (**Figure 1**). This stream is a tributary of the Tar River. Reach 1 begins downstream of Forest Acres Drive and flows for approximately 1,900 feet. Reach 2 begins downstream of Martin Luther King Jr. Drive and continues downstream for approximately 2,900 linear feet to St. James St. The project is located primarily on town of Tarboro and the Edgecombe County Board of Education properties.

Source: USGS Quadrangle, Tarboro, NC

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.)







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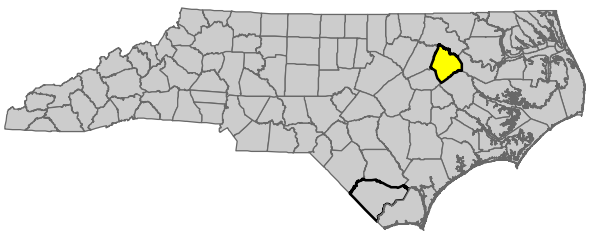


FIGURE 1
Site Location Map
East Tarboro Canal Stream Restoration Project
EEP No. 123
Edgecombe County, North Carolina
November 2008

1.4 PROJECT HISTORY AND BACKGROUND

Exhibit Table II. Project Activity and Reporting History East Tarboro Canal Stream Restoration - EEP Project No. 123		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
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	NA
Year 2 Monitoring	NA	NA
Year 3 Monitoring	NA	NA
Year 4 Monitoring	NA	NA
Year 5 Monitoring	NA	NA

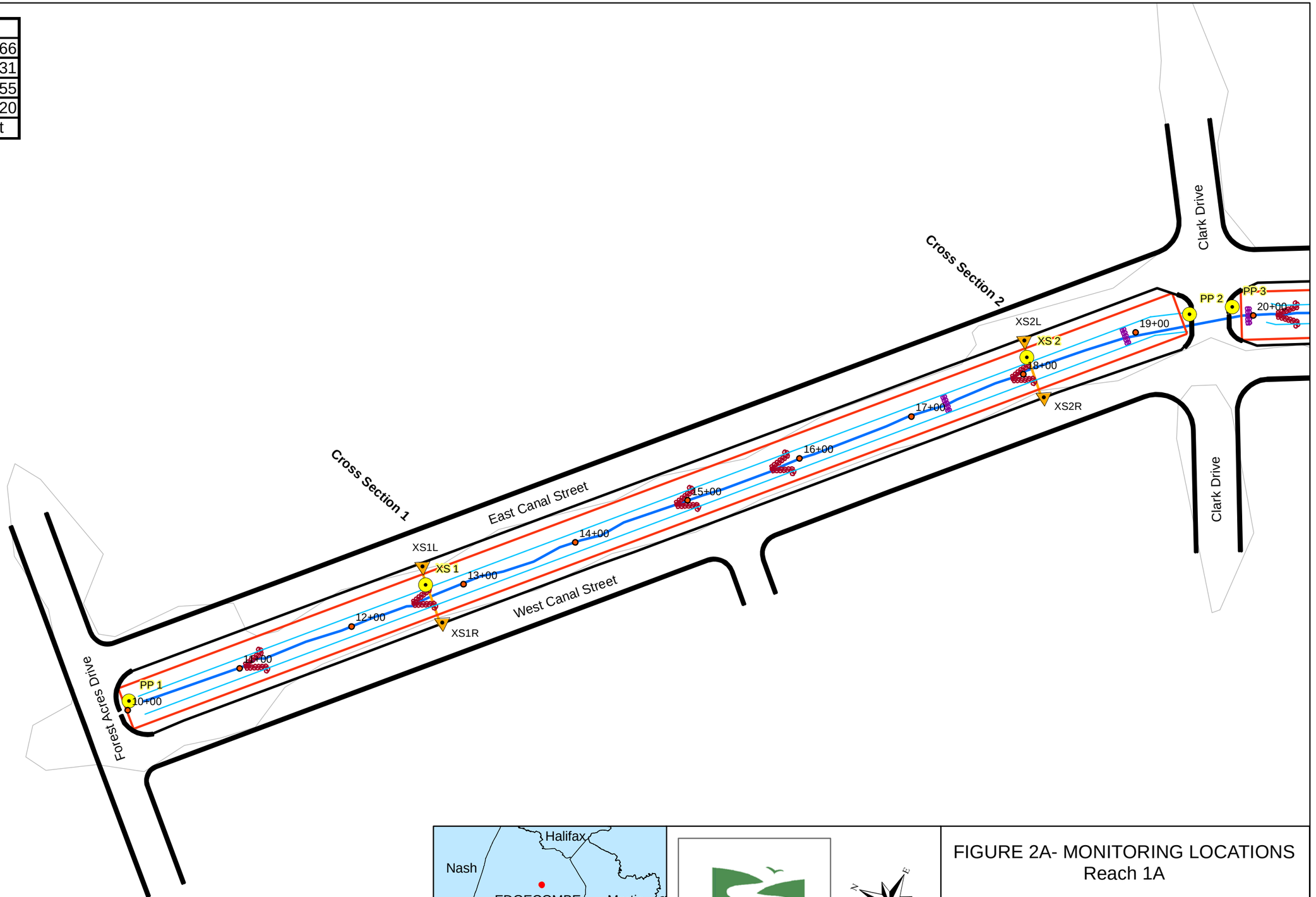
Exhibit Table III. Project Component Table East Tarboro Canal Stream Restoration - EEP Project No. 123	
Designer Primary project design POC	Earth Tech 701 Corporate Center Drive Suite 475 Raleigh, NC 27607
Construction Contractor Construction contractor POC	Shamrock Environmental Corporation P.O. Box 14987 Greensboro, NC 27415 Mike Granson (336)-375-1989
Planting Contractor Planting Contractor POC	Shamrock Environmental Corporation P.O. Box 14987 Greensboro, NC 27415 Mike Granson (336)-375-1989
Seeding Contractor Seeding Contractor POC	Shamrock Environmental Corporation P.O. Box 14987 Greensboro, NC 27415 Mike Granson (336)-375-1989
Seed Mix Sources	contact Shamrock Environmental Corporation
   Nursery Stock Suppliers	Mellow Marsh Farm 1312 Woody Store Road Siler City, NC 27344 (919) 742-1200
Monitoring Performers (Year 1)	Rummel, Klepper, and Kahl, LLP 900 Ridgefield Drive Suite 250 Raleigh, NC 27609
Stream Monitoring POC Vegetation Monitoring POC Wetland Monitoring POC	Pete Stafford (919)878-9560 Pete Stafford (919)878-9560 NA

Exhibit Table IV. Project Background Table East Tarboro Canal Restoration Site - EEP Project No. 123	
Project County	Edgecombe
Drainage Area	2.78 sq mi
Drainage impervious cover estimate (%)	10 percent
Stream Order	1st/2nd
Physiographic Region	Coastal Plain
Ecoregion	Southeastern Floodplains and Low Terraces
Rosgen Classification of As-built	Reach 1 –NA, Reach 2 – C5
Cowardin Classification	Riverine
Dominant soil types	Grantham-Urban land complex
	Portsmouth fine sandy loam
	Roanoke Loam
Reference site ID	UT to Mill Creek
USGS HUC for Project	03020103
USGS HUC for Reference	Unnamed tributary to Mill Creek (03020201)
NCDWQ Subbasin for Project	030303
NCDWQ Subbasin for Reference	Unnamed tributary to Mill Creek (030404)
NCDWQ Classification for Project	East Tarboro Canal (C, NSW)
NCDWQ Classification for Reference	Unnamed tributary to Mill Creek (C, NSW)
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
Percent of project easement fenced	0%

1.5 MONITORING PLAN VIEW

See the following as-built drawings for the Monitoring Plan Views.

Pin	Northing	Easting
XC1LPIN	789958	2434466
XC1RPIN	789922.8	2434431
XC2LPIN	789587.4	2434855
XC2RPIN	789552	2434820
NAD 1983 NC State Plane Feet		



Legend

- Stations
- Cross Section Pins
- Photopoints
- Roads
- Easement Boundary
- Bank
- Cross Vane
- Leaf Collector
- J-Hook
- Sill
- Rootwads
- Contours
- Thalweg
- Created Depression
- Vegetation Plot

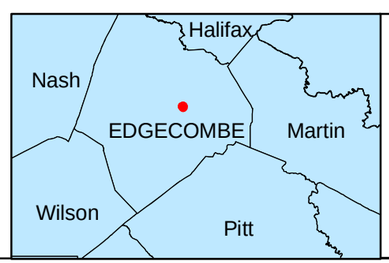


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FIGURE 2A- MONITORING LOCATIONS
Reach 1A

East Tarboro Canal Stream Restoration Site
Edgecombe County, North Carolina

120 60 0 120 Feet

December 2007

Pin	Northing	Easting
XC3LPIN	789294.3	2435053
XC3RPIN	789274.2	2435008
XC4LPIN	789175.1	2435115
XC4RPIN	789152.4	2435071
XC5LPIN	788784.7	2435314
XC5RPIN	788758.1	2435261
NAD 1983 NC State Plane Feet		

Clark Drive

Cross Section 3

Cross Section 4

Cross Section 5

East Canal Street

West Canal Street

XS3L

XS3

XS3R

XS4L

XS4R

XS5L

XS5

XS5R

PP 2

PP 3

PP 4

VP 1

VP1 PP

19+00

20+00

21+00

22+00

23+00

24+00

25+00

26+00

27+00

28+00

29+00

S2R

Clark Drive

Legend

- Stations
- Cross Section Pins
- Photopoints
- Roads
- Easement Boundary
- Bank
- Cross Vane
- Leaf Collector
- J-Hook
- Sill
- Rootwads
- Contours
- Thalweg
- Created Depression
- Vegetation Plot

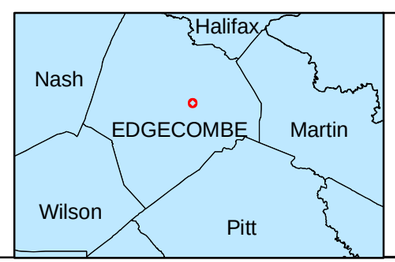

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FIGURE 2A- MONITORING LOCATIONS
Reach 1B

East Tarboro Canal Stream Restoration Site
Edgecombe County, North Carolina

120 60 0 120 Feet

December 2007

Pin	Northing	Easting
XS6LPIN	788640.3	2437904
XS6RPIN	788725.1	2437851
XS7LPIN	788375.2	2437826
XS7RPIN	788360	2437727
XS8LPIN	788191.3	2437894
XS8RPIN	788199.8	2437819
NAD 1983 NC State Plane Feet		

Parking Lot

Parking Lot

VP2 PP

PP 6

VP 2

PP 5

10+00

11+00

12+00

13+00

XS6R

14+00

XS 6

XS6L

Cross Section 6

VP 3

VP3 PP

15+00

VP4 PP

VP 4

16+00

VP6 PP

VP 6

XS7L

Cross Section 8

XS8L

17+00

XS7R

XS7

18+00

VP 5

VP5 PP

19+00

XS8R

XS 8

20+00

21+00

Cross Section 7

22+00

PP 7

Wilson Street

PP 8

23+00

XS9L

Legend

- Stations
- Cross Section Pins
- Photopoints
- Roads
- Easement Boundary
- Bank
- Cross Vane
- Leaf Collector
- J-Hook
- Sill
- Rootwads
- Contours
- Thalweg
- Created Depression
- Vegetation Plot

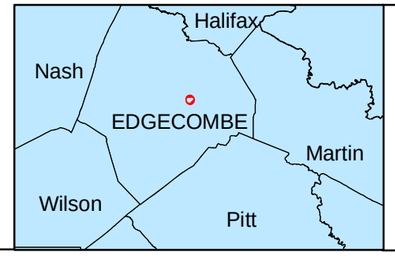

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FIGURE 2A- MONITORING LOCATIONS
Reach 2A

East Tarboro Canal Stream Restoration Site
Edgecombe County, North Carolina

120 60 0 120 Feet

December 2007

Pin	Northing	Easting
XS9LPIN	787750.5	2437837
XS9RPIN	787742.6	2437736
XS10LPIN	787532.4	2437804
XS10RPIN	787602.8	2437733
XS11LPIN	787299.8	2437627
XS11RPIN	787360.4	2437548
XS12LPIN	787017.1	2437495
XS12RPIN	787051.2	2437401
XS13LPIN	786776.9	2437396
XS13RPIN	786763.5	2437298
NAD 1983 NC State Plane Feet		

PP 8
23+00
XS9L
VP7 PP
XS 9
VP 7
24+00
25+00
26+00
XS10L
Cross Section 10
XS13
XS9R
Cross Section 9
VP 8
VP8 PP
27+00
XS10R
28+00
29+00
XS11L
30+00
XS 10
VP 9
VP9 PP
XS11R
Cross Section 11
31+00
VP 10
VP10 PP
32+00
XS12L
XS 11
33+00
34+00
PP 9
XS12R
Cross Section 12
PP 10
35+00
VP 11
VP11 PP
XS13L
36+00
VP 12
VP12 PP
37+00
XS12
38+00
39+00
VP 13
VP13 PP
PP 11
40+00
XS13R
Cross Section 13

Legend

- Stations
- Cross Section Pins
- Photopoints
- Roads
- Easement Boundary
- Bank
- Cross Vane
- Leaf Collector
- J-Hook
- Sill
- Rootwads
- Contours
- Thalweg
- Created Depression
- Vegetation Plot

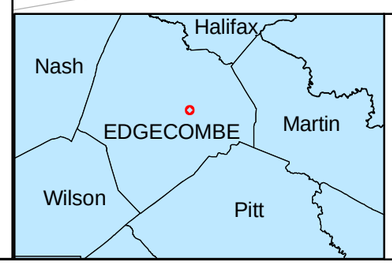

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FIGURE 2A- MONITORING LOCATIONS
Reach 2B

East Tarboro Canal Stream Restoration Site
Edgecombe County, North Carolina

120 60 0 120 Feet

December 2007

2.0 Project Condition and Monitoring Results

2.1 VEGETATION ASSESSMENT

Vegetative sample plots were quantitatively monitored during the first growing season. One (1) 100m2 plot was established for Reach 1 and twelve (12) 100m2 plots were established for Reach 2 for a total of thirteen (13) plots. Species composition, density, vigor and survival were monitored. Each plot corner is permanently located with rebar. On November 10, 2008, year 1 vegetation monitoring was completed using the Carolina Vegetation Survey (CVS) – EEP protocol Level 1 (version 4.1). Baseline data provided was not completed utilizing the CVS-EEP protocol, therefore some data will be skewed.

As per the mitigation plan, the vegetative success criteria are based on the US Army Corps of Engineers Stream Mitigation Guidelines (USACE, 2003). The final vegetative success criteria will be the survival of 260 5-year old planted woody stems per acre at the end of the year 5 monitoring period. An interim measure of vegetation planting success will be the survival of at least 320 3-year old planted woody stems per acre at the end of year 3 of the monitoring period. 9 of 13 vegetation plots meet or exceed the minimum success requirements. Additional vegetative problems include:

- Areas outside of the planted vegetation plots exhibit vegetation mortality
- Exotic species within the stream channel
- Mowing of planted stems in Reach 1

The Year 1 stem counts within each of the vegetative monitoring plots are included in Exhibit Tables A1 through A5 in Appendix A.

2.1.1 Vegetation Problem Areas

Even though the site has met vegetative success criteria, a number of trees across the site have died. North Carolina has been in a drought this year contributing to much of the vegetation failure along with the small caliper size of the bare root seedlings.

2.1.2 Vegetation Problem Area Plan View

Vegetation problem areas are shown on the Integrated Plan View map in Appendix D.

2.2 STREAM ASSESSMENT

2.2.1 Hydrology

As per the project scope, RK&K did not measure flows with peak stage recorders. However, during the most recent field visit, racklines were observed and photographed (Appendix B.4 Photo 12). A crest gauge will be installed on Reach 2 during 2009 to monitor flow activity.

Exhibit Table V. Verification of Bankfull Events East Tarboro Canal Stream Restoration Site - EEP Project No. 123			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo**
November 10, 2008	October/November 2008	Visual Observation	Appendix B.4 Photo 12

2.2.2 Bank Stability

According to the NCEEP guidelines for monitoring, bank stability assessments will be performed during year 5 monitoring. Bank stability will be assessed using the near bank stress (NBS) assessment and bank erodibility hazard index (BEHI).

Exhibit Table VI. BEHI and Sediment Export Estimates East Tarboro Canal Stream Restoration Project - EEP Project No. 123
Bank stability will be assessed in monitoring Year 5

2.2.3 Stream Problem Areas

Overall the stream reaches at East Tarboro Canal are stable and are showing few signs of instability. Reach 2 has a structure that is in need of immediate attention. Photos and location of these areas are shown in Appendix D Current Conditions Plan View. As discussed above, there are some vegetation issues throughout the site. These issues are most likely being compounded by the persistent drought the project site has experienced during 2007 and 2008 growing seasons. A review of NC Climate office data revealed that Edgecombe County experienced a moderate to severe drought from June of 2007 until November of 2008. During this time period, the rainfall totals were approximately fifteen inches below normal amounts.

The channel is overgrown with vegetation in many areas suggesting that there is not a consistent flow of water in the channel and also an occurrence of an exotic species (*Murdannia keisak*). The identity of the exotic species can not be confirmed because it had died off due to frost during the assessment (Appendix B.4 Photo 7). The lack of flow is likely due to the extreme drought during the 2007 and 2008 growing seasons. A detailed table and photos can be found in Appendix B. Current problem areas are:

- Rock Vein Structure Failure at Station 21+50
- Invasive and exotic vegetation found throughout the stream channel of Reach 2

RK&K recommends that the rock vein at station 21+50 (Photo B.3 SP3) be removed and replaced immediately to prevent more damage to the stream in this area. It is also recommended that all exotic species found within the stream channel be treated with herbicide.

