Mill Branch Stream Restoration Project
Columbus County
North Carolina

CU: 03040103
SCO# 020611301A
EEP Project No. 251

2nd Year 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 Mill Branch Restoration Site is located on the James P. Jones property off Lebanon Church Road (SR1141) south of Whiteville, Columbus County, North Carolina. The UT to Mill Branch is located in a primarily agricultural watershed that has a total drainage area of 178 acres. The approximately 3,500 linear foot project area is divided into four reaches: western, upper, middle and lower. Priority 2 stream restoration was carried out on each of the reaches resulting in restored C type channels. The pattern, dimension, and profile were restored throughout the project site. Rock structures and root wads were installed to provide further stability to the streams. Cattle were excluded from each of the newly planted riparian areas. Streambanks, the floodplain and the upland areas within the easements were all planted with vegetation to stabilize the channel and provide shade, food, and habitat as well as a vegetated buffer to treat contributing overland flows. Approximately 1,750 linear feet of stream and 37.3 acres of wetlands along Mill Branch downstream of the project were also preserved as part of this project.

Year 2 monitoring site visits were completed on October 15, 2008, October 16, and November 6, 2008. Year 2 vegetation monitoring was completed using the Carolina Vegetation Survey (CVS) – EEP protocol (Version 4.1). Two of the four vegetation plots met vegetative success criteria of 320 stems per acre. Even though the site has met success criteria, a number of trees across the site have died. The most significant area of vegetation distress occurs in the Middle Reach. North Carolina has been in a severe drought this year contributing to much of the vegetation stress along with the small caliper size of the bare root seedlings.

During the geomorphic assessment, some parts of the channel were dry. The channel is overgrown with vegetation in many areas suggesting that there is not a consistent flow of water in the channel. The lack of flow is likely due to the drought. Overall the stream reaches at Mill Branch are stable and are showing few signs of instability. The middle and lower reach have some minor to moderate structure scouring and piping issues. None of these issues require immediate attention, however, they will be reassessed in subsequent monitoring years.

Table of Contents

1.0 Project Background

1.1 PROJECT OBJECTIVES

Project goals and objectives for the Mill Branch stream restoration project included:

- Improving water quality;
- Providing wildlife habitat through the creation of a riparian zone;
- Improving aquatic habitat with the use of natural material stabilization structures and a riparian buffer;
- Excluding cattle from the stream;
- Reducing nutrient loads from entering the stream via the buffer acting as a filter exclusion of cattle;
- Increasing the stream's access to its floodplain;
- Reducing erosion and sedimentation; and
- Protecting floral and biotic diversity via preservation.

1.2 PROJECT STRUCTURE

The UT to Mill Branch is located in a primarily agricultural watershed that has a total drainage area of 178 acres. The approximately 3,500 linear foot project area is divided into four reaches: western, upper, middle and lower. The upper, middle and lower reaches are all sections of a main UT to Mill Branch that generally flows south to north across the property. The western reach flows southwest to northeast and is a smaller tributary to the main UT. The upper reach begins at the most upstream end of the main UT and transitions to the middle reach at the confluence with the western tributary. The middle reach then continues past the ford crossing and transitions to the lower reach at the culverted road crossing. The lower reach then flows to the end of the restoration project. Prior to the restoration project, the banks of the reaches were severely eroded and unstable with little or no riparian buffer. Cattle had unfettered access to the Mill Branch causing bank erosion, vegetation degradation, and decreased water quality. Both the western tributary and the main UT were classified as unstable G5 channel types.

Priority 2 stream restoration was carried out on each of the reaches resulting in restored C type channels. The pattern, dimension, and profile were restored throughout the project site. Rock structures and root wads were installed to provide further stability to the streams. Cattle were excluded from each of the newly planted riparian areas. Streambanks, the floodplain and the upland areas within the easements were all planted with vegetation to stabilize the channel and provide shading, food, and habitat as well as a vegetated buffer to treat surrounding overland flows.

Approximately 1,750 linear feet of stream and 37.3 acres of wetlands along Mill Branch downstream of the project were also preserved as part of this project. The stream preservation occurs on Mill Branch from the vicinity of the restoration project downstream to the area where it loses its defined channel to a beaver dam complex. Please see Figure 1.2 for a map of the easement area (to be provided by EEP).

Exhibit Table I. Project Restoration Components Mill Branch Stream Restoration Project (EEP 0251)								
Reach ID	**Existing Feet/Acres**	**Type**	**Approach**	**Footage or Acreage**	**Mitigation Ratio**	**Mitigation Units**	**Stationing**	**Comment**
Western	660	R	P2	765.2	1.0	765.2	10+00.0 to 17+65.2	Smaller tributary
Upper	340	R	P2	439.2	1.0	439.2	10+00.0 to 14+39.2	Above confluence with trib
Middle	1265	R	P2	1555.3	1.0	1555.3	10+00.0 to 25+55.3	Between confluence and road crossing (includes ford crossing)
Lower	670	R	P2	747.8	1.0	747.8	10+00.0 to 17+47.8	Below road crossing
Restoration Summary	*2935*			*3507.5*				
Mill Branch	1750	P	-	1750.0	5.0	350.0		Downstream of restoration project
Riparian Wetlands	35.8	P	-	35.8	5.0	7.2		Downstream of restoration project
Non-Riparian Wetlands	1.5	P	-	1.5	5.0	0.3		Downstream of restoration project
Mitigation Unit Summations								
Stream (lf)	Riparian Wetland (ac)		Nonriparian Wetland (ac)		Total Wetland (ac)		Buffer (ac)	Comment
3857.5	**7.2**		**0.3**		**7.5**		0.0	

R = Restoration
P2 = Priority 2
P = Preservation

1.3 LOCATION AND SETTING

The Mill Branch Restoration Site is located on the James P. Jones property off Lebanon Church Road (SR 1141) south of Whiteville, North Carolina. (see Figure 1.1 Location Map). The project is located in Columbus County, North Carolina, in the Lumber River 03040206 Cataloging Unit (CU) and North Carolina Division of Water Quality Subbasin 03-07-57. The site is immediately surrounded by cattle pastures.

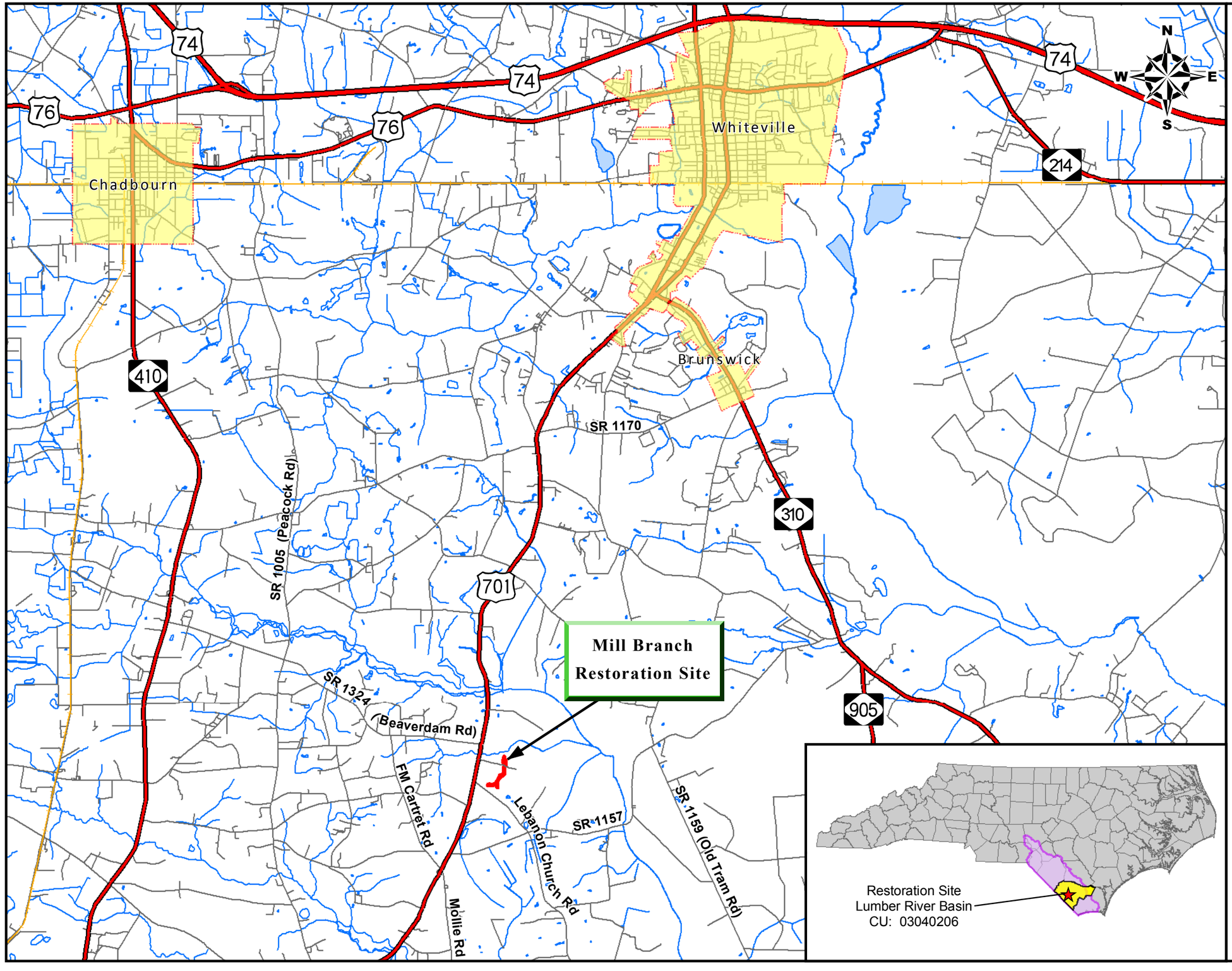

Figure 1.1 Location Map

Mill Branch
Stream Restoration Project
EEP No. 0251
Columbus County, North Carolina