2.2.4 Stream Problem Area Plan View

Stream problem areas are shown on the Integrated Current Condition Area Plan View in Appendix D.

2.2.5 Stability Assessment

Exhibit Table VII-A. Categorical Stream Feature Visual Stability Assessment East Tarboro Canal Stream Restoration Site/EEP Project No. 123 Reach 1						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	100%				
B. Pools	100%	100%				
C. Thalweg	NA	NA				
D. Meanders	100%	100%				
E. Bed General	100%	100%				
F. Bank Condition	100%	100%				
G. Vanes/J Hooks, etc.	100%	100%				
H. Wads and Boulders	NA	NA				

Exhibit Table VII-B. Categorical Stream Feature Visual Stability Assessment East Tarboro Canal Stream Restoration Site/EEP Project No. 123 Reach 2						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	96%				
B. Pools	100%	98%				
C. Thalweg	NA	NA				
D. Meanders	100%	100%				
E. Bed General	100%	100%				
F. Bank Condition	100%	95%				
G. Vanes/J Hooks, etc.	100%	95%				
H. Wads and Boulders	100%	95%				

2.2.6 Quantitative Measures Summary

Exhibit Table VIII. Baseline Morphology and Hydraulics Summary
East Tarboro Canal Stream Restoration Site - EEP Project No. 123
Reach 1 (1869 feet)

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Stream Reference			Design			As-Built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)						10.12	7.3	9.8	7.3	10.8	11	10.9	Na	Na	12	10.26	11.63	11.12
Flood Prone Width (ft)						12.53	10.1	14.7	12.3	8.3	9.6	9	Na	Na	12	12.05	17.13	14.82
BF Cross Sectional Area (SF)						1.21	1.23	2.02	1.5	0.77	0.87	0.80	Na	Na	1	1.09	1.55	1.33
BF Mean Depth (ft)						Na	1.54	2.92	2	1.24	1.45	1.34	Na	Na	1.6	1.7	2.85	2.13
BF Max Depth (ft)						Na	3.6	8	5.6	12.6	14.1	13.4	Na	Na	12	7.14	10.13	8.47
Width/Depth Ratio						Na	1.3	2.9	NA	9.1	9.3	Na	Na	Na	2.2	1.88	2.43	2.15
Entrenchment Ratio						Na	12.4	14.1	12.8	Na	Na	Na	Na	Na	Na	11.5	13.3	12.48
Bank Height Ratio						Na	0.79	0.97	1.04	Na	Na	Na	Na	Na	Na	1.03	1.25	1.18
Wetted Perimeter (ft)																		
Hydraulic Radius (ft)																		
Pattern																		
Channel Beltwidth (ft)									Na	12.5	25	18.8	Na	Na	Na			Na
Radius of Curvature (ft)									Na	14.4	39.8	23.3	Na	Na	Na			Na
Meander Wavelength (ft)									Na	39	64	50.4	Na	Na	Na			Na
Meander Width ratio									Na	3.6	5.9	4.6	Na	Na	Na			Na
Profile																		
Riffle Length									Na	Na	Na	Na	Na	Na	Na	13.6	123.04	65.47
Riffle Slope									Na	0.00	.055	.0022	0	.004	Na	.00152	.00523	.00334
Pool Length									Na	Na	Na	13	Na	Na	15	112.67	609.88	289.02
Pool Spacing									Na	16	45	32.3	18	50	34	134	506.48	356.01
Substrate																		
d50 (mm)																0.04	.34	.05
d84 (mm)																0.63	10.64	1.2
Additional Reach Parameters																		
Valley Length (ft)									1891						1875			1871
Channel Length (ft)									1833			280			1876			1869
Sinuosity									1.01			1.3			1.003			1.01
Water Surface Slope									.0001	0	.0055	.003	0	.004	.0022			.00215
BF Slope									Na			Na			Na			.00413
Rosgen Classification									G5c			C5			C5			C5
*Habitat Index																		
*Macrobenthos																		

Exhibit Table VIII. Baseline Morphology and Hydraulics Summary
East Tarboro Canal Stream Restoration Site - EEP Project No. 123
Reach 2 (2933 feet)

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Stream Reference			Design			As-Built		
Dimension	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)																		
Pattern																		
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
Profile																		
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
Substrate																		
d50 (mm)																.05	2	1.14
d84 (mm)																1.88	18.06	4.49
Additional Reach Parameters																		
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																		

Exhibit Table IX-A. Morphology and Hydraulic Monitoring Summary
East Tarboro Canal Stream Restoration Site - EEP Project No. 123
Reach 1 (1869 feet)

Parameter	Cross Section 1			Cross Section 2			Cross Section 3			Cross Section 4			Cross Section 5		
Dimension	MY0	MY1		MY0	MY1		MY0	MY1		MY0	MY1		MY0	MY1	
BF Width (ft)	10.26	13.3		11.07	9.4		11.622	10.9		11.04	10.9		11.63	13	
Floodprone Width (ft) (approx)	22.9	22.5		25.2	23.7		22.4	22.7		20.74	22.9		28.23	30.6	
BF Cross Sectional Area (ft2)	13.72	11.5		17.13	12.7		14.78	14.3		12.05	12.6		16.42	25.6	
BF Mean Depth (ft)	1.34	0.9		1.55	1.4		1.27	1.3		1.09	1.2		1.41	2.8	
BF Max Depth (ft)	1.9	1.8		2.85	2.8		1.76	1.8		1.7	2.2		2.44	2.0	
Width/Depth Ratio	7.66	915.3		7.14	7.0		9.15	8.4		10.13	9.4		8.25	6.6	
Entrenchment Ratio	2.23	1.7		2.28	2.5		1.93	2.1		1.88	2.1		2.43	8.9	
Wetted Perimeter (ft)		14.6			11.0			12.5			11.7			14.9	
Hydraulic radius (ft)		0.8			1.2			1.1			1.1			1.7	
Substrate															
d50 (mm)	0.05	0.07		0.34	0.18		0.04	0.096		0.12	0.11		0.04	0.1	
d84 (mm)	1.2	0.28		4.95	1.6		0.85	1.3		0.63	0.45		10.64	0.43	

Parameter	**MY-00 (2007)**			**MY-01 (2008)**			**MY-02 (2009)**			**MY-03 (2010)**			**MY-04 (2011)**			**MY-05 (2012)**		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)																		
Radius of Curvature (ft)																		
Meander Wavelength (ft)																		
Meander Width Ratio																		
Profile																		
Riffle Length (ft)																		
Riffle Slope (ft)																		
Pool Length (ft)																		
Pool Spacing (ft)																		
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinousity																		
Water Surface Slope (ft/ft)																		
BF Slope (ft/ft)																		
Rosgen Classification																		
*Habitat Index																		
*Macrobenthos																		

Exhibit Table IX-A. Morphology and Hydraulic Monitoring Summary
East Tarboro Canal Stream Restoration Site - EEP Project No. 123
Reach 2 (2933 feet)

Parameter	Cross Section 6			Cross Section 7			Cross Section 8			Cross Section 9			Cross Section 10		
Dimension	MY0	MY1		MY0	MY1		MY0	MY1		MY0	MY1		MY0	MY1	
BF Width (ft)	30.32	36.6		22.54	26.8		20.6	12.7		19.36	34.7		20.6	22.7	
Floodprone Width (ft) (approx)	100	115		100	85.5		75	51.7		101.4	78.6		100	92.4	
BF Cross Sectional Area (ft2)	26.95	24		31.22	30		22.99	12.1		27.34	22.118		25.78	21.6	
BF Mean Depth (ft)	0.89	.67		1.39	1.1		1.12	0.95		1.41	0.5		1.25	0.95	
BF Max Depth (ft)	1.75	1.6		3.5	4.2		2.6	3.0		3.21	4.9		2.63	2.9	
Width/Depth Ratio	34.07	55.7		16.22	23.9		18.39	13.3		13.73	66.9		16.48	23.8	
Entrenchment Ratio	3.3	3.1		4.44	3.2		3.64	4.1		5.24	12.3		4.85	4.1	
Wetted Perimeter (ft)		24.1			28.6			15			12.6			23.9	
Hydraulic radius (ft)		0.7			1			0.8			1			0.9	
Substrate															
d50 (mm)	1.05	0.67		0.05	.062		0.05	0.1		1.95	1.7		2	2	
d84 (mm)	1.88	1.6		18.06	.49		4	4.6		5.25	3.9		5.26	5.4	

Parameter	**MY-00 (2007)**			**MY-01 (2008)**			**MY-02 (2009)**			**MY-03 (2010)**			**MY-04 (2011)**			**MY-05 (2012)**		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)																		
Radius of Curvature (ft)																		
Meander Wavelength (ft)																		
Meander Width Ratio																		
Profile																		
Riffle Length (ft)																		
Riffle Slope (ft)																		
Pool Length (ft)																		
Pool Spacing (ft)																		
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinousity																		
Water Surface Slope (ft/ft)																		
BF Slope (ft/ft)																		
Rosgen Classification																		
*Habitat Index																		
*Macrobenthos																		

Exhibit Table IXA. Morphology and Hydraulic Monitoring Summary
East Tarboro Canal Stream Restoration Site - EEP Project No. 123
Reach 2 (2933 feet)

Parameter	Cross Section 11			Cross Section 12			Cross Section 13								
Dimension	MY0	MY1		MY0	MY1		MY0	MY1							
BF Width (ft)	18.93	15.1		18.13	15.6		21.52	9.6							
Floodprone Width (ft) (approx)	100	97.3		100	89.5		100	38							
BF Cross Sectional Area (ft2)	26.71	18.2		24.83	12.9		26.73	13.5							
BF Mean Depth (ft)	1.41	1.2		1.37	0.8		1.24	1.4							
BF Max Depth (ft)	2.68	2.9		2.52	2.3		2.96	2.7							
Width/Depth Ratio	13.43	12.6		13.23	18.9		17.35	6.9							
Entrenchment Ratio	5.28	6.4		5.52	5.7		4.65	3.9							
Wetted Perimeter (ft)	20.87	16.6		19.2	16.7		23.18	12.1							
Hydraulic radius (ft)	1.28	1.1		1.29	0.8		1.15	1.1							
Substrate															
d50 (mm)	N/A	0.76		1.14	0.71		1.97	2.1							
d84 (mm)	N/A	2.7		4.49	2.8		4.19	4.6							

Parameter	MY-00 (2007)			MY-01 (2008)			MY-02 (2009)			MY-03 (2010)			MY-04 (2011)			MY-05 (2012)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)																		
Radius of Curvature (ft)																		
Meander Wavelength (ft)																		
Meander Width Ratio																		
Profile																		
Riffle Length (ft)																		
Riffle Slope (ft)																		
Pool Length (ft)																		
Pool Spacing (ft)																		
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinousity																		
Water Surface Slope (ft/ft)																		
BF Slope (ft/ft)																		
Rosgen Classification																		
*Habitat Index																		
Macrobenthos																		

3.0 References

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APPENDIX A

A.1 Vegetation Data Tables

Exhibit Table A1. Vegetation Metadata

Report Prepared By	William (Pete) Stafford
Date Prepared	11/12/2008 10:47
Database Name	EastTarboroCanal.mdb
Database Location	C:\Documents and Settings\pstafford\Desktop\CVS Veg Data
Computer Name	STAFFORDP
Description Worksheets In This Document	
Metadata	This worksheet, which is a summary of the project data.
Planted	Each project is listed with its PLANTED stems, for each year. This excludes live stakes and lists stems per acre.
Total Stems	Each Project is listed with its total stems for each year. This includes live stakes, all planted stems, and all natural/volunteer stems. Listed in stems per acre.
Plots	List of Plots surveyed
Vigor	Frequency distribution of vigor classes
Vigor by Species	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 Species	Damage values tallied by type for each species
Damage by Plot	Damage values tallied by type for each plot
Planted Stems by Plot	Count of planted living stems of each species for each plot; dead and missing stems are excluded
Project Summary	
EEP Project Number	123
Project Name	East Tarboro Canal
Description	Stream Restoration
River Basin	Tar-Pamlico
Length (ft)	
Stream to Edge width (ft)	
Area (sq. m)	
Required Plots (calculated)	
Sampled Plots	13

Exhibit Table A2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing	Unknown
	Alnus serrulata	1	1					
	Betula nigra		2					
	Callicarpa americana	1	3	1				
	Cornus florida	1						
	Fraxinus pennsylvanica		1	1				
	Itea virginica		2					
	Nyssa biflora	1	4	3				
	Quercus laurifolia	2		1				
	Quercus lyrata	1						
	Quercus pagoda	4	3					
	Quercus palustris	2						
	Quercus phellos	2	1	1				
	Rosa palustris	3	3	1				
	Salix caroliniana		2	2				
	Taxodium distichum	1						
	Myrica	12	1	2				
	Unknown	1	15	10	21	1		
TOT:	**17**	**32**	**38**	**22**	**21**	**1**		

Exhibit Table A3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Cut	Deer	Unknown
	Alnus serrulata	2	1		1	
	Betula nigra	2	2			
	Callicarpa americana	5	4			1
	Cornus florida	1			1	
	Fraxinus pennsylvanica	2	2			
	Itea virginica	2	1			1
	Myrica	15	15			
	Nyssa biflora	8	7		1	
	Quercus laurifolia	3	3			
	Quercus lyrata	1	1			
	Quercus pagoda	7	7			
	Quercus palustris	2	2			
	Quercus phellos	4	4			
	Rosa palustris	7	7			
	Salix caroliniana	4	3	1		
	Taxodium distichum	1	1			
	Unknown	48	42		5	1
TOT:	**17**	**114**	**102**	**1**	**8**	**3**

Exhibit Table A4. Vegetation Damage by Plot

	plot	All Damage Categories	(no damage)	Cut	Deer	Unknown
	123-wes-0001-year:1	4	2		1	1
	123-wes-0002-year:1	8	8			
	123-wes-0003-year:1	7	7			
	123-wes-0004-year:1	10	10			
	123-wes-0005-year:1	12	11	1		
	123-wes-0006-year:1	6	5			1
	123-wes-0007-year:1	11	9		1	1
	123-wes-0008-year:1	6	4		2	
	123-wes-0009-year:1	9	8		1	
	123-wes-0010-year:1	11	10		1	
	123-wes-0011-year:1	11	11			
	123-wes-0012-year:1	10	8		2	
	123-wes-0013-year:1	9	9			
TOT:	**13**	**114**	**102**	**1**	**8**	**3**

Exhibit Table A5. Stem Count by Plot and Species

	Species	Total Planted Stems	# plots	avg# stems	plot 123-wes-0001-year:1	plot 123-wes-0002-year:1	plot 123-wes-0003-year:1	plot 123-wes-0004-year:1	plot 123-wes-0005-year:1	plot 123-wes-0006-year:1	plot 123-wes-0007-year:1	plot 123-wes-0008-year:1	plot 123-wes-0009-year:1	plot 123-wes-0010-year:1	plot 123-wes-0011-year:1	plot 123-wes-0012-year:1	plot 123-wes-0013-year:1
	Alnus serrulata	2	2	1	1								1				
	Betula nigra	2	1	2													2
	Callicarpa americana	5	3	1.67		2		1		2							
	Cornus florida	1	1	1										1			
	Fraxinus pennsylvanica	2	2	1					1			1					
	Itea virginica	2	2	1	1										1		
	Myrica	15	7	2.14		3		3		1				2	2	2	2
	Nyssa biflora	8	3	2.67				3	2				3				
	Quercus laurifolia	3	2	1.5				2						1			
	Quercus lyrata	1	1	1			1										
	Quercus pagoda	7	3	2.33			2				1		4				
	Quercus palustris	2	2	1						1	1						
	Quercus phellos	4	2	2	2										2		
	Rosa palustris	7	6	1.17			1		1		2	1		1	1		
	Salix caroliniana	4	1	4					4								
	Taxodium distichum	1	1	1		1											
	Unknown	47	12	3.92		2	3	1	4	2	6	4	1	6	5	8	5
TOT:	**17**	**113**	**17**		**4**	**8**	**7**	**10**	**12**	**6**	**10**	**6**	**9**	**11**	**11**	**10**	**9**

Exhibit Table A6. Stream Problem Areas

Feature Issue	Reach	Station Number	Suspected Cause	Photo Number
Deer Browse	Reach 1	Located throughout the project	Deer	
	Reach 2	Located throughout the project	Deer	
Mowing	Reach1	Entire Reach	Mowing	VPA1
Vegetation constricting channel flow	Reach 2	Located throughout Reach 2	Dry conditions that have allowed seeds to germinate	VPA2
Cattails	Reach 2	Located throughout Reach 2	Dry conditions that have allowed seeds to germinate	VPA 3

A.2 Vegetation Problem Areas (All Photos taken on October 14, 2008)

VPA 1 Reach 1 mowed riparian area

VPA 2 Reach 2 Vegetation Growing in the stream bed

Photos recorded on October 14, 2008

VPA 3 Reach 2 (throughout) Cattails growing in stream bed

Photos recorded on October 14, 2008

A.3 Vegetation Plot Photos (all photos recorded on November 10, 2008)

Vegetation Plot 1 (October 14, 2008)