Monitoring Report
November 2008

0 1 2 3 Miles

Legend

- Highways
- Railroad
- Roads
- Streams
- Waterbodies
- Municipalities
- Project_boundary

Lat\ Long: 34.2222N, 78.7496W

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Directions to Mill Branch Stream Restoration Site: From Raleigh, take I-95 South to Exit 20 (NC 211). At the end of the ramp turn left to go east on NC 211. Stay on road as it becomes NC-72, follow for about 12 miles, then turn left onto US-74. In Whiteville, take US-701 Bypass south and follow for approximately 10 miles. Turn left onto Lebanon Church Road (SR 1141). The gated entrance into the pasture surrounding the projet site is on the left just past Lebanon United Methodist Chruch.

Figure 1.2 Easement Map with Preservation to be provided by EEP

1.4 PROJECT HISTORY AND BACKGROUND

Exhibit Table II. Project Activity and Reporting History Mill Branch Stream Restoration - EEP Project No. 251		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	NA	Jan 2005
Final Design - 90%	NA	Sept 2005
Construction	Jan 2007	Jan 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 2007	Dec 2007
Year 2 Monitoring	Nov 2008	NA
Year 3 Monitoring	NA	NA
Year 4 Monitoring	NA	NA
Year 5 Monitoring	NA	NA

Exhibit Table III. Project Component Table Mill Branch Stream Restoration - EEP Project No. 251	
Designer Primary project design POC	Stantec Consulting Services, Inc. 801 Jones Franklin Road Suite 300 Raleigh, NC 27606 Brad Fairley, (919) 851-6866
Construction Contractor Construction contractor POC	North State Environmental, Inc 2889 Lowery St. Suite B Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2405
Planting Contractor Planting Contractor POC	North State Environmental, Inc 2889 Lowery St. Suite B Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2405
Seeding Contractor Seeding Contractor POC	North State Environmental, Inc 2889 Lowery St. Suite B Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2405
Seed Mix Sources	contact North State Environmental, Inc
Nursery Stock Suppliers	Dykes & Son Nursery 825 Maude Etter Rd McMinnville, TN 37110 North State Environmental, Inc 2889 Lowery St. Suite B Winston-Salem, NC 27101 Stephen C. Joyce (336) 725-2405
Monitoring Performers (Year 2)	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 Mill Branch Stream Restoration Site/EEP Project No. 0251	
Project County	Columbus
Drainage Area	178 acres
Drainage impervious cover estimate (%)	< 1 percent
Stream Order (from Soil Survey)	1st order: Western & Upper Reaches
	2nd order: Middle & Lower Reaches
Physiographic Region	Coastal Plain
Ecoregion	Atlantic Southern Loam Plains (65l)
Rosgen Classification of As-built	C
Cowardin Classification	Preservation Areas: PFO4/1A; PFO1C; PFO1A; PSS1/3A
Dominant soil types	Muckalee: Lower, Middle, and Western Reaches
	Goldsboro, Wagram: Upper Reach
Reference site ID	UT to Hog Swamp, UT to Ironhill Branch, Muddy Creek, Mill Creek
USGS HUC for Project	03040206060020
USGS HUC for Reference	UT to Hog Swamp: 03040203180030
	UT to Ironhill Branch: 03040206060040
	Muddy Creek: 03030004080090
	Mill Creek: 03030004070060
NCDWQ Subbasin for Project	03-07-57
NCDWQ Subbasin for Reference	UT to Hog Swamp: 03-07-54
	UT to Ironhill Branch: 03-07-57
	Muddy Creek: 03-06-14
	Mill Creek: 03-06-14
NCDWQ Classification for Project	C SW
NCDWQ Classification for Reference	C - Muddy Creek
	C SW - UT to Hog Swamp; UT to Ironhill Branch
	WS-III - Mill Creek
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	No
Percent of project easement fenced	100%