Vegetation Plot 2

Photos recorded on November 10, 2008

Vegetation Plot 3

Vegetation Plot 4

Photos recorded on November 10, 2008

Vegetation Plot 5

Vegetation Plot 6

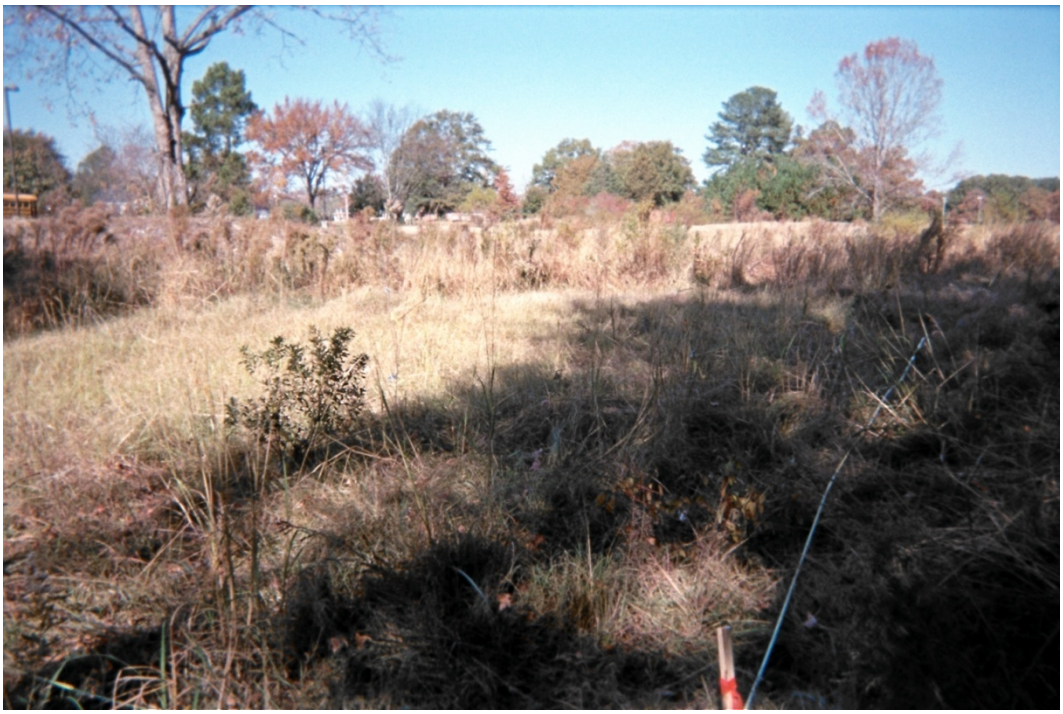
Photos recorded on November 10, 2008

Vegetation Plot 7

Vegetation Plot 8

Photos recorded on November 10, 2008

Vegetation Plot 9



Vegetation Plot 10

Photos recorded on November 10, 2008

Vegetation Plot 11

Vegetation Plot 12

Photos recorded on November 10, 2008

Vegetation Plot 13

Photos recorded on November 10, 2008

APPENDIX B

Appendix B. Geomorphologic Raw Data

B.1 Problem Area Plan View (Stream)

See the integrated Problem Area Plan View in Appendix D for stream problem areas

B.2 Stream Problem Areas Table

Exhibit Table B.1 Stream Problem Areas East Tarboro Canal Stream Restoration Site EEP Project No. 123				
Feature Issue	**Reach**	**Station Number**	**Suspected Cause**	**Photo Number**
Aggradation	Reach 1	20+25	Sediment from upstream	SP1
Aggradation	Reach 2	10+50	Sediment from upstream	N/A
Debris	Reach 2	10+100	N/A	SP2
Structure Failure	Reach 2	21+50	Poor Installation	SP3

B.3 Representative Stream Problem Areas Photos (Photos recorded on October 14, 2008)

SP1 Reach 1 Station 20+25 Aggradation

SP2 Reach 2 Station 10+100 Debris in channel

SP3 Reach 2 Station 21+ 50 Rock Vein Failure

Photos recorded on October 14, 2008

B.5 Qualitative Visual Stability Assessment

Exhibit Table B.2.2. Visual Morphological Stability Assessment East Tarboro Canal Stream Restoration Site EEP Project No. 123 Reach 1						
Feature Category	**Metric (per As-built and reference baselines)**	**(# Stable) Number Performing as Intended**	**Total Number per As-built**	**Total Number/Feet in Unstable State**	**% Perform in Stable Condition**	**Feature Perform. Mean or Total**
A. Riffles	1. Present?	17	17	0.00	100.00	
	2. Armor stable (eg no displacement?)	NA	NA	0.00	NA	
	3. Facet grade appears stable?	17	17	0.00	100.00	
	4. Minimal evidence of embedding/fining?	17	17	0.00	100.00	
	5. Length appropiate?	17	17	0.00	100.00	100
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	16	16	0.00	100.00	
	2. Sufficiently deep (Max Pool D:Mean Bkf > 1.6?)	16	16	0.00	100.00	
	3. Length appropriate?	16	16	0.00	100.00	100
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	NA	NA	NA		
	2. Downstream of meander (glide/inflection) centering?	NA	NA	NA		NA
D. Meanders	1. Outer bend in state of limited/controlled erosion?	1	1	0.00	100.00	
	2. Of those eroding, # w/concomitant point bar formation?	1	1	0.00	100.00	
	3. Apparent Rc within spec?	1	1	0.00	100.00	
	4. Sufficient floodplain access and relief?	1	1	0.00	100.00	100
E. Bed General	1. General channel bed aggradation areas (bar formation)	1800	1800	0.00	100.00	
	2. Channel bed degradation - areas of increasing down-cutting or head-cutting?	1800	1800	0.00	100.00	100
F. Bank	1. Actively eroding, wasting, or slumping bank?	1800	1800	0.00	100.00	100
G. Vanes	1. Free of back or arm scour?	7	7	0.00	100.00	
	2. Height appropriate?	7	7	0.00	100.00	
	3. Angle and geometry appear appropriate?	7	7	0.00	100.00	
	4. Free of piping or other structural failures?	7	7	0.00	100.00	100
H. Wads/Boulders	1. Free of scour?	NA	NA	NA	NA	
	2. Footing stable?	NA	NA	NA	NA	NA

Exhibit Table B.2.3. Visual Morphological Stability Assessment East Tarboro Canal Stream Restoration Site EEP Project No. 123 Reach 2						
Feature Category	**Metric (per As-built and reference baselines)**	**(# Stable) Number Performing as Intended**	**Total Number per As-built**	**Total Number/Feet in Unstable State**	**% Perform in Stable Condition**	**Feature Perform. Mean or Total**
A. Riffles	1. Present?	42	44	0	95.00	
	2. Armor stable (eg no displacement?)	NA	NA	NA	NA	
	3. Facet grade appears stable?	44	44	0	100.00	
	4. Minimal evidence of embedding/fining?	44	44	0	100.00	
	5. Length appropiate?	44	44	0	100.00	95
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	41	42	1	97.62	
	2. Sufficiently deep (Max Pool D:Mean Bkf > 1.6?)	42	42	1	97.62	
	3. Length appropriate?	42	42	0	100.00	98
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	NA	NA	NA		
	2. Downstream of meander (glide/inflection) centering?	NA	NA	NA		NA
D. Meanders	1. Outer bend in state of limited/controlled erosion?	44	44	0	100.00	
	2. Of those eroding, # w/concomitant point bar formation?	44	44	0	100.00	
	3. Apparent Rc within spec?	44	44	0	100.00	
	4. Sufficient floodplain access and relief?	44	44	0	100.00	100.00
E. Bed General	1. General channel bed aggradation areas (bar formation)	2733	2933	0	93.18	
	2. Channel bed degradation - areas of increasing down-cutting or head-cutting?	2933	2933	0	100.00	93.18
F. Bank	1. Actively eroding, wasting, or slumping bank?	2933	2933	0	99.61	100
G. Vanes	1. Free of back or arm scour?	19	19	0	100.00	
	2. Height appropriate?	19	19	0	100.00	
	3. Angle and geometry appear appropriate?	19	19	0	100.00	
	4. Free of piping or other structural failures?	19	19	0	100.00	100
H. Wads/Boulders	1. Free of scour?	NA	NA	0	100.00	
	2. Footing stable?	NA	NA	0	100.00	100

B.4 Stream Photo Station Photos (all photos recorded on October 14, 2008)

Photo Station 1. Beginning of Reach 1

Photo Station 2. Reach 1 Culvert upstream

Photos recorded on October 14, 2008

Photo Station 3. Reach 1 Culvert Downstream

Photo Station 4. End of Reach 1 Upstream

Photos recorded on October 14, 2008

Photo Station 5. Beginning of Reach 2 Downstream

Photo Station 6. Beginning of Reach 2 Upstream

Photos recorded on October 14, 2008

Photo Station 7. Wilson Street Crossing Upstream

Photo Station 8. Wilson Street Crossing – Downstream

Photos recorded on October 14, 2008

Photo Station 9. Culvert Upstream

Photo Station 10. Pool Culvert Downstream

Photos recorded on October 14, 2008

Photo Station 11. Reach 2 End of Project

12 Rack line in the floodplain

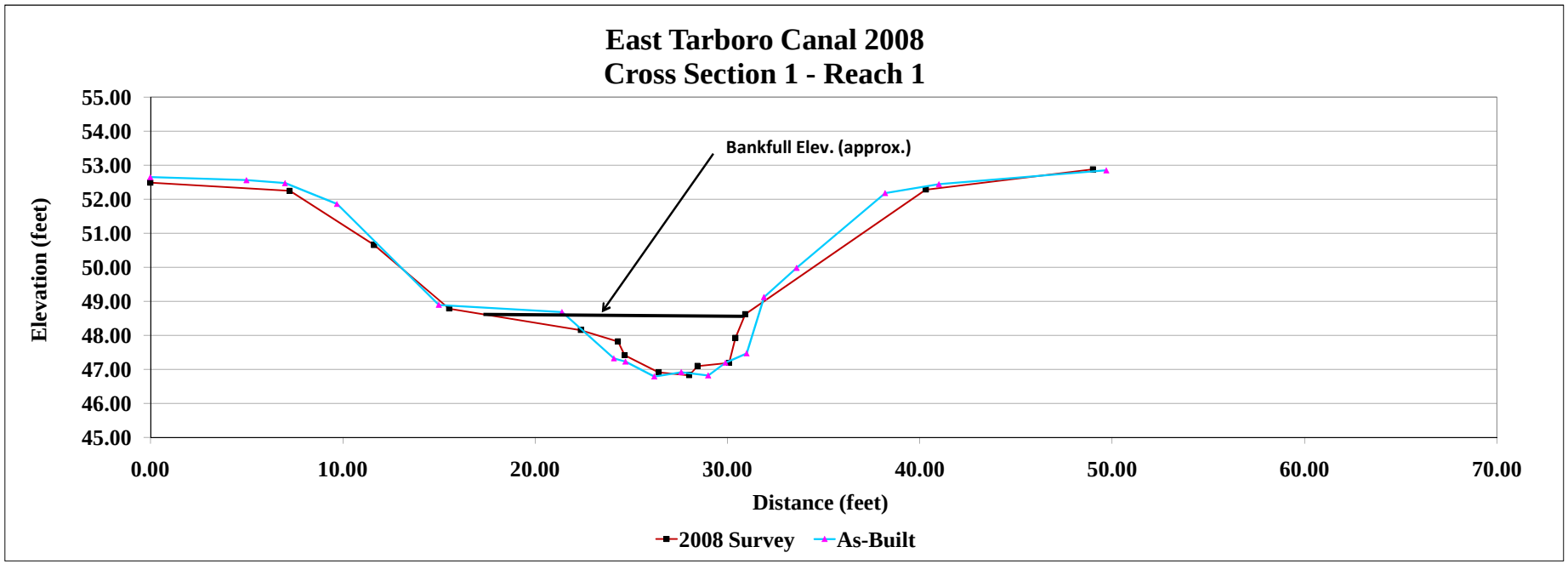
Photos recorded on October 14, 2008

Project Name	East Tarboro Canal
Cross Section	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0	52.65	LPIN	0.00	52.49													
5	52.56		7.24	52.25													
7	52.47		11.63	50.65													
9.7	51.86		15.53	48.78													
15	48.89		22.38	48.15													
21.4	48.68	BKF	24.31	47.82													
24.1	47.32		24.66	47.41													
24.7	47.22	LEW	26.42	46.91													
26.2	46.78	TW	28.01	46.82													
27.6	46.91		28.44	47.10													
29	46.81		30.09	47.19													
29.9	47.19	REW	30.41	47.92													
31.00	47.460		30.92	48.61													
31.90	49.120		40.32	52.28													
33.60	49.980		49.00	52.88													
38.20	52.180																
41.00	52.440																
49.70	52.850	RPIN															

Photo of Cross-Section #1 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	13.72	11.5				
Width	10.26	13.3				
Mean Depth	1.34	0.9				
Max Depth	1.90	1.8				
W/D	7.66	14.8				



Project Name	East Tarboro Canal
Cross Section	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey
As-Built Survey

Station	Elevation	Notes
0.00	51.77	LPIN
9.00	51.62	
10.00	51.32	
14.00	48.8	
19.00	48.43	BKF
21.00	47.65	
21.80	46.91	LEW
23.00	46.25	
24.30	45.92	
25.50	45.86	
26.80	45.58	TW
27.70	46.03	
27.70	46.93	REW
28.80	48.09	
31.50	48.81	
37.30	52.58	
42.00	53.4	
50.00	52.48	RPIN

2008
2008 Survey

Station	Elevation	Notes
0.00	51.77	
6.00	51.72	
11.12	51.58	
15.20	48.82	
18.38	48.07	
18.85	47.55	
21.17	47.18	
26.50	45.28	
30.62	48.72	
33.75	49.72	
36.60	52.46	
49.16	53.19	

2009
2009 Survey

Station	Elevation	Notes

2010
2010 Survey

Station	Elevation	Notes

2011
2011 Survey

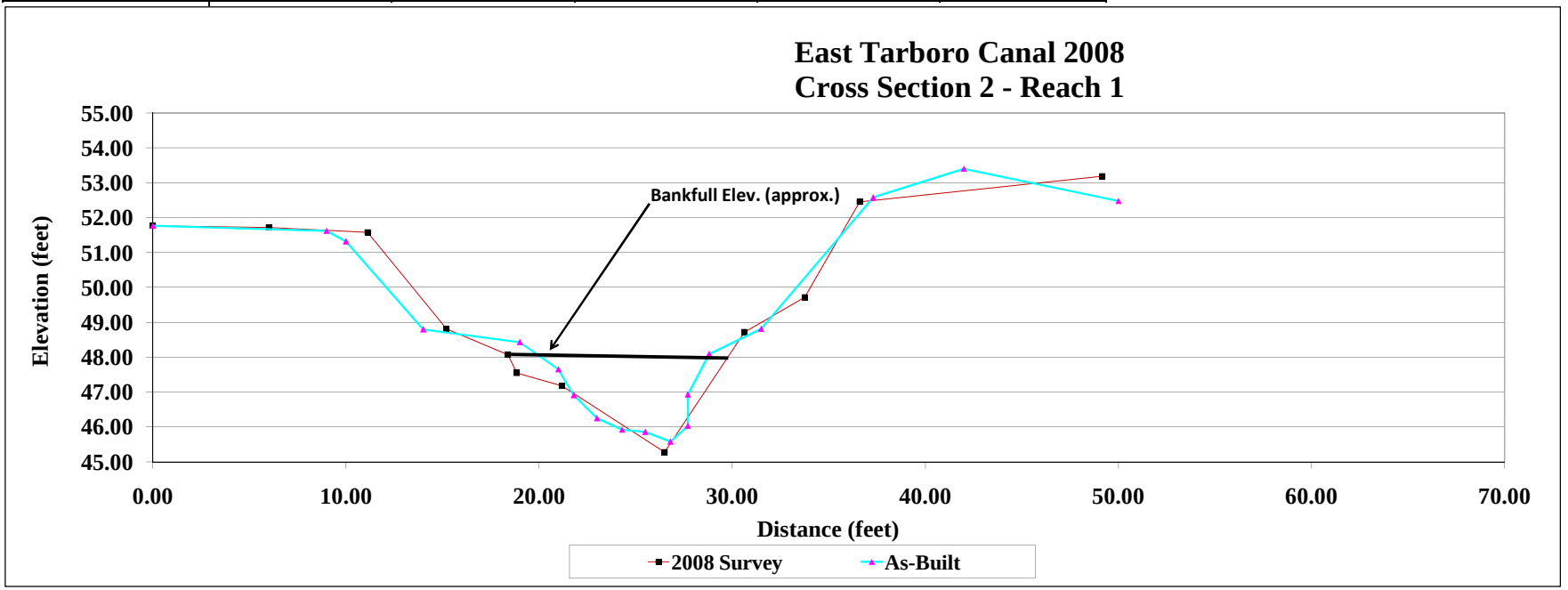
Station	Elevation	Notes

2012
2012 Survey

Station	Elevation	Notes

Photo of Cross-Section #2 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	17.13	12.70				
Width	11.07	10.90				
Mean Depth	1.55	1.40				
Max Depth	2.85	2.80				
W/D	7.14	7.00				

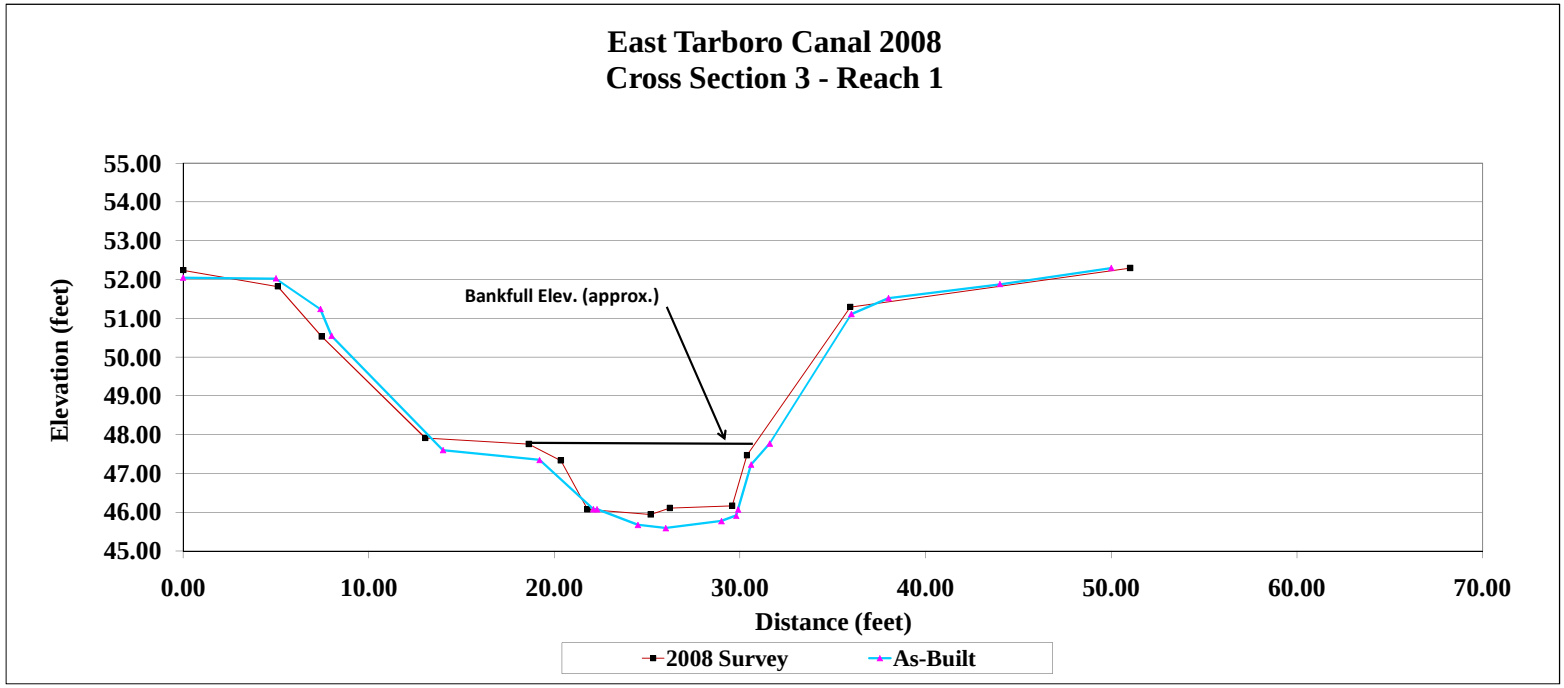


Project Name	East Tarboro Canal
Cross Section	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey		
Station	**Elv.**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0	52.05	LPIN	0.00	52.25													
5	52.03		5.10	51.82													
7.4	51.24		7.46	50.53													
8	50.55		13.05	47.91													
14	47.6		18.62	47.76													
19.2	47.35	BKF	20.35	47.33													
22.1	46.08		21.78	46.07													
22.3	46.08	LEW	25.19	45.94													
24.5	45.67		26.22	46.11													
26	45.59	TW	29.58	46.17													
29	45.77		30.37	47.47													
29.8	45.91		35.94	51.30													
29.9	46.07	REW	51.02	52.30													
30.6	47.23																
31.6	47.77																
36	51.11																
38	51.52																
44	51.88																
50	52.3	RPIN															

Photo of Cross-Section #3 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	14.78	14.30				
Width	11.62	10.90				
Mean Depth	1.27	1.30				
Max Depth	1.76	1.80				
W/D	9.15	8.40				

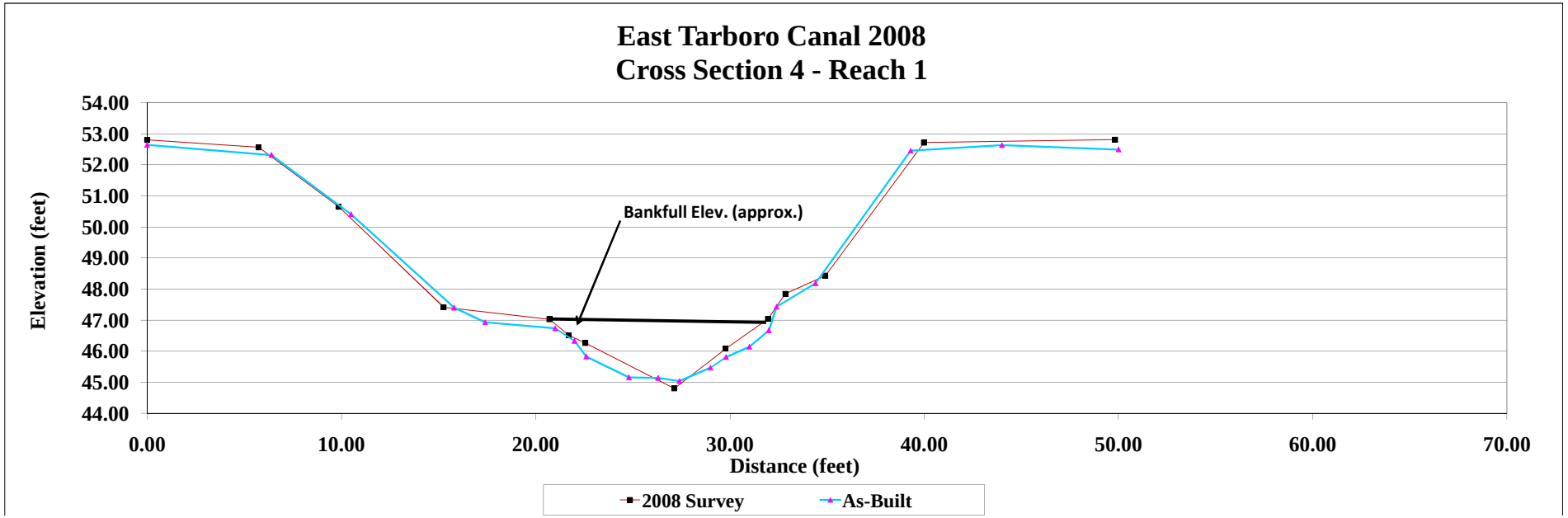


Project Name	East Tarboro Canal
Cross Section	#1
Feature	Riffle
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey Station	Elevation	Notes	2008 2008 Survey Station	Elevation	Notes	2009 2009 Survey Station	Elevation	Notes	2010 2010 Survey Station	Elevation	Notes	2011 2011 Survey Station	Elevation	Notes	2012 2012 Survey Station	Elevation	Notes
0	52.64	LPIN	0.00	52.79													
6.4	52.31		5.74	52.56													
10.5	50.4		9.85	50.65													
15.8	47.4		15.26	47.41													
17.4	46.93		20.71	47.03													
21	46.74	BKF	21.71	46.51													
22	46.33		22.56	46.26													
22.6	45.83	LEW	27.14	44.80													
24.8	45.16		29.78	46.08													
26.3	45.14		31.96	47.04													
27.4	45.04	TW	32.85	47.85													
29	45.47		34.91	48.43													
29.8	45.81	REW	39.99	52.71													
31	46.14		49.83	52.80													
32	46.67																
32.4	47.43																
34.4	48.18																
39.3	52.45																
44	52.63																
50	52.49	RPIN															

Photo of Cross-Section #4 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	12.05	12.60				
Width	11.04	10.90				
Mean Depth	1.09	1.20				
Max Depth	1.70	2.20				
W/D	10.13	9.40				

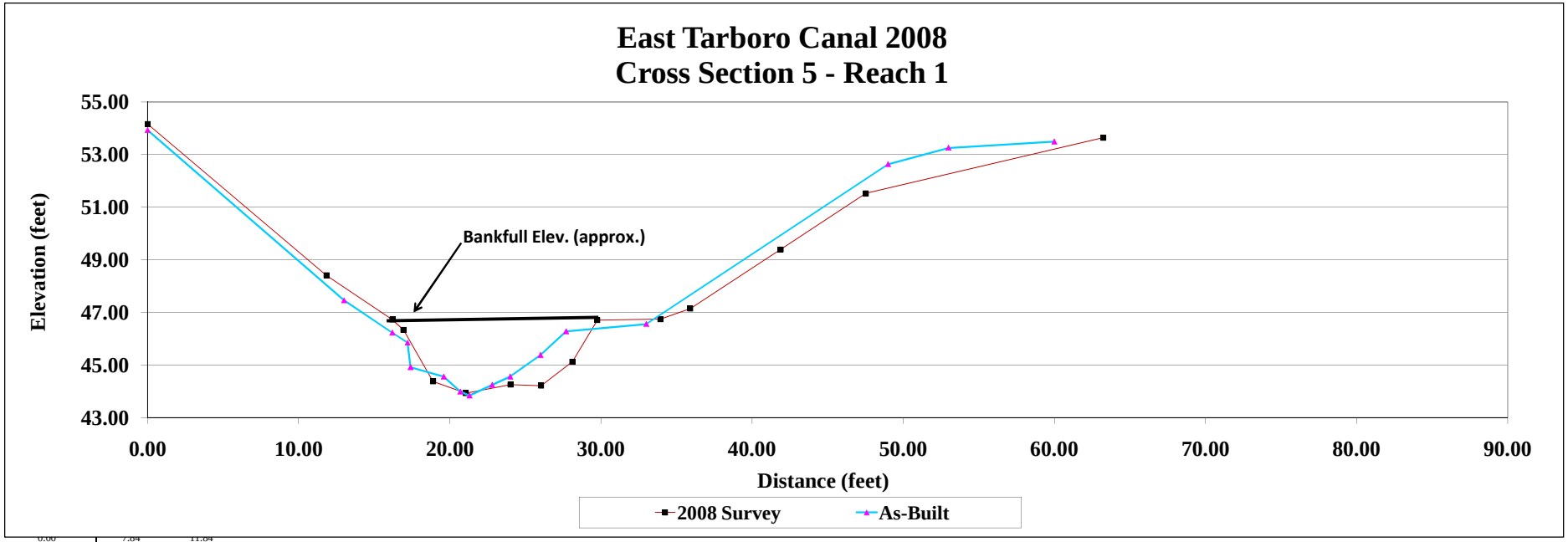


Project Name	East Tarboro Canal
Cross Section	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0	53.93	LPIN	0.00	54.16													
13	47.46		11.84	48.41													
16.2	46.23		16.20	46.73													
17.2	45.85		16.93	46.34													
17.4	44.92		18.89	44.38													
19.6	44.56	LEW	21.06	43.93													
20.7	43.99		24.01	44.25													
21.3	43.84	TW	26.04	44.22													
22.8	44.25		28.11	45.13													
24	44.56	REW	29.76	46.70													
26	45.38		33.94	46.74													
27.7	46.28	BKF	35.91	47.15													
33	46.56		41.89	49.39													
49	52.63		47.53	51.53													
53	53.25		63.25	53.64													
60	53.49	RPIN															

Photo of Cross-Section #5 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	16.42	25.60				
Width	11.63	13.00				
Mean Depth	1.41	2.80				
Max Depth	2.44	2.00				
W/D	8.25	6.60				



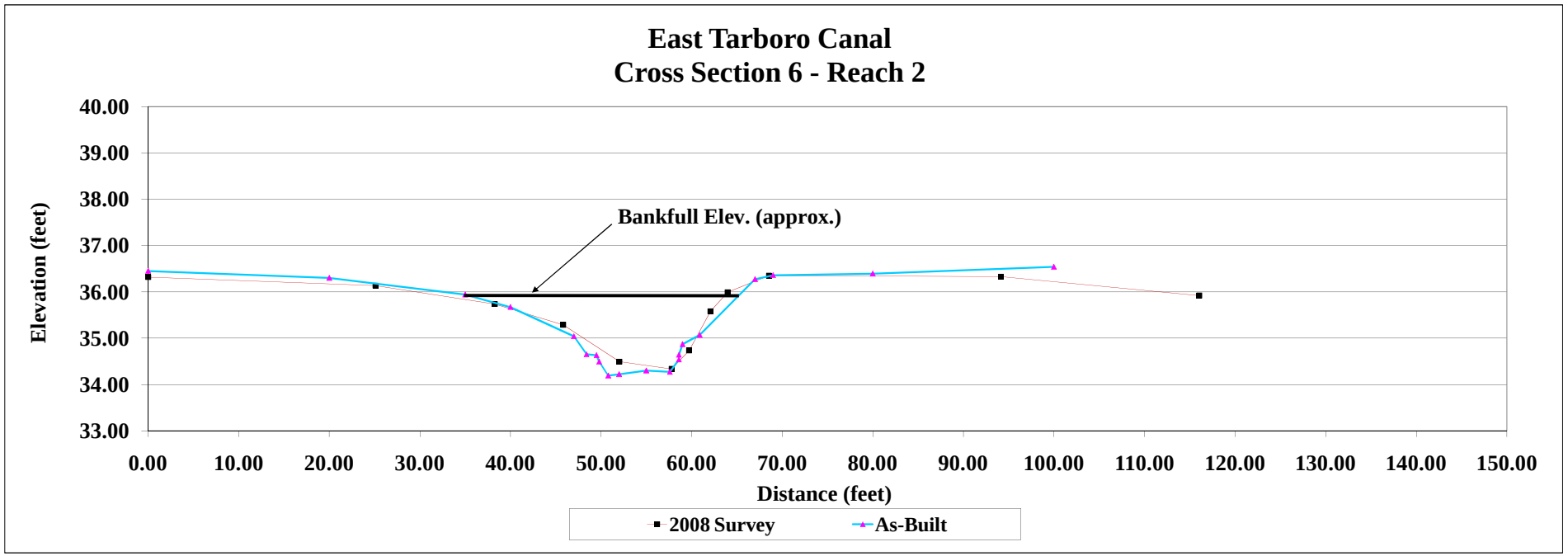
0.00	7.84	11.64
7.84	12.20	16.20

Project Name	East Tarboro Canal
Cross Section	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey			2012 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													
20	36.3		25.08	36.14													
35	35.94	BKF	38.26	35.74													
40	35.67		45.82	35.29													
47	35.04		52.03	34.49													
48.4	34.65		57.78	34.33													
49.5	34.63	LEW	59.72	34.73													
49.8	34.49		62.08	35.58													
50.8	34.19	TW	63.97	35.99													
52	34.22		68.53	36.35													
55	34.3		94.15	36.33													
57.6	34.27		116.05	35.92													
58.6	34.54																
58.6	34.64	REW															
59	34.87																
60.9	35.07																
67	36.27																
69	36.36																
80	36.39																
100	36.54	RPIN															

Photo of Cross-Section #6 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	26.95	24.00				
Width	30.32	36.60				
Mean Depth	0.89	0.67				
Max Depth	1.75	1.60				
W/D	34.07	55.70				

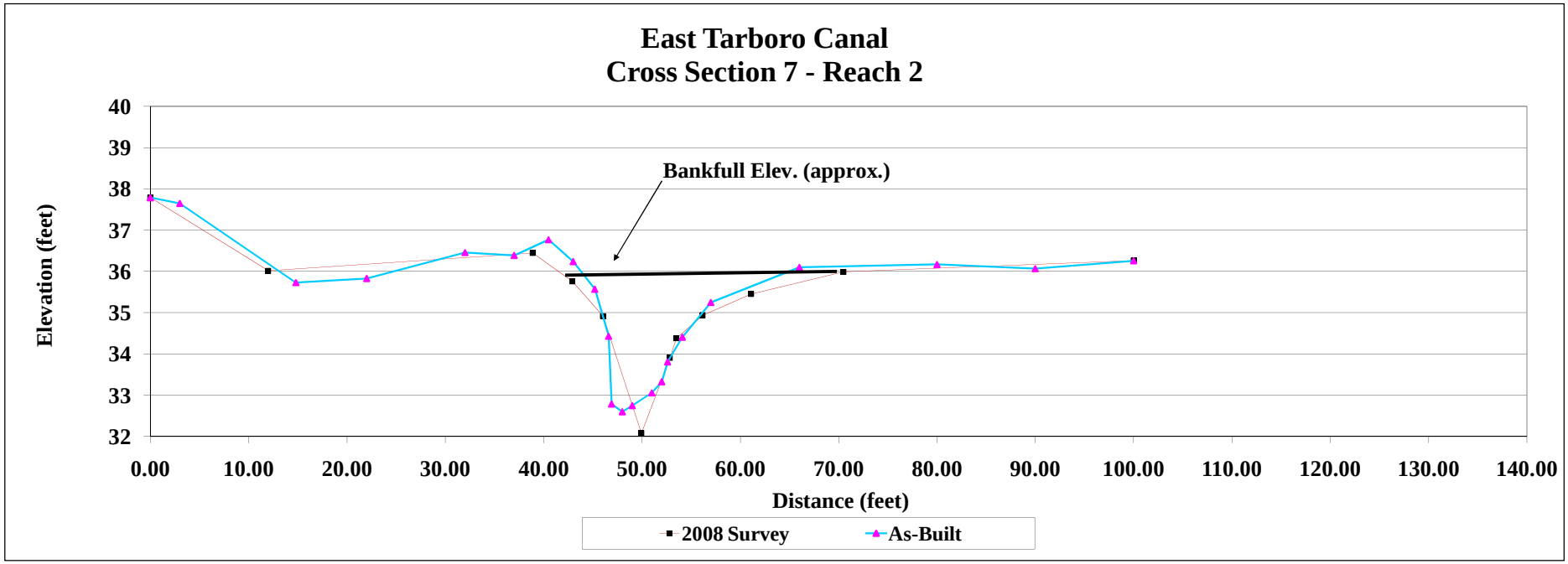


Project Name	East Tarboro Canal
Cross Section	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0	37.79	LPIN	0.00	37.79													
3	37.65		12.00	36.02													
14.8	35.73		38.87	36.45													
22	35.83		42.91	35.76													
32	36.46		46.03	34.92													
37	36.39		49.94	32.08													
40.5	36.77		52.84	33.91													
43	36.24		53.48	34.38													
45.2	35.57		56.17	34.94													
46.6	34.43	LEW	61.09	35.45													
46.9	32.79		70.47	35.99													
48	32.6	TW	100.00	36.26													
49	32.75																
51	33.06																
52	33.33																
52.6	33.81																
54.1	34.41	REW															
57	35.25																
66	36.1	BKF															
80	36.17																
90	36.07																
100	36.26	RPIN															