1.5 MONITORING PLAN VIEW

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

N

S

Ecosystem Enhancement PROGRAM

SEE FIGURE 3.2

8 VP-1B

VEG PLOT 1

VP-1A

7

RIFFLE 1

POOL 2

4 5

3

6

GATE

1

2

LEGEND

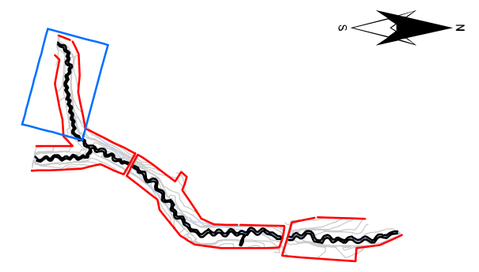
VEG PLOT PINS

PHOTO POINTS

CROSS-SECTIONS

VEG PLOTS

PROJECT BOUNDARY



MAP LOCATION

0 25 50 75 Feet

UT to Mill Branch
SCO# : 02-0611301A

Monitoring
Columbus County, North Carolina

Monitoring Plan View

Figure 3.1

SEE FIGURE 3.1

N

S

Ecosystem Enhancement PROGRAM

SEE FIGURE 3.3

17

18

19

20

RIFFLE 4

POOL 3

14

13

12

15

VP-2A

VEG PLOT 2

11

10

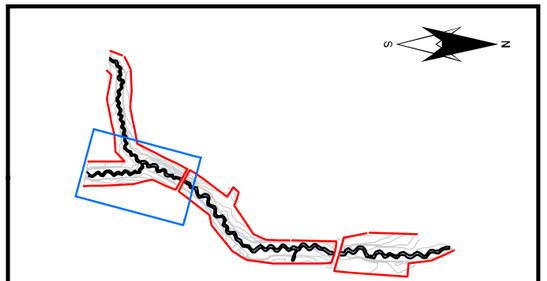
9

VP-2B

16

LEGEND

- VEG PLOT PINS
- PHOTO POINTS
- CROSS-SECTIONS
- VEG PLOTS
- PROJECT BOUNDARY



MAP LOCATION

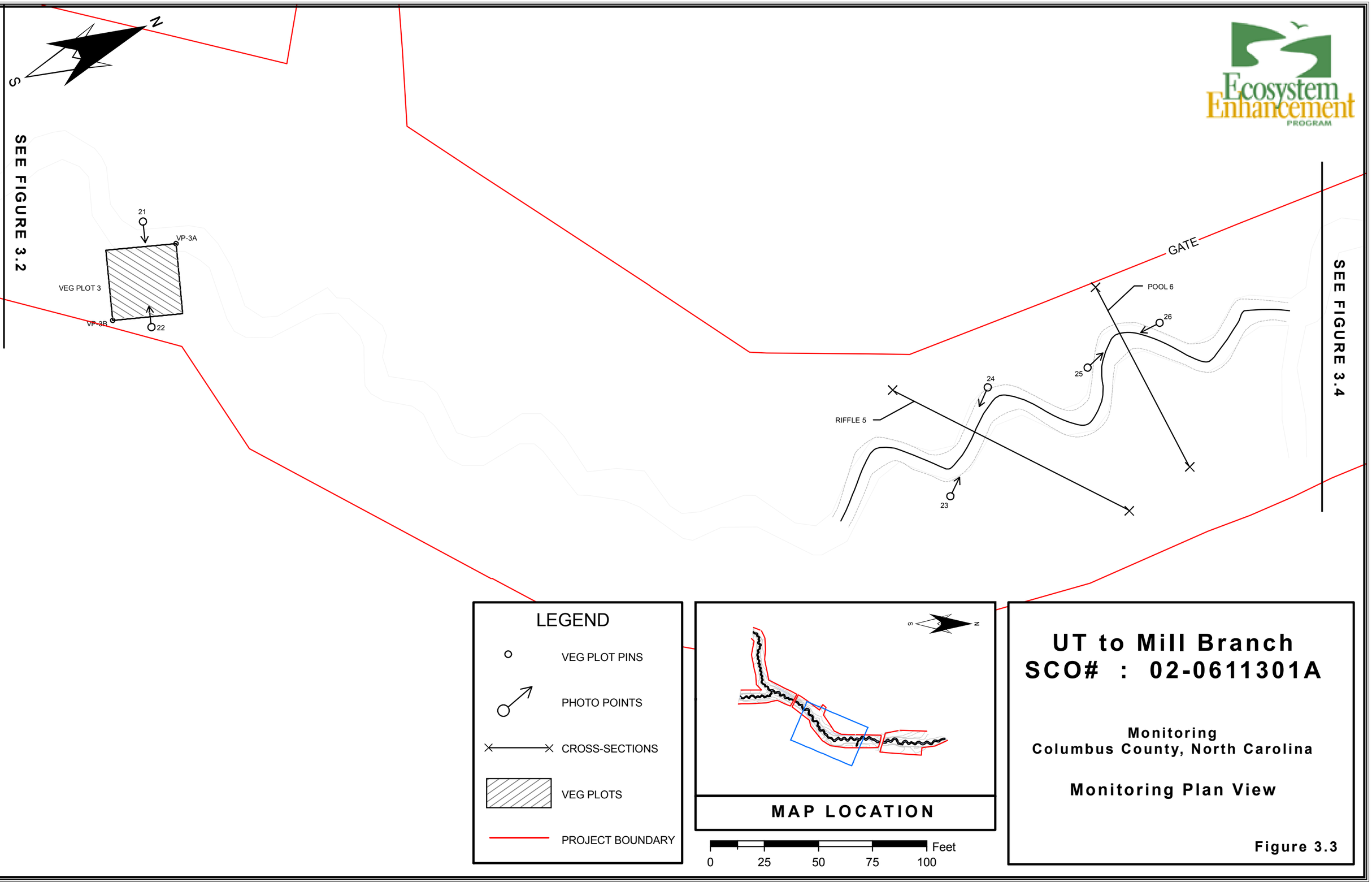
0 25 50 75 100 Feet

UT to Mill Branch
SCO# : 02-0611301A

Monitoring
Columbus County, North Carolina

Monitoring Plan View

Figure 3.2



Ecosystem Enhancement PROGRAM

LEGEND

- VEG PLOT PINS
- PHOTO POINTS
- CROSS-SECTIONS
- VEG PLOTS
- PROJECT BOUNDARY

MAP LOCATION

0 25 50 75 100 Feet

UT to Mill Branch
SCO# : 02-0611301A

Monitoring
Columbus County, North Carolina

Monitoring Plan View

Figure 3.3

Ecosystem Enhancement PROGRAM

GATE

SEE FIGURE 3.3

27 28

29 VP-4B

VEG PLOT 4

VP-4A

30

31

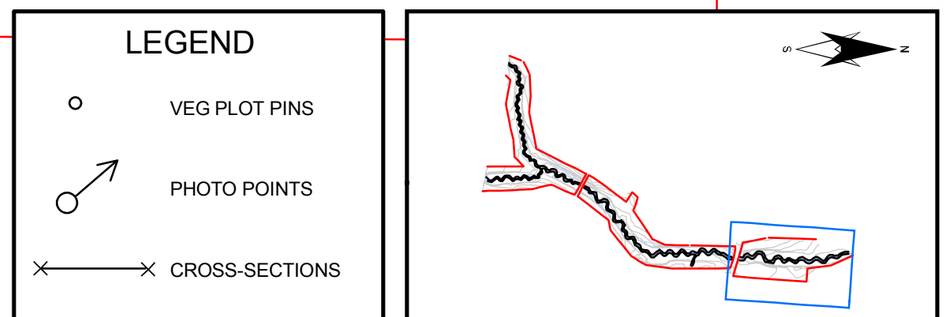
RIFFLE 7

POOL 8

32

33

34



MAP LOCATION

LEGEND

VEG PLOT PINS

PHOTO POINTS

CROSS-SECTIONS

VEG PLOTS

PROJECT BOUNDARY

0 25 50 75 100 Feet

UT to Mill Branch
SCO# : 02-0611301A

Monitoring
Columbus County, North Carolina

Monitoring Plan View

Figure 3.4

2.0 Project Condition and Monitoring Results

2.1 VEGETATION ASSESSMENT

Vegetative sample plots were quantitatively monitored during the first growing season. One 100m2 plot was established for each of the four stream reaches (four plots total). Species composition, density, vigor and survival were monitored. In each plot two plot corners are permanently located with rebar. On November 6, 2008 the Year 2 vegetation monitoring was completed using the Carolina Vegetation Survey (CVS) – EEP protocol (version 4.1).