Photo of Cross-Section #7 - Looking Upstream

	AsBuilt	2008	2009	2010	2011	2012
Area	31.22	30.00				
Width	22.54	26.80				
Mean Depth	1.39	1.10				
Max Depth	3.50	4.20				
W/D	16.22	23.90				



Project Name	East Tarboro Canal
Cross Section	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey Station	Elevation	Notes
0	36.03	LPIN
20	36.02	
34	36.02	
39	35.92	
40	35.88	
42	35.56	
44.8	34.47	LEW
45.4	33.71	
46	33.52	
48	33.38	TW
50.2	33.46	
50.5	33.66	
51	34.35	
51.5	34.47	REW
56.6	35.98	BKF
64	36.2	
66	36.39	
75	37.18	RPIN

2008 2008 Survey Station	Elevation	Notes
0.00	35.76	
27.39	35.90	
40.41	35.77	
44.41	34.53	
46.63	33.80	
48.09	32.65	
52.77	34.69	
53.36	34.95	
55.78	35.28	
56.84	35.66	
63.32	36.38	
75.55	36.82	

2009 2009 Survey Station	Elevation	Notes

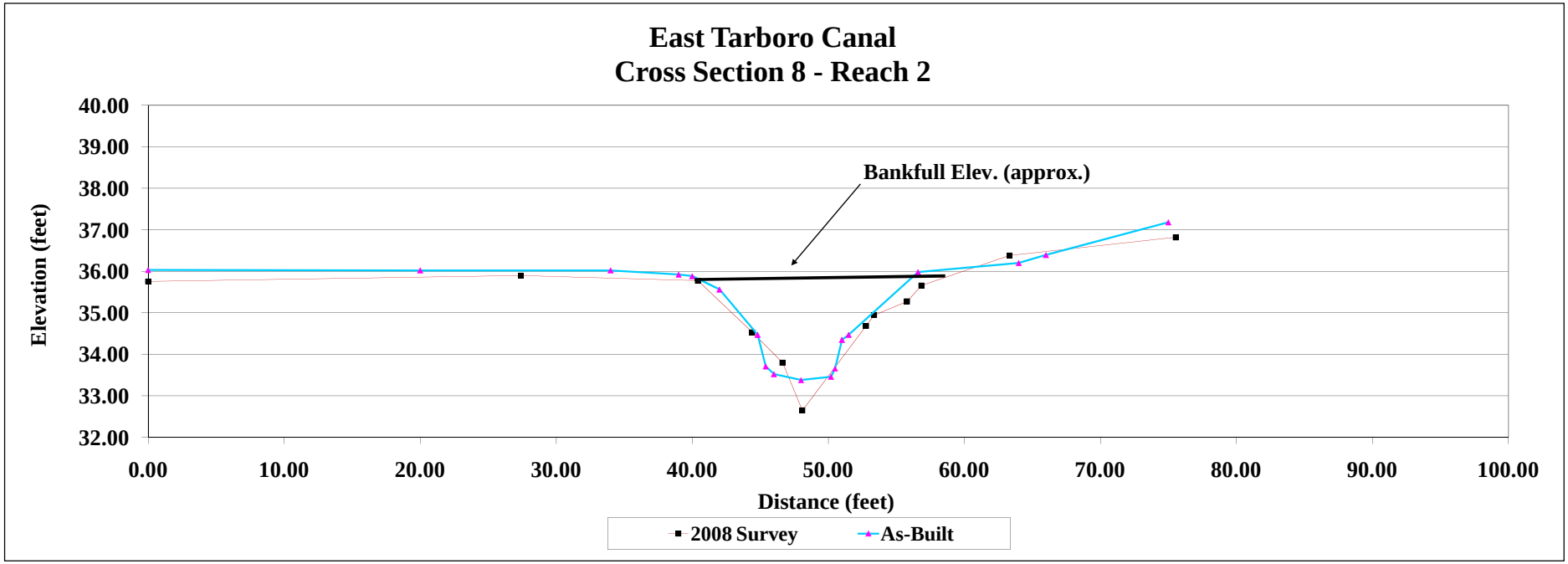
2010 2010 Survey Station	Elevation	Notes

2011 2011 Survey Station	Elevation	Notes

2012 2012 Survey Station	Elevation	Notes

Photo of Cross-Section #8 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	22.99	12.10				
Width	20.60	12.70				
Mean Depth	1.12	1.00				
Max Depth	2.60	3.00				
W/D	18.39	13.30				

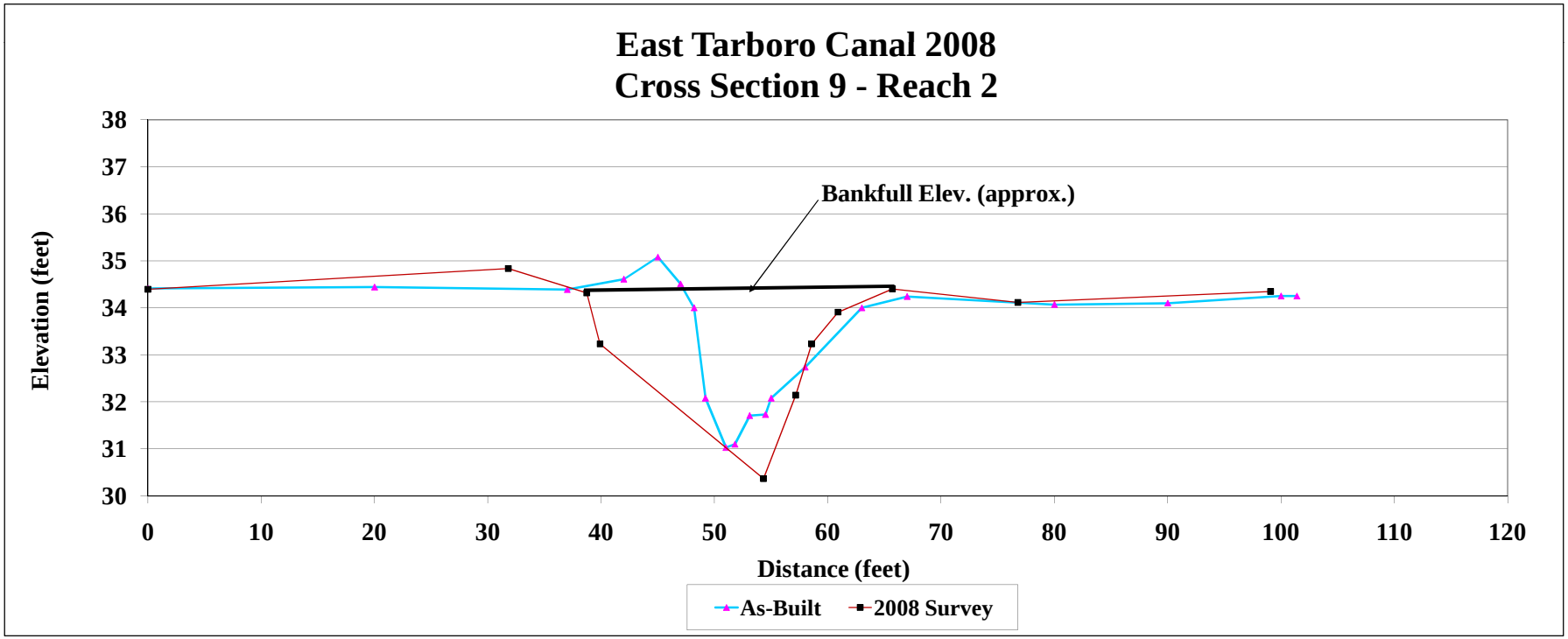


Cross Secti #1
Feature
Date Oct-08
Crew Tutt, Stafford

As-Built Survey As-Built Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	34.41	LPIN	0.00	34.40													
20	34.44		31.81	34.84													
37	34.39		38.72	34.32													
42	34.61		39.90	33.24													
45	35.08		54.34	30.37													
47	34.51		57.17	32.15													
48.2	34		58.59	33.23													
49.2	32.08	LEW	60.90	33.91													
51	31.03	TW	65.70	34.41													
51.8	31.1		76.79	34.12													
53.1	31.71		99.09	34.35													
54.5	31.73																
55	32.08	REW															
58	32.74																
63	34																
67	34.24	BKF															
80	34.07																
90	34.1																
100	34.25																
101.4	34.25	RPIN															

Photo of Cross-Section #9 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	27.34	22.11				
Width	19.36	34.70				
Mean Depth	1.41	0.50				
Max Depth	3.21	4.90				
W/D	13.73	66.90				

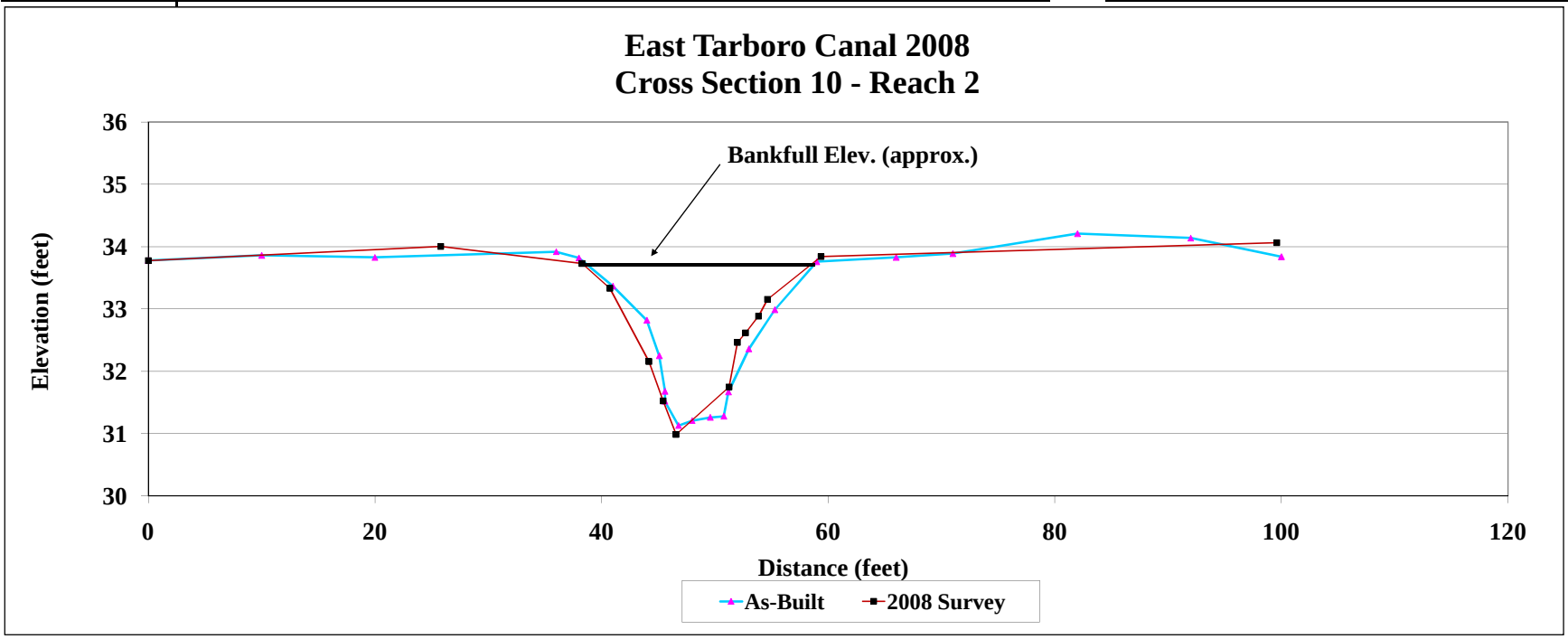


Project Nar East Tarboro Canal
Cross Secti #1
Feature
Date Oct-08
Crew Tutt, Stafford

As-Built Survey As-Built Survey Station	Elevation	Notes	2008 2008 Survey Station	Elevation	Notes	2009 2009 Survey Station	Elevation	Notes	2010 2010 Survey Station	Elevation	Notes	2011 2011 Survey Station	Elevation	Notes	2012 2012 Survey Station	Elevation	Notes
0	33.78	LPIN	0.00	33.78													
10	33.86		25.81	34.00													
20	33.83		38.28	33.73													
36	33.92		40.74	33.33													
38	33.82		44.20	32.16													
41	33.37		45.45	31.53													
44	32.82		46.60	30.99													
45.1	32.25		51.25	31.75													
45.6	31.68	LEW	51.99	32.46													
45.6	31.52		52.72	32.62													
46.8	31.13	TW	53.86	32.89													
48	31.21		54.66	33.16													
49.6	31.26		59.39	33.85													
50.8	31.28		99.61	34.07													
51.2	31.67	REW															
53	32.36																
55.3	32.99																
59	33.76	BKF															
66	33.83																
71	33.89																
82	34.21																
92	34.14																
100	33.84	RPIN															

Photo of Cross-Section #10 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	25.78	21.60				
Width	20.60	22.70				
Mean Depth	1.25	1.00				
Max Depth	2.63	2.90				
W/D	16.48	23.80				

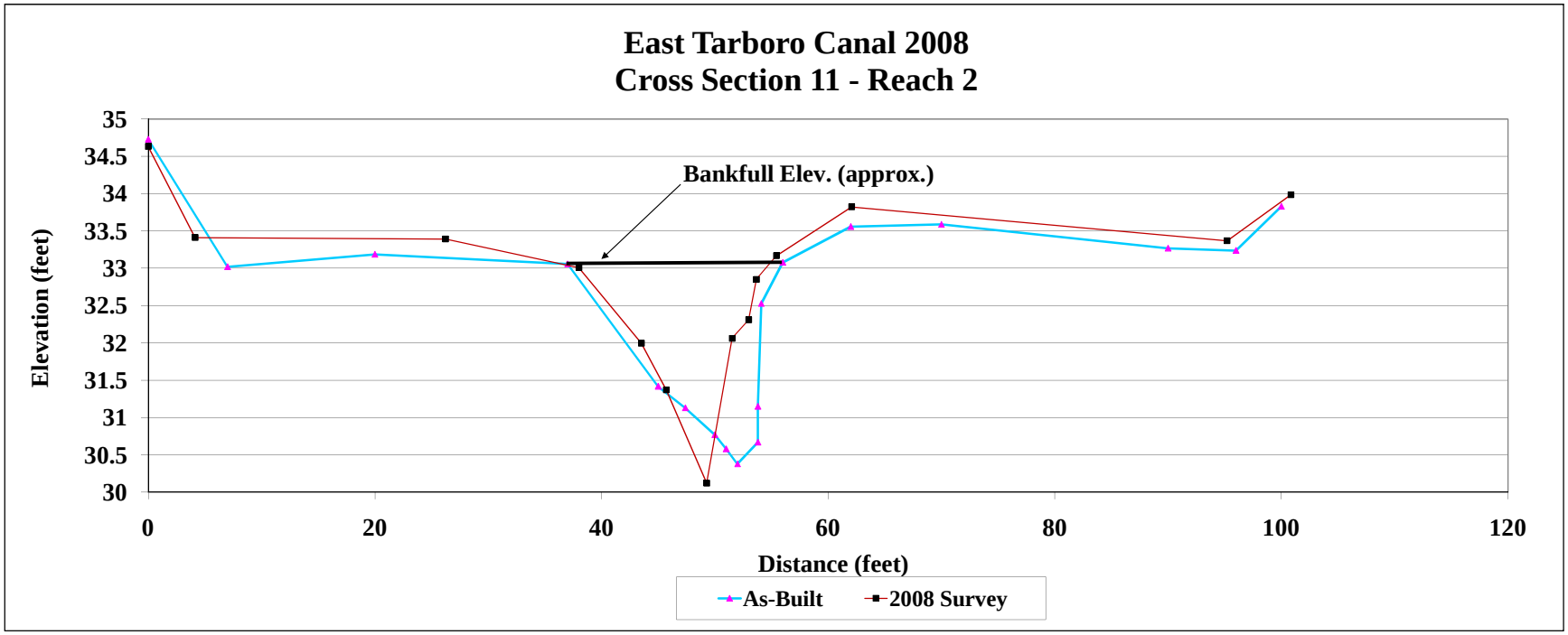


Project Nar	East Tarboro Canal
Cross Secti	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0	34.73	LPIN	100.86	33.99													
7	33.02		95.21	33.37													
20	33.19		62.08	33.82													
37	33.06	BKF	55.44	33.17													
45	31.42		53.68	32.85													
47.4	31.13	LEOW	52.99	32.31													
50	30.77		51.53	32.06													
51	30.58		49.29	30.12													
52	30.38	TW	45.72	31.37													
53.8	30.67		43.52	32.00													
53.8	31.15	REOW	38.01	33.01													
54.1	32.53		26.25	33.39													
56	33.08		4.14	33.41													
62	33.56		0.00	34.63													
70	33.59																
90	33.27																
96	33.24																
100	33.83	RPIN															

Photo of Cross-Section #11 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	26.71	18.20				
Width	18.93	15.10				
Mean Depth	1.41	1.20				
Max Depth	2.68	2.90				
W/D	13.43	12.60				

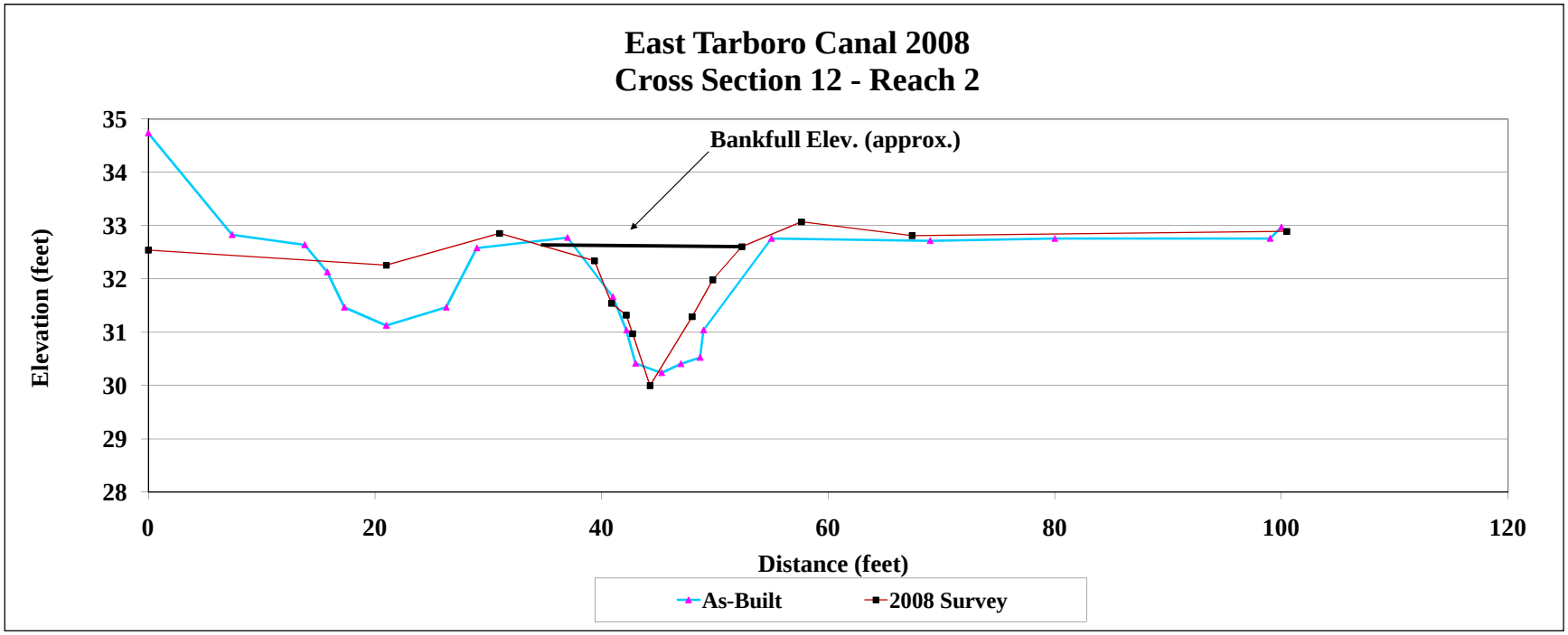


Project Nar	East Tarboro Canal
Cross Secti	#1
Feature	
Date	Oct-08
Crew	Tutt, Stafford

As-Built Survey As-Built Survey			2008 2008 Survey			2009 2009 Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
0	34.74	LPIN	0	32.54													
7.4	32.83		21.01	32.262													
13.8	32.64		31.01	32.855													
15.8	32.13		39.38	32.3439													
17.3	31.47		40.89	31.545													
21	31.13		42.18	31.3237													
26.3	31.47		42.76	30.9748													
29	32.58		44.28	29.9971													
37	32.78		48.01	31.2924													
41	31.67		49.82	31.9828													
42.2	31.04	LEW	52.41	32.6088													
43	30.42		57.65	33.074													
45.3	30.24	TW	67.42	32.814													
47	30.41		100.49	32.896													
48.7	30.53																
49	31.04	REW															
55	32.76	BKF															
69	32.72																
80	32.76																
99	32.76																
100	32.97	RPIN															

Photo of Cross-Section #12 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	24.83	12.90				
Width	18.13	15.60				
Mean Depth	1.37	0.80				
Max Depth	2.52	2.30				
W/D	13.23	18.90				



Project Nar East Tarboro Canal
Cross Secti #1
Feature
Date Oct-08
Crew Tutt, Stafford

As-Built Survey As-Built Survey Station	Elevation	Notes
0	32.41	LPIN
5	32.16	
26	32.04	
40	31.92	BKF
49	31.14	
51.4	30.34	LEW
52.7	29.68	
55	29.54	
57.8	28.96	TW
58.6	29.22	
59.1	30.36	REW
60	30.95	
61.3	31.89	
69	32.92	
80	32.32	
92.4	32.32	
100	34.44	RPIN

2008 2008 Survey Station	Elevation	Notes
0.00	32.50	
27.52	32.15	
41.46	32.04	
45.78	31.55	
47.33	31.09	
49.27	30.34	
52.64	30.73	
55.19	29.67	
57.49	29.30	
58.70	30.30	
59.76	31.12	
61.62	31.24	
62.70	31.84	
68.18	32.82	
92.94	32.27	
108.00	35.50	

2009 2009 Survey Station	Elevation	Notes

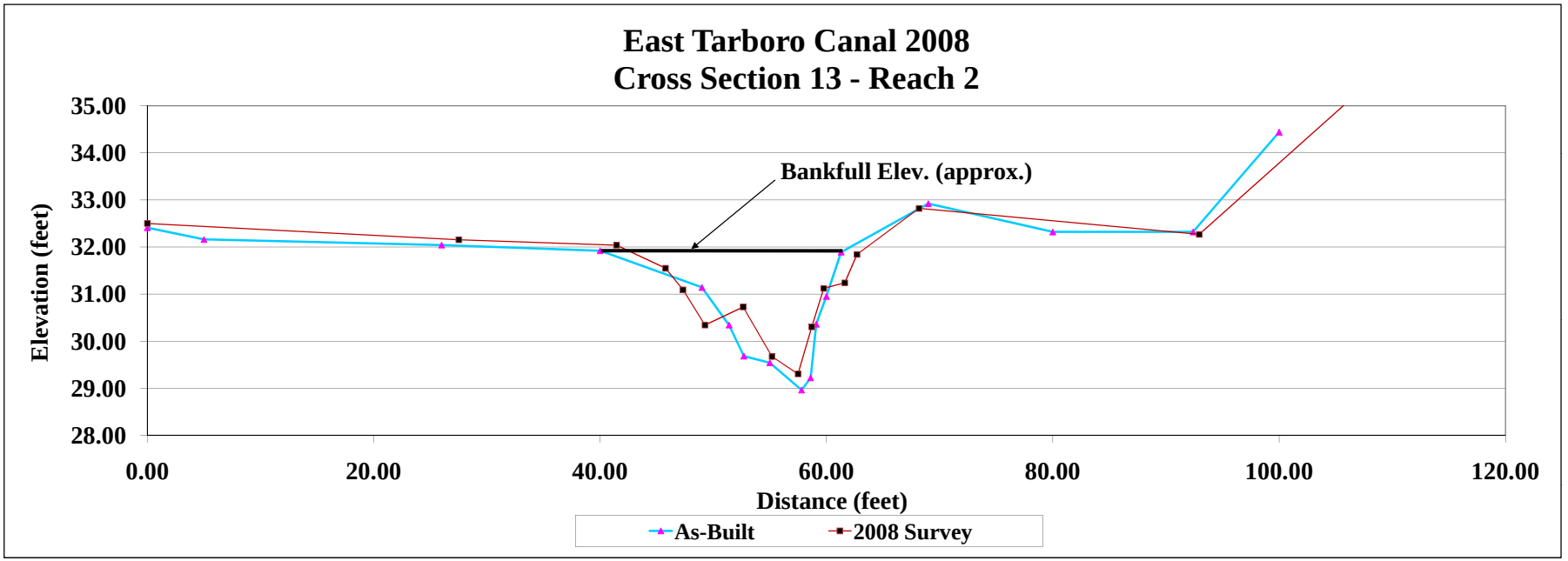
2010 2010 Survey Station	Elevation	Notes

2011 2011 Survey Station	Elevation	Notes

2012 2012 Survey Station	Elevation	Notes

Photo of Cross-Section #13 - Looking Downstream

	AsBuilt	2008	2009	2010	2011	2012
Area	26.73	13.50				
Width	21.52	9.60				
Mean Depth	1.24	1.40				
Max Depth	2.96	2.70				
W/D	17.35	6.90				

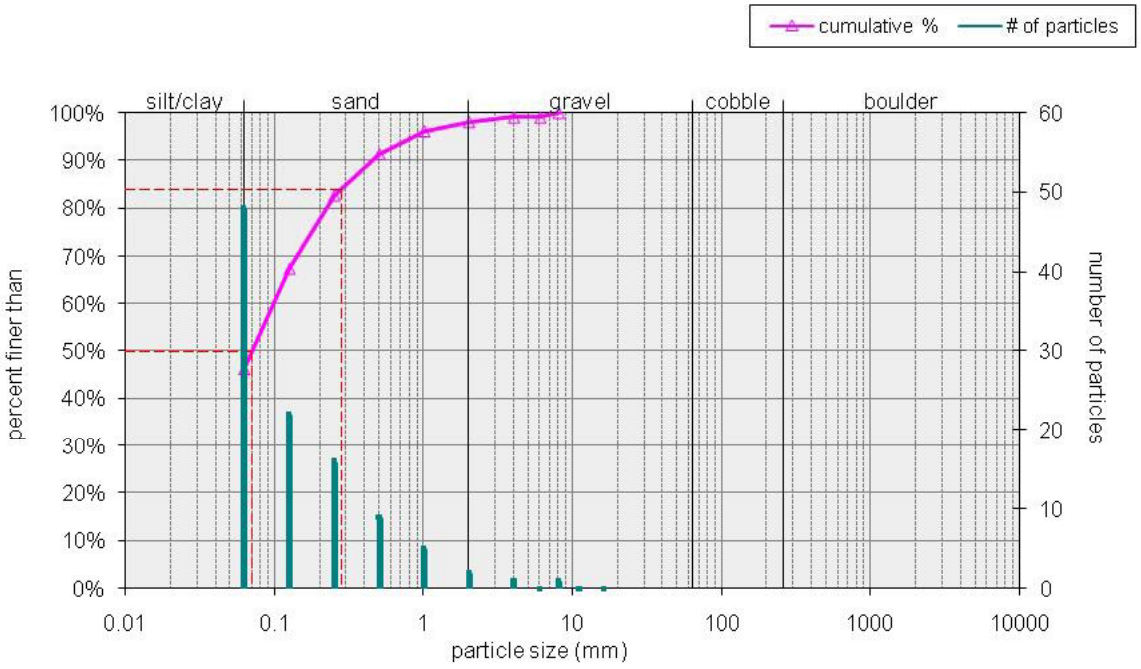


B.8 Pebble Count Distribution

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	48
very fine sand	0.062 - 0.125	22
fine sand	0.125 - 0.25	16
medium sand	0.25 - 0.5	9
coarse sand	0.5 - 1	5
very coarse sand	1 - 2	2
very fine gravel	2 - 4	1
fine gravel	4 - 6	0
fine gravel	6 - 8	1
medium gravel	8 - 11	0
medium gravel	11 - 16	0
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	104
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	104

Note: Cross Section 1

Cross Section 1 Pebble Count



Size (mm)	
D16	0.062
D35	0.062
D50	0.07
D65	0.12
D84	0.28
D95	0.85

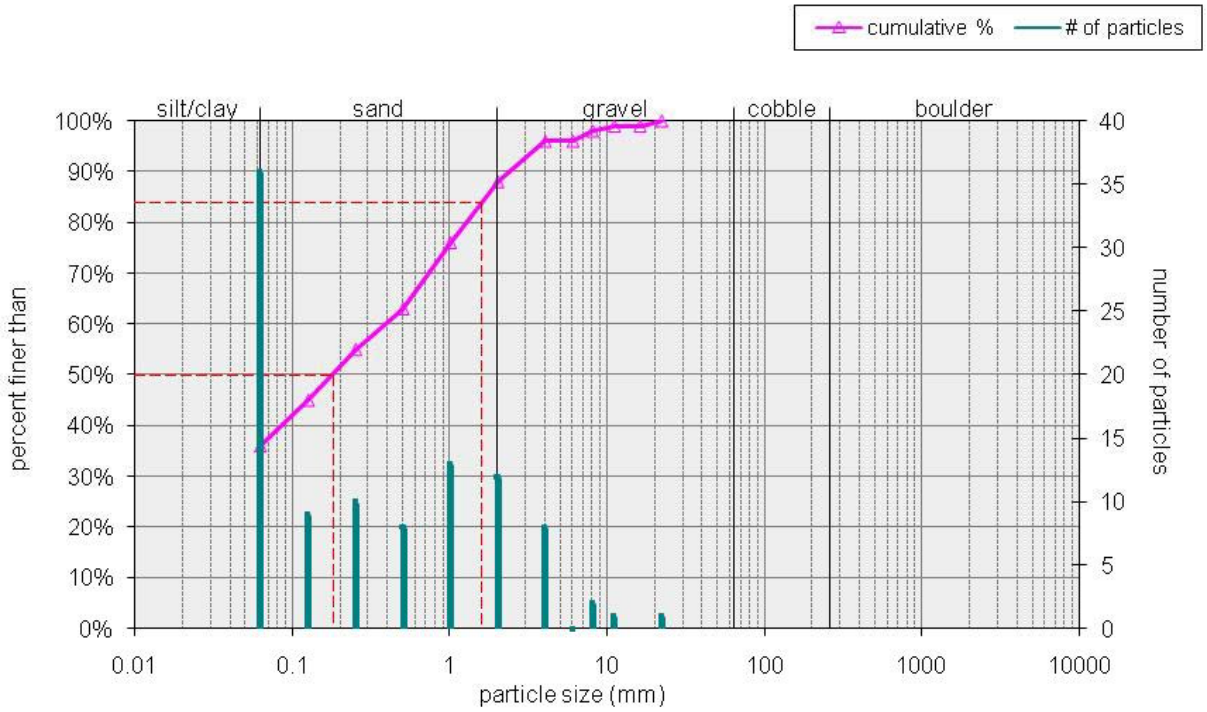
Size Distribution	
mean	0.131757
dispersion	2.564516
skewness	0.339452

Type	
silt/clay	0.461538
sand	0.519231
gravel	0.019231
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	36
very fine sand	0.062 - 0.125	9
fine sand	0.125 - 0.25	10
medium sand	0.25 - 0.5	8
coarse sand	0.5 - 1	13
very coarse sand	1 - 2	12
very fine gravel	2 - 4	8
fine gravel	4 - 6	0
fine gravel	6 - 8	2
medium gravel	8 - 11	1
medium gravel	11 - 16	
coarse gravel	16 - 22	1
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: Cross Section 2

Cross Section 2 Pebble Count



Size (mm)	
D16	0.062
D35	0.062
D50	0.18
D65	0.56
D84	1.6
D95	3.7

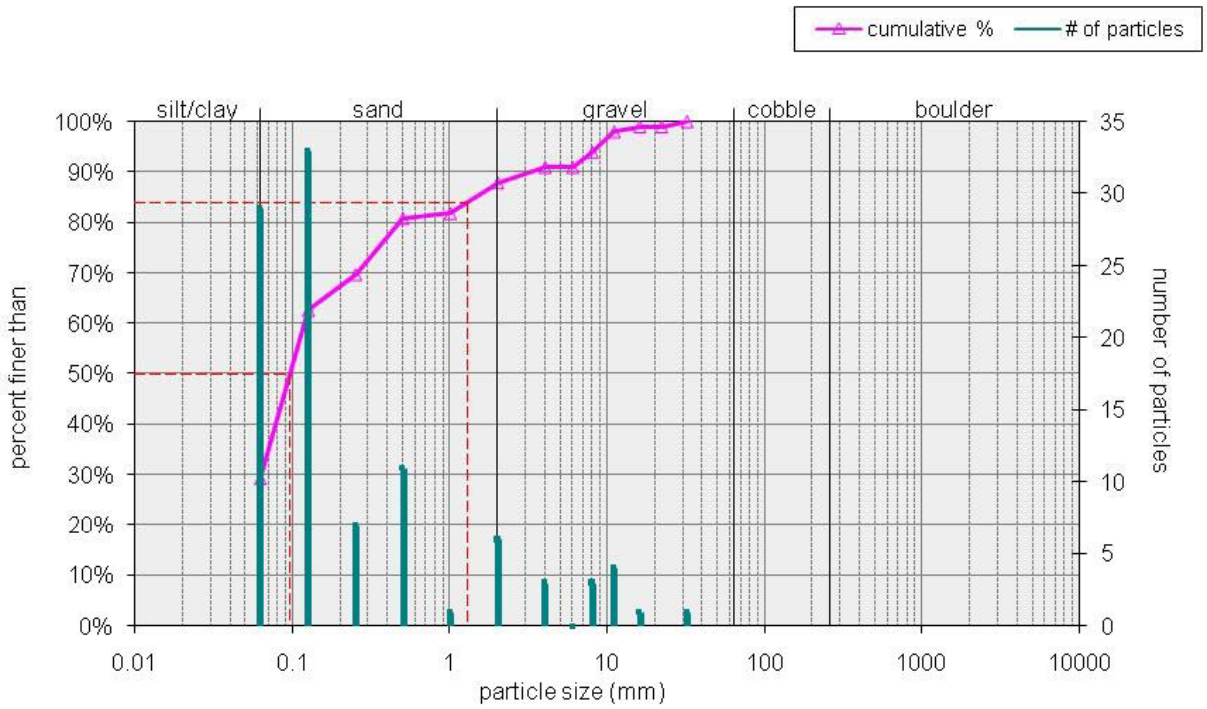
Size Distribution	
mean	0.31496
dispersion	5.896057
skewness	0.204504

Type	
silt/clay	0.36
sand	0.52
gravel	0.12
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	29
very fine sand	0.062 - 0.125	33
fine sand	0.125 - 0.25	7
medium sand	0.25 - 0.5	11
coarse sand	0.5 - 1	1
very coarse sand	1 - 2	6
very fine gravel	2 - 4	3
fine gravel	4 - 6	0
fine gravel	6 - 8	3
medium gravel	8 - 11	4
medium gravel	11 - 16	1
coarse gravel	16 - 22	
coarse gravel	22 - 32	1
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	99
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	99