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. Two vegetation plots were successful in Year 2.

The Year 2 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. The most significant area of vegetation distress occurs in the Middle Reach. Southeastern North Carolina has been in a severe drought this year contributing to much of the vegetation failure along with the small caliper size of the bare root seedlings. Year 0 "As-built" vegetation sampling was completed in March before any of the trees had sprouted leaves. It is likely that some of these very small newly planted seedlings that were counted in Year 0 were not viable enough to survive the summer or the extreme drought.

2.1.2 Vegetation Problem Area Plan View

Bare areas are shown on the Integrated Problem Areas Plan View map in Appendix D.

2.2 STREAM ASSESSMENT

2.2.1 Hydrology

Any changes to land use in the two watersheds that would affect changes to flow within the project streams will be assessed over the five-year monitoring period. 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.

Exhibit Table V. Verification of Bankfull Events Mill Branch Stream Restoration Site/ EEP Project No. 251			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo**
November 6, 2008	October/November 2008	Visual Observation	Photo 35 Appendix B.4

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 Mill Branch Stream Restoration - EEP Project No. 251
Bank stability will be assessed in monitoring Year 5

2.2.3 Stream Problem Areas

Overall the stream reaches at Mill Branch are stable and are showing few signs of instability. The middle and lower reach have some minor to moderate structure scouring and piping issues. As discussed above, there are some vegetation issues on upper, middle and lower reaches, and these issues are most likely being compounded by the persistent drought.