Note: Cross Section 3

Cross Section 3 Pebble Count



Size (mm)	
D16	0.062
D35	0.07
D50	0.096
D65	0.16
D84	1.3
D95	8.7

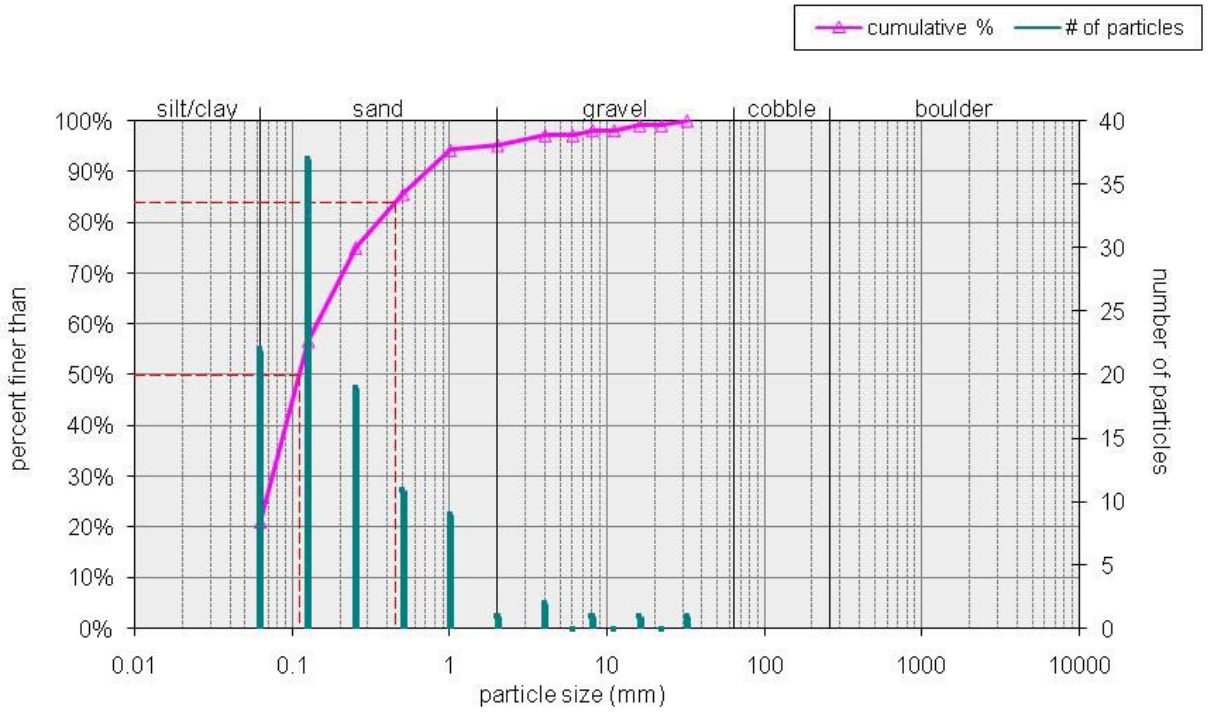
Size Distribution	
mean	0.283901
dispersion	7.545027
skewness	0.409622

Type	
silt/clay	0.292929
sand	0.585859
gravel	0.121212
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	22
very fine sand	0.062 - 0.125	37
fine sand	0.125 - 0.25	19
medium sand	0.25 - 0.5	11
coarse sand	0.5 - 1	9
very coarse sand	1 - 2	1
very fine gravel	2 - 4	2
fine gravel	4 - 6	0
fine gravel	6 - 8	1
medium gravel	8 - 11	0
medium gravel	11 - 16	1
coarse gravel	16 - 22	0
coarse gravel	22 - 32	1
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	104
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	104

Note: Cross Section 4

Cross Section 4 Pebble Count



Size (mm)	
D16	0.062
D35	0.081
D50	0.11
D65	0.17
D84	0.45
D95	1.7

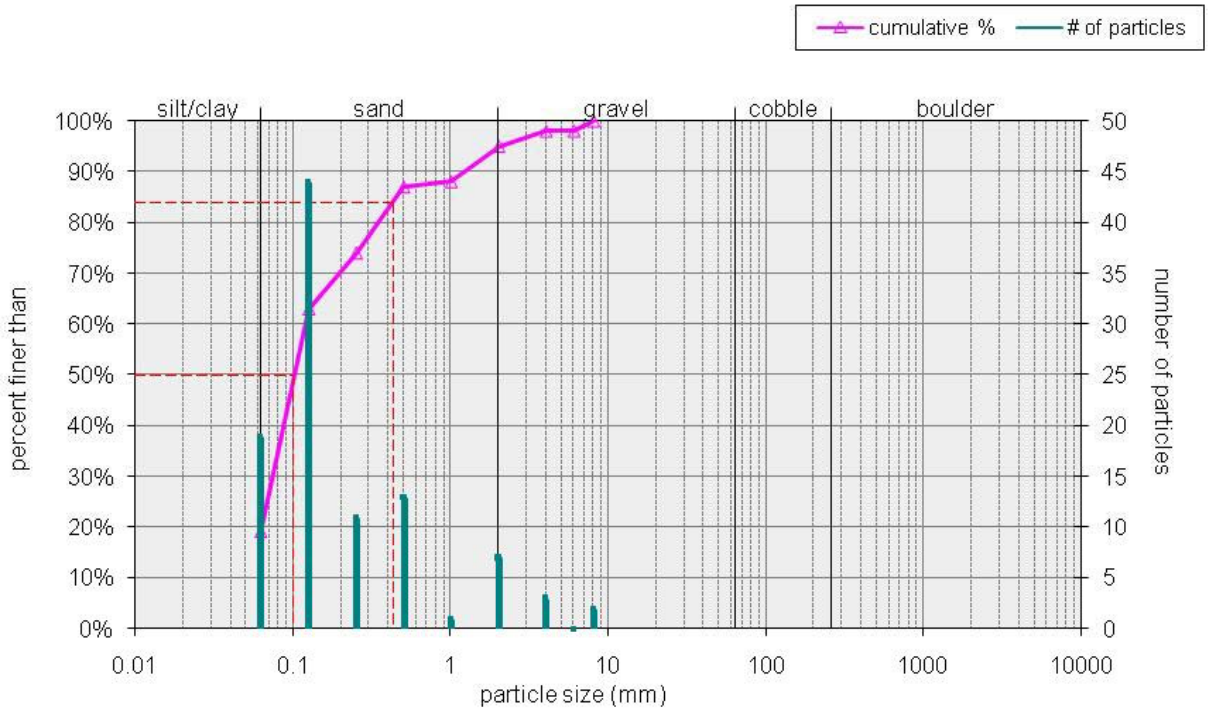
Size Distribution	
mean	0.2
dispersion	2.9
skewness	0.20

Type	
silt/clay	21%
sand	74%
gravel	5%
cobble	0%
boulder	0%

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	19
very fine sand	0.062 - 0.125	44
fine sand	0.125 - 0.25	11
medium sand	0.25 - 0.5	13
coarse sand	0.5 - 1	1
very coarse sand	1 - 2	7
very fine gravel	2 - 4	3
fine gravel	4 - 6	0
fine gravel	6 - 8	2
medium gravel	8 - 11	
medium gravel	11 - 16	
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: Cross Section 5

Cross Section 5 Pebble Count



Size (mm)	
D16	0.062
D35	0.08
D50	0.1
D65	0.14
D84	0.43
D95	2

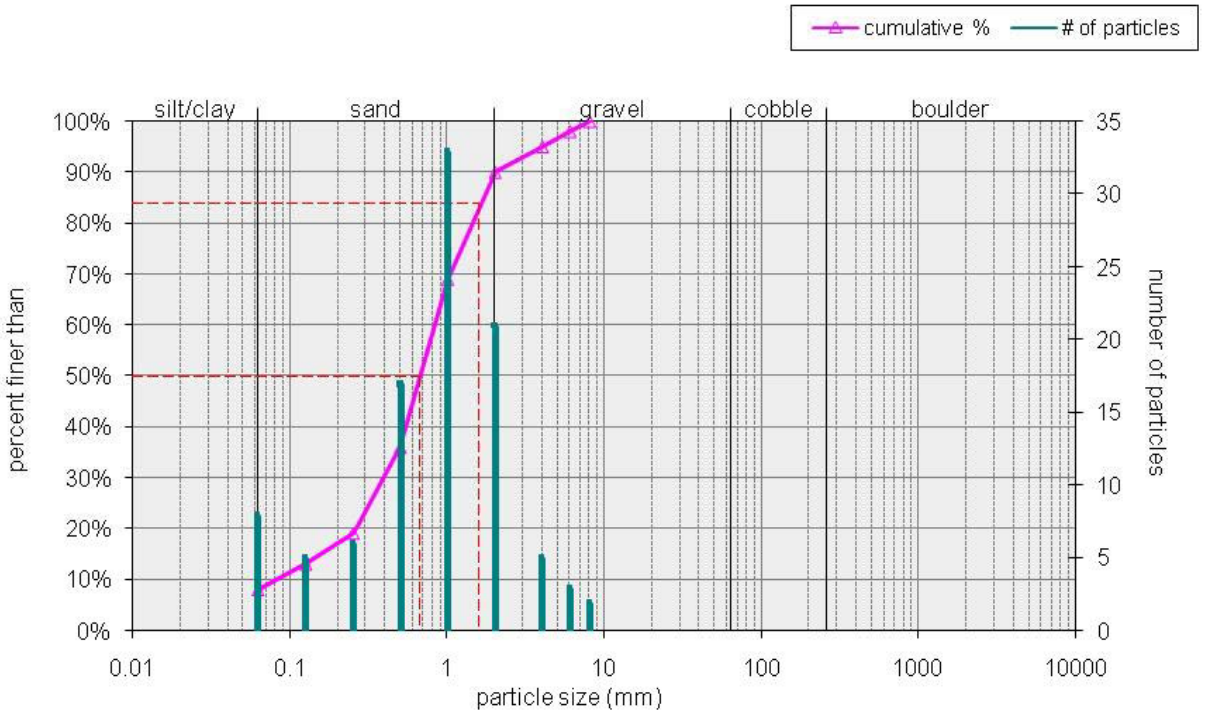
Size Distribution	
mean	0.163279
dispersion	2.956452
skewness	0.232177

Type	
silt/clay	0.19
sand	0.76
gravel	0.05
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	8
very fine sand	0.062 - 0.125	5
fine sand	0.125 - 0.25	6
medium sand	0.25 - 0.5	17
coarse sand	0.5 - 1	33
very coarse sand	1 - 2	21
very fine gravel	2 - 4	5
fine gravel	4 - 6	3
fine gravel	6 - 8	2
medium gravel	8 - 11	
medium gravel	11 - 16	
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: Cross Section 6

Cross Section 6 Pebble Count



Size (mm)	
D16	0.18
D35	0.48
D50	0.67
D65	0.92
D84	1.6
D95	4

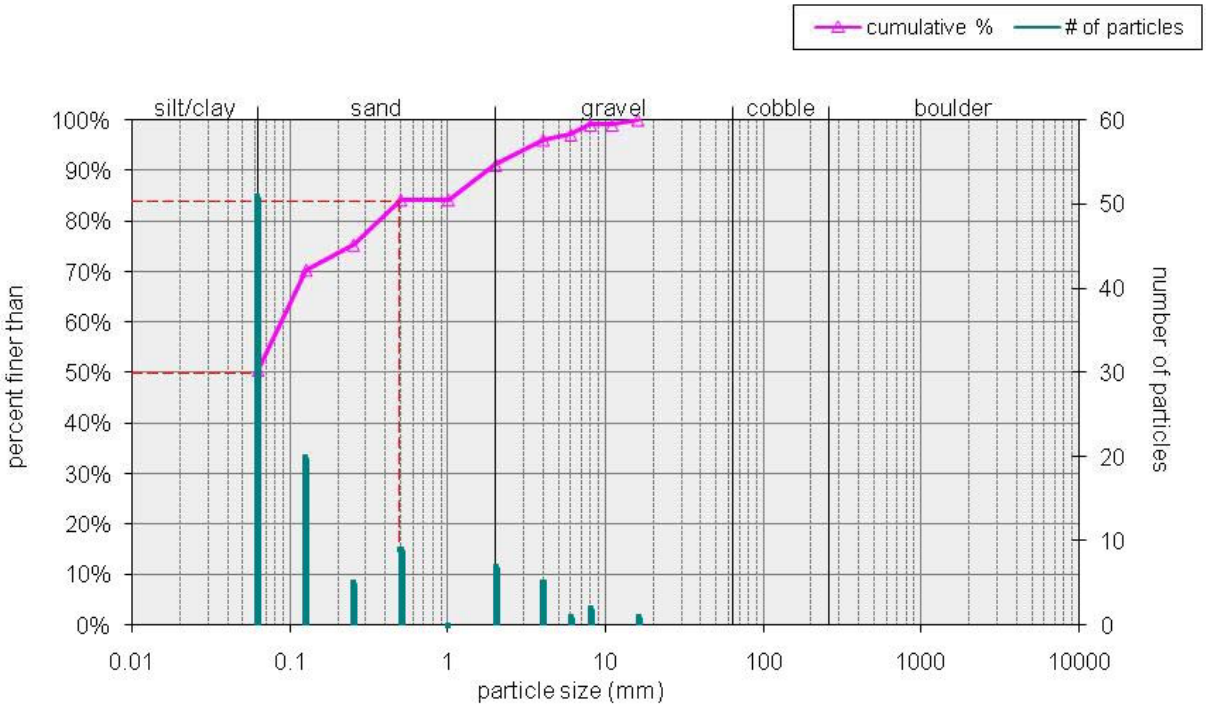
Size Distribution	
mean	0.5
dispersion	3.1
skewness	-0.10

Type	
silt/clay	8%
sand	82%
gravel	10%
cobble	0%
boulder	0%

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	51
very fine sand	0.062 - 0.125	20
fine sand	0.125 - 0.25	5
medium sand	0.25 - 0.5	9
coarse sand	0.5 - 1	0
very coarse sand	1 - 2	7
very fine gravel	2 - 4	5
fine gravel	4 - 6	1
fine gravel	6 - 8	2
medium gravel	8 - 11	
medium gravel	11 - 16	1
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	101
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	101

Note: Cross Section 7

Cross Section 7 Pebble Count



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.1
D84	0.49
D95	3.5

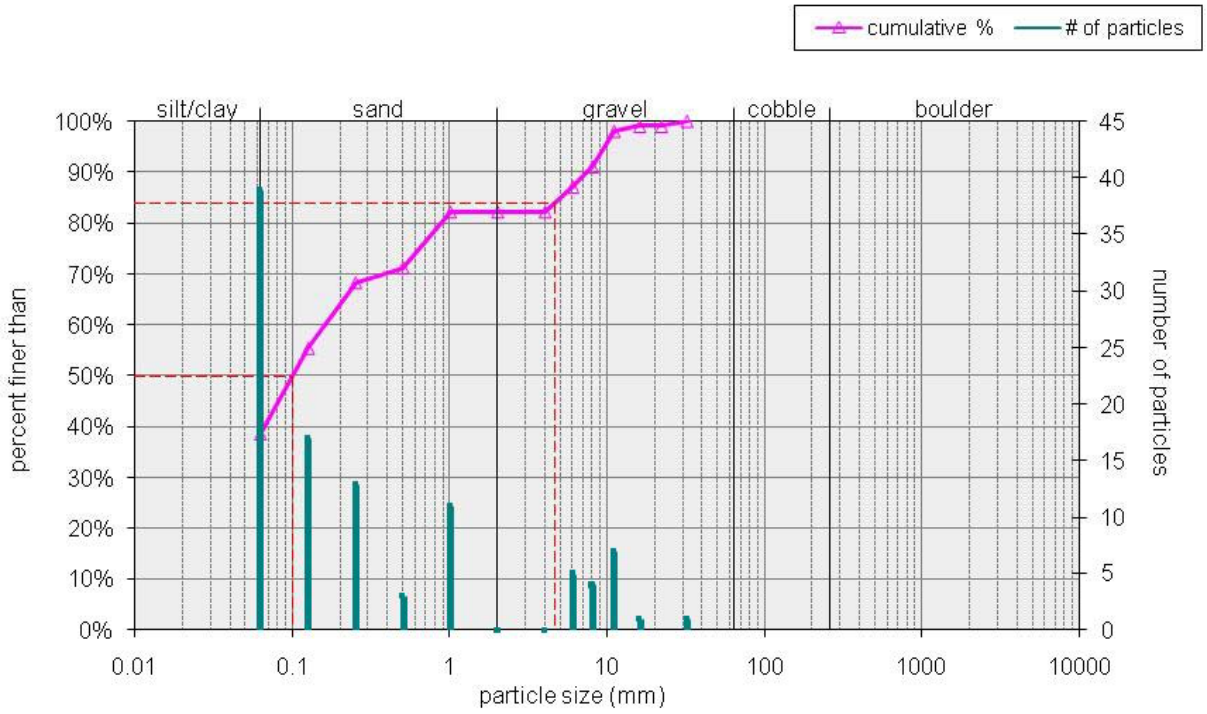
Size Distribution	
mean	0.174299
dispersion	4.451613
skewness	0.473763

Type	
silt/clay	0.50495
sand	0.405941
gravel	0.089109
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	39
very fine sand	0.062 - 0.125	17
fine sand	0.125 - 0.25	13
medium sand	0.25 - 0.5	3
coarse sand	0.5 - 1	11
very coarse sand	1 - 2	0
very fine gravel	2 - 4	0
fine gravel	4 - 6	5
fine gravel	6 - 8	4
medium gravel	8 - 11	7
medium gravel	11 - 16	1
coarse gravel	16 - 22	
coarse gravel	22 - 32	1
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	101
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	101