The problems areas in detail are as follows and are the same as previous years: In the Upper Reach at STA 10+20 (left floodplain) and STA 11+55 (right floodplain) the vegetation is sparse and medium sized bare areas are present. In the middle reach there are vegetation issues at STA 12+20 (left floodplain), 20+50 (left floodplain), 20+60 (far left floodplain), and 22+50 (left floodplain). These areas are sparse in vegetation with small to medium bare areas. The middle reach also has some structure issues; there is piping around a log sill at STA 17+49, scour at the header boulder of a rock cross vane occurring at STA 24+61, piping around the header boulder of a rock cross vane at STA 24+88. The middle reach is showing signs of aggradation at STA 15+04 in the pool. The lower reach's floodplain vegetation is semi-bare at STA 15+40 (right floodplain) and 16+50 (right floodplain). The lower reach is experiencing the following structure problems: scour around the log sill at STA 10+76, scour at the end of a rock vane arm at STA 11+16, and scour around the log sill at STA 13+54. The lower reach is also showing some minor rill erosion in the left floodplain at STA 12+85.

The channel is overgrown with vegetation in many areas suggesting that there is not a consistent flow of water in the channel. The lack of flow is likely due to the extreme drought. A detailed table and photos can be found in Appendix B.

2.2.4 Stream Problem Area Plan View

Stream problem areas are shown on the Integrated Problem Areas Plan View in Appendix D.

2.2.5 Stability Assessment

Exhibit Table VII-A. Categorical Stream Feature Visual Stability Assessment Mill Branch Stream Restoration Site/EEP Project No. 0251 Mill Branch Stream Restoration (3,507.5 l.f.) Western Reach						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	100%	100%			
B. Pools	100%	100%	100%			
C. Thalweg	NA	NA	NA			
D. Meanders	100%	100%	100%			
E. Bed General	100%	100%	99%			
F. Bank Condition	100%	100%	100%			
G. Vanes/J Hooks, etc.	100%	100%	100%			
H. Wads and Boulders	NA	NA	NA			

Exhibit Table VII-B. Categorical Stream Feature Visual Stability Assessment Mill Branch Stream Restoration Site/EEP Project No. 0251 Mill Branch Stream Restoration (3,507.5 l.f.) Upper Reach						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	100%	100%			
B. Pools	100%	100%	100%			
C. Thalweg	NA	NA	NA			
D. Meanders	100%	100%	100%			
E. Bed General	100%	100%	99%			
F. Bank Condition	100%	100%	100%			
G. Vanes/J Hooks, etc.	100%	100%	100%			
H. Wads and Boulders	NA	NA	NA			

Exhibit Table VII-C. Categorical Stream Feature Visual Stability Assessment Mill Branch Stream Restoration Site/EEP Project No. 0251 Mill Branch Stream Restoration (3,507.5 l.f.) Middle Reach						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	100%	100%			
B. Pools	100%	98%	98%			
C. Thalweg	NA	NA	NA			
D. Meanders	100%	97%	97%			
E. Bed General	100%	99%	99%			
F. Bank Condition	100%	100%	100%			
G. Vanes/J Hooks, etc.	100%	90%	90%			
H. Wads and Boulders	100%	100%	100%			

Exhibit Table VII-D. Categorical Stream Feature Visual Stability Assessment Mill Branch Stream Restoration Site/EEP Project No. 0251 Mill Branch Stream Restoration (3,507.5 l.f.) Lower Reach						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	100%	100%			
B. Pools	100%	100%	100%			
C. Thalweg	NA	NA	NA			
D. Meanders	100%	96%	96%			
E. Bed General	100%	100%	99%			
F. Bank Condition	100%	99%	99%			
G. Vanes/J Hooks, etc.	100%	93%	93%			
H. Wads and Boulders	100%	100%	100%			

2.2.6 Quantitative Measures Summary

Exhibit Table VIII. Baseline Morphology and Hydraulics Summary Mill Branch Stream Restoration Site/EEP Project No. 251																		
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)							2.8	6.5	4.7	3.8	14.2	9.0	6.0	12.0	9.0	5.9	10.8	8.4
Flood Prone Width (ft)							2.9	70.0	36.5	100.0	300.0	200.0	38.0	90	64.0	40.6	85.8	63.2
BF Cross Sectional Area (SF)							0.9	5.6	3.3	1.5	21.0	11.3	2.0	9	5.5	2.2	9.0	5.6
BF Mean Depth (ft)							0.3	0.9	0.59	0.5	1.9	1.2	0.4	1.1	0.7	0.4	0.8	0.6
BF Max Depth (ft)							0.5	2.0	1.2	0.7	2.6	1.7	0.6	2	1.3	0.7	1.8	1.3
Width/Depth Ratio							4.0	8.7	6.4	6.1	15	10.7	12.0	18	15.0	13.1	20.2	16.6
Entrenchment Ratio							1.00	10.8	5.9	20.4	26.6	23.5	4.0	10	7.0	6.3	8.7	7.5
Bank Height Ratio																		
Wetted Perimeter (ft)																		
Hydraulic Radius (ft)																		
Pattern																		
Channel Beltwidth (ft)							50	85	67.5	10	59	34.5	18	38	28	20	36	28
Radius of Curvature (ft)							10	25	17.5	10	46	28	10	18	14	11	20	15
Meander Wavelength (ft)							210	260	235	12	97	54.5	32	80	56	36	82	59
Meander Width ratio							40	78.6	59.3	2.1	4.4	3.25	5.0	9.0	7	6.00	7.50	7
Profile																		
Riffle Length																6.3	12.5	9
Riffle Slope																0.003	0.005	0.004
Pool Length																13	19.1	16
Pool Spacing							1.3	1.3	1.3	1	5.4	3.2				26.9	41.00	34
Substrate																		
d50 (mm)																0.09	0.1	0.1
d84 (mm)																0.27	0.4	0.34
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinuosity																		
Water Surface Slope																		
BF Slope																		
Rosgen Classification																		
*Habitat Index																		
*Macrobenthos																		

*Inclusion will be project specific and determined primarily by As-built monitoring plan/success criteria

Exhibit Table IXA. Morphology and Hydraulic Monitoring Summary
Mill Branch Stream Restoration Site/EEP Project No. 0251
Western Reach

Parameter	Cross Section 1			Cross Section 2														
	Riffle			Pool														
Dimension	MY0	MY1	MY2	MY0	MY1	MY2												
BF Width (ft)	6	8.7	19.5	11.7	11.2	17.4												
Floodprone Width (ft) (approx)	45	4.5	44.9	52	43	45.6												
BF Cross Sectional Area (ft2)	1.8	2.3	4.0	8.7	7.5	8.2												
BF Mean Depth (ft)	0.3	0.3	0.2	0.7	0.7	0.5												
BF Max Depth (ft)	0.6	0.6	1.1	1.7	1.3	1.4												
Width/Depth Ratio	33.5	19.80	96	15.7	16.7	37.1												
Entrenchment Ratio	7.5	5.2	2.3	4.4	3.8	2.6												
Wetted Perimeter (ft)	-	-	19.9	-	-	17.9												
Hydraulic radius (ft)	-	-	0.2	-	-	0.5												
Substrate																		
d50 (mm)		0.12	0.11		0.12	0.11												
d84 (mm)		0.26	0.28		0.26	0.28												

Parameter	MY-00 (2007)			MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med			Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	16	26	20	15	25	19	14	27	20									
Radius of Curvature (ft)	8	15	11.3	7	16	11	7	17	12									
Meander Wavelength (ft)	32	42	36	31	44	37	32	44	38									
Meander Width Ratio	5.37	7.12	6.30	-	-	4.20	-	-	4.8									
Profile																		
Riffle Length (ft)	4	10	6	-	-	-												
Riffle Slope (ft)				-	-	-												
Pool Length (ft)	8	23	12	-	-	-												
Pool Spacing (ft)	19	40	27	18	40	25	17	40	18									
Additional Reach Parameters																		
Valley Length (ft)	253.0																	
Channel Length (ft)	304																	
Sinousity	1.20																	
Water Surface Slope (ft/ft)																		
BF Slope (ft/ft)																		
Rosgen Classification	C5																	
*Habitat Index																		
*Macrobenthos																		

Exhibit Table IXB. Morphology and Hydraulic Monitoring Summary
Mill Branch Stream Restoration Site/EEP Project No. 0251
Upper Reach

Parameter	Cross Section 3			Cross Section 4															
	Pool			Riffle															
Dimension	MY0	MY1	MY2	MY0	MY1	MY2													
BF Width (ft)	12.7	11.15	7.3	8.10	8.40	8.5													
Floodprone Width (ft) (approx)	57	48	23.1	47	45	23.9													
BF Cross Sectional Area (ft2)	9.8	5.8	2.0	3.2	3.7	2.4													
BF Mean Depth (ft)	0.8	0.5	0.3	0.4	0.4	0.3													
BF Max Depth (ft)	1.50	1.10	1.0	0.7	0.9	1.3													
Width/Depth Ratio	16.60	21.20	26.9	20.3	18.9	30.6													
Entrenchment Ratio	4.5	4.30	6.2	5.8	5.4	2.8													
Wetted Perimeter (ft)	-	-	8.2	-	-	9.5													
Hydraulic radius (ft)	-	-	0.2	-	-	03													
Substrate																			
d50 (mm)		0.10	0.07		0.10	0.07													
d84 (mm)		0.23	0.26		0.23	0.062													