Note: Cross Section 8

Cross Section 8 Pebble Count



Size (mm)	
D16	0.062
D35	0.062
D50	0.1
D65	0.21
D84	4.6
D95	9.6

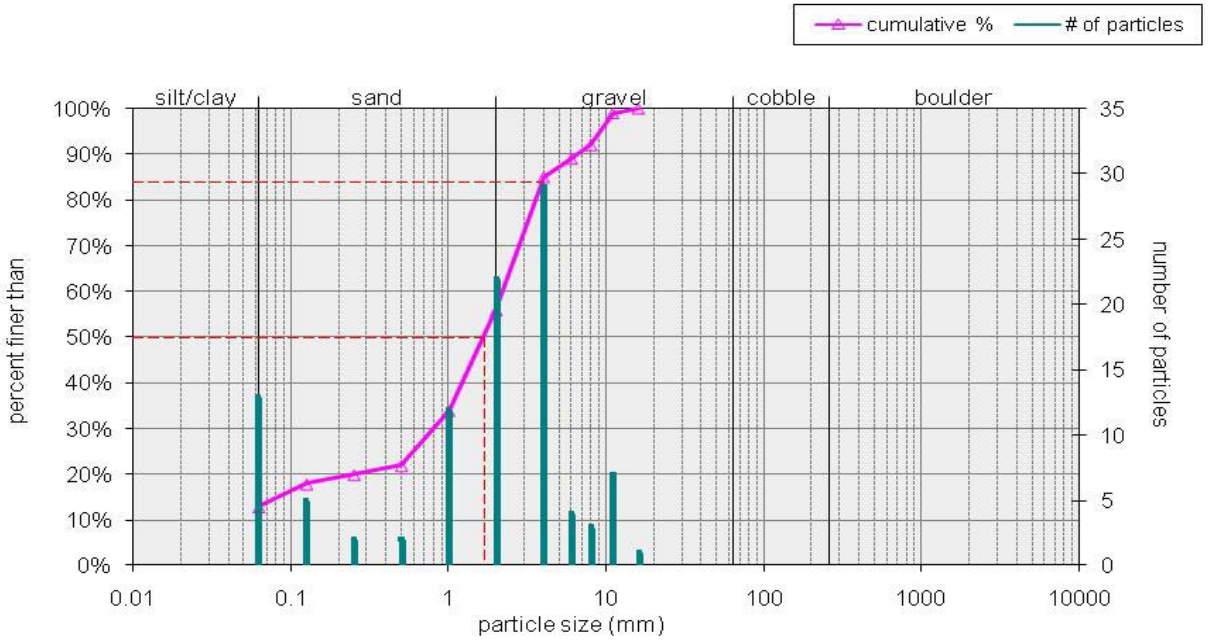
Size Distribution	
mean	0.534041
dispersion	23.80645
skewness	0.532003

Type	
silt/clay	0.386139
sand	0.435644
gravel	0.178218
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	13
very fine sand	0.062 - 0.125	5
fine sand	0.125 - 0.25	2
medium sand	0.25 - 0.5	2
coarse sand	0.5 - 1	12
very coarse sand	1 - 2	22
very fine gravel	2 - 4	29
fine gravel	4 - 6	4
fine gravel	6 - 8	3
medium gravel	8 - 11	7
medium gravel	11 - 16	1
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: Cross Section 9

Cross Section 9 Pebble Count



Size (mm)	
D16	0.094
D35	1
D50	1.7
D65	2.5
D84	3.9
D95	9.2

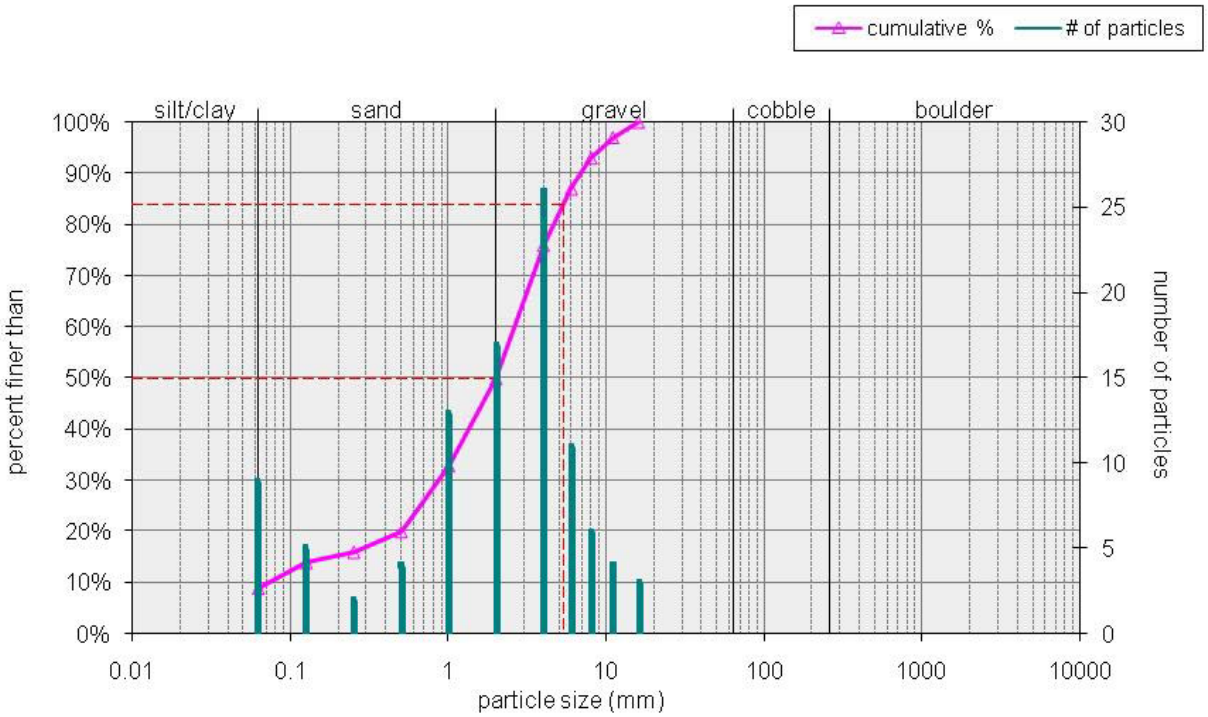
Size Distribution	
mean	0.6
dispersion	10.2
skewness	-0.35

Type	
silt/clay	13%
sand	43%
gravel	44%
cobble	0%
boulder	0%

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	9
very fine sand	0.062 - 0.125	5
fine sand	0.125 - 0.25	2
medium sand	0.25 - 0.5	4
coarse sand	0.5 - 1	13
very coarse sand	1 - 2	17
very fine gravel	2 - 4	26
fine gravel	4 - 6	11
fine gravel	6 - 8	6
medium gravel	8 - 11	4
medium gravel	11 - 16	3
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: Cross Section 10

Cross Section 10 Pebble Count



Size (mm)	
D16	0.25
D35	1.1
D50	2
D65	3
D84	5.4
D95	9.4

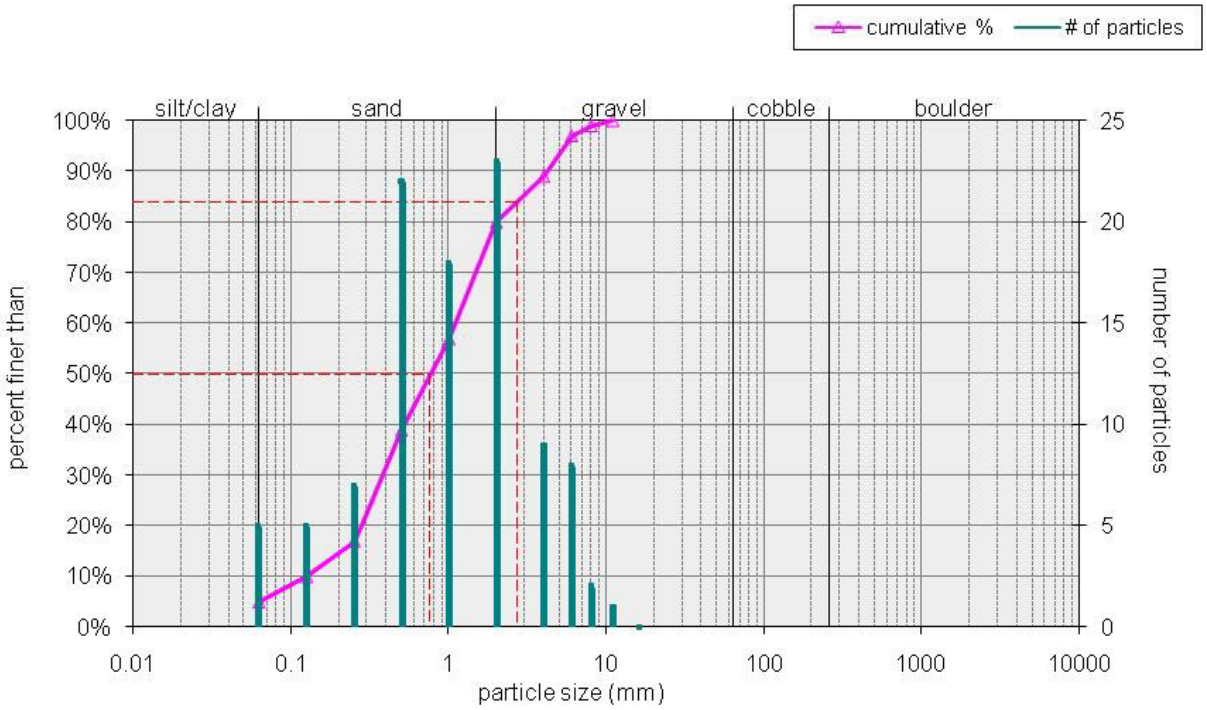
Size Distribution	
mean	1.161895
dispersion	5.35
skewness	-0.20418

Type	
silt/clay	0.09
sand	0.41
gravel	0.5
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	5
very fine sand	0.062 - 0.125	5
fine sand	0.125 - 0.25	7
medium sand	0.25 - 0.5	22
coarse sand	0.5 - 1	18
very coarse sand	1 - 2	23
very fine gravel	2 - 4	9
fine gravel	4 - 6	8
fine gravel	6 - 8	2
medium gravel	8 - 11	1
medium gravel	11 - 16	0
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: Cross Section 11

Cross Section 11 Pebble Count



Size (mm)	
D16	0.23
D35	0.44
D50	0.76
D65	1.3
D84	2.7
D95	5.4

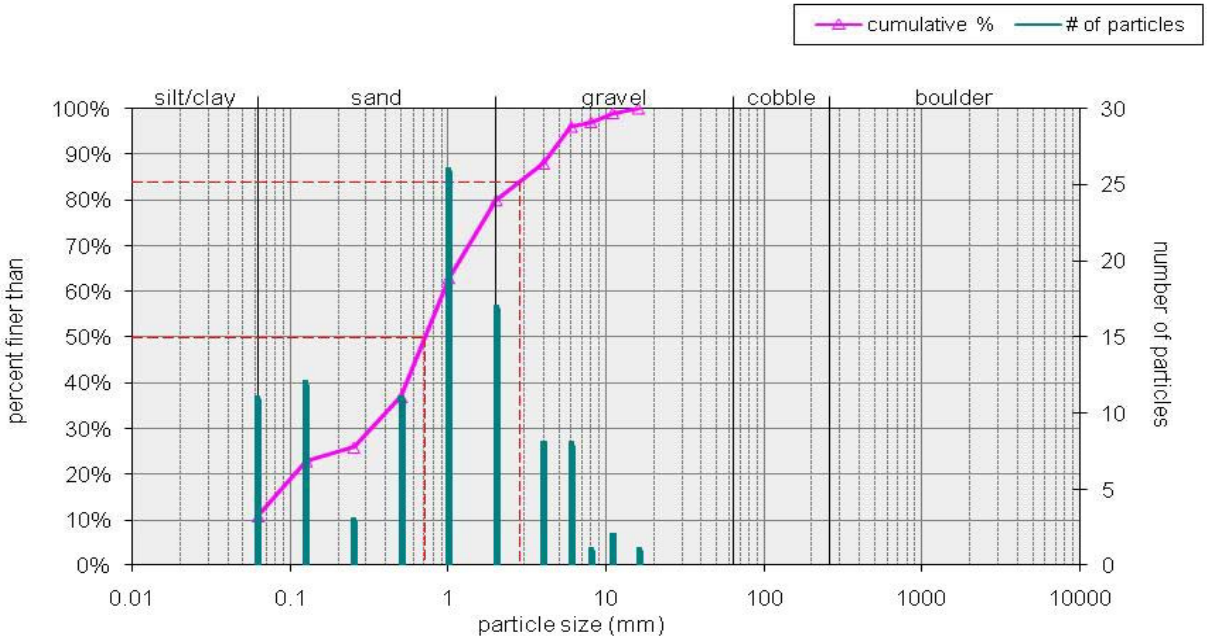
Size Distribution	
mean	0.788036
dispersion	3.42849
skewness	0.015211

Type	
silt/clay	0.05
sand	0.75
gravel	0.2
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	11
very fine sand	0.062 - 0.125	12
fine sand	0.125 - 0.25	3
medium sand	0.25 - 0.5	11
coarse sand	0.5 - 1	26
very coarse sand	1 - 2	17
very fine gravel	2 - 4	8
fine gravel	4 - 6	8
fine gravel	6 - 8	1
medium gravel	8 - 11	2
medium gravel	11 - 16	1
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: Cross Section 12

Cross Section 12 Pebble Count



Size (mm)	
D16	0.083
D35	0.44
D50	0.71
D65	1.1
D84	2.8
D95	5.7

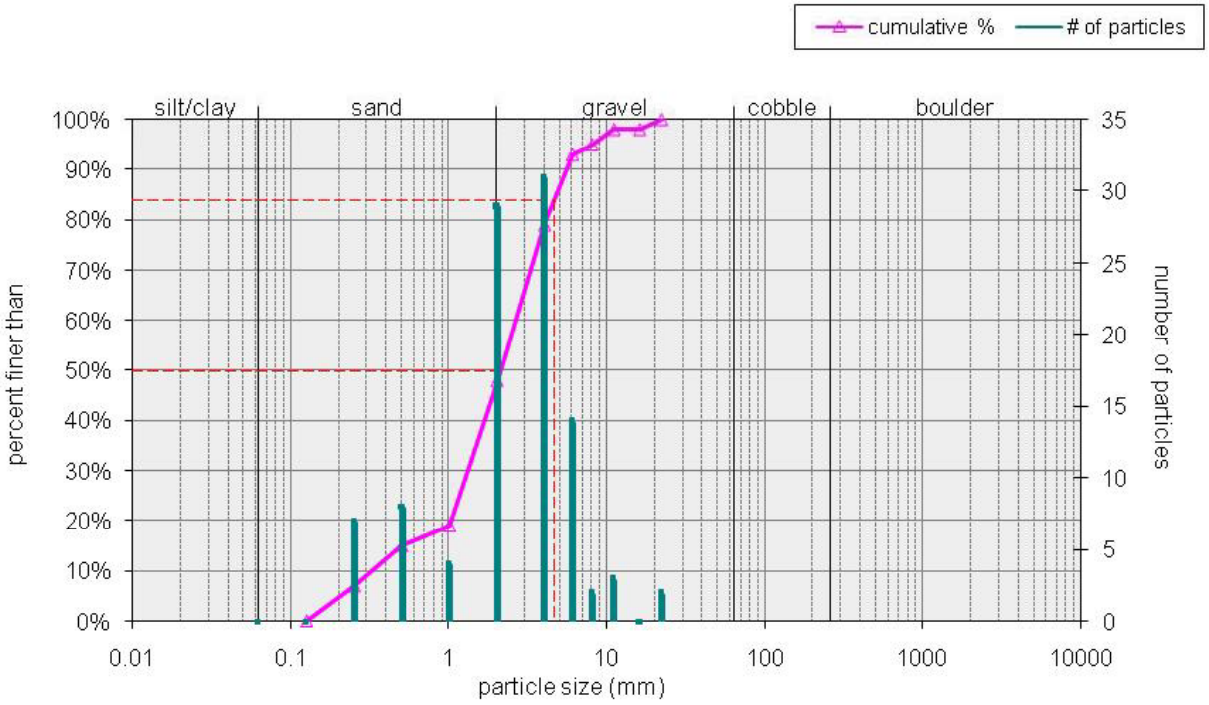
Size Distribution	
mean	0.482079
dispersion	6.248939
skewness	-0.13602

Type	
silt/clay	0.11
sand	0.69
gravel	0.2
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	0
very fine sand	0.062 - 0.125	0
fine sand	0.125 - 0.25	7
medium sand	0.25 - 0.5	8
coarse sand	0.5 - 1	4
very coarse sand	1 - 2	29
very fine gravel	2 - 4	31
fine gravel	4 - 6	14
fine gravel	6 - 8	2
medium gravel	8 - 11	3
medium gravel	11 - 16	0
coarse gravel	16 - 22	2
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: Cross Section 13

Cross Section 13 Pepple Count



Size (mm)	
D16	0.59
D35	1.5
D50	2.1
D65	2.9
D84	4.6
D95	8

Size Distribution	
mean	1.647422
dispersion	2.874899
skewness	-0.11162

Type	
silt/clay	0
sand	0.48
gravel	0.52
cobble	0
boulder	0

Appendix C. Wetland Raw Data

Wetlands were not restored as part of this project

APPENDIX D

Current Conditions Plan View
Reach 1

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

Legend

- Stream Thalweg
- Cross Section

Vegetation Monitoring Counts

- Less Than 320 Stems per Acre
- More Than 320 Stems per Acre

N
E
W
S

0 200 400 Feet

Ecosystem Enhancement PROGRAM

November 2008

Current Conditions Plan View
Reach 2

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

Legend

Stream Thalweg

Cross Section

Vegetation Monitoring Counts

Less Than 320 Stems per Acre

More Than 320 Stems per Acre

0 200 400 Feet

Ecosystem Enhancement Program

November 2008