Parameter	MY-00 (2007)			MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	23	29	26	22	28	26	21	27	25									
Radius of Curvature (ft)	11	18	14	11	19	13	11	18	13									
Meander Wavelength (ft)	39	59	46	40	59	45	38	59	45									
Meander Width Ratio	2.94	3.72	3	-	-	5.38	-	-	4.9									
Profile																		
Riffle Length (ft)	5	14	9	-	-	-	-	-	-									
Riffle Slope (ft)	0.001	0.013	0.005	-	-	-	-	-	-									
Pool Length (ft)	5	21	13	-	-	-	-	-	-									
Pool Spacing (ft)	23	40	29	22	38	31	20	28	30									
Additional Reach Parameters																		
Valley Length (ft)	233			233			233											
Channel Length (ft)	286			286			286											
Sinousity	1.23			1.23			1.23											
Water Surface Slope (ft/ft)	0.00260			n/a			.00366											
BF Slope (ft/ft)	0.0027			0.0033			.0048											
Rosgen Classification	C5			C5			C5											
*Habitat Index																		
*Macrobenthos																		

Exhibit Table IXC. Morphology and Hydraulic Monitoring Summary
Mill Branch Stream Restoration Site/EEP Project No. 0251
Middle Reach

Parameter	Cross Section 5			Cross Section 6															
	Riffle			Pool															
Dimension	MY0	MY1	MY2	MY0	MY1	MY2													
BF Width (ft)	9.50	9.70	8.6	13.7	14.2	19													
Floodprone Width (ft) (approx)	88	93	77.5	77	75	31.5													
BF Cross Sectional Area (ft2)	5.20	5.10	3.9	15.5	16.6	14.8													
BF Mean Depth (ft)	0.60	0.50	0.5	1.1	1.2	0.8													
BF Max Depth (ft)	1.00	1.00	1.0	2.2	2.3	2.5													
Width/Depth Ratio	17.2	18.8	19	12.2	12.1	24.4													
Entrenchment Ratio	9.10	9.80	9	4.5	5.4	1.7													
Wetted Perimeter (ft)	-	-	8.9	-	-	21.1													
Hydraulic radius (ft)	-	-	0.4	-	-	0.7													
Substrate																			
d50 (mm)		0.09	0.062		0.09	0.0622													
d84 (mm)		0.20	0.2		0.20	0.2													

Parameter	MY-00 (2007)			MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	31	41	36	28	39	35	28	40	35									
Radius of Curvature (ft)	15	20	17	13	19	18	13	21	18									
Meander Wavelength (ft)	60	68	64	58	69	64	58	68	64									
Meander Width Ratio	8	4	6	-	-	7	-	-	7									
Profile																		
Riffle Length (ft)	7	17	13	-	-	-	-	-	-									
Riffle Slope (ft)	0.001	0.008	0.003	-	-	-	-	-	-									
Pool Length (ft)	10	23	18	-	-	-	-	-	-									
Pool Spacing (ft)	28	48	41	28	47	41	29	49	42									
Additional Reach Parameters																		
Valley Length (ft)	234			234			234											
Channel Length (ft)	299			299			299											
Sinousity	1.28			1.28			1.28											
Water Surface Slope (ft/ft)	0.0011			n/a			.00338											
BF Slope (ft/ft)	0.0011			0.0006			.00689											
Rosgen Classification	C5			C5			C5											
*Habitat Index																		
*Macrobenthos																		

Exhibit Table IXD. Morphology and Hydraulic Monitoring Summary
Mill Branch Stream Restoration Site/EEP Project No. 0251
Lower Reach

Parameter	Cross Section 7			Cross Section 8															
	Run			Pool															
Dimension	MY0	MY1	MY2	MY0	MY1	MY2													
BF Width (ft)	10.8	11.8	14.7	17	16.9	11.2													
Floodprone Width (ft) (approx)	84	84	92.7	-	-	17.5													
BF Cross Sectional Area (ft2)	8.9	8.9	8.4	12.6	12.5	8.7													
BF Mean Depth (ft)	0.8	0.8	0.6	0.7	0.7	0.8													
BF Max Depth (ft)	1.8	1.7	2.0	2.2	2.2	2.6													
Width/Depth Ratio	13.6	15.6	25.1	22.9	22.8	14.5													
Entrenchment Ratio	7.8	7.2	6.4	-	-	1.5													
Wetted Perimeter (ft)	-	-	15.6	-	-	15.3													
Hydraulic radius (ft)	-	-	0.5	-	-	0.6													
Substrate																			
d50 (mm)		0.10	0.067		0.10	0.067													
d84 (mm)		0.23	0.21		0.23	0.21													

Parameter	MY-00 (2007)			MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	37	37	37	35	39	38	35	38	37									
Radius of Curvature (ft)	17	24	20	17	24	20	17	23	19									
Meander Wavelength (ft)	77	86	82	75	85	82	75	85	82									
Meander Width Ratio	7.1	8.1	7.6	-	-	7	-	-	7									
Profile																		
Riffle Length (ft)	4	11	8	-	-	-	-	-	-									
Riffle Slope (ft)	0.002	0.01	0.004	-	-	-	-	-	-									
Pool Length (ft)	28	53	41	-	-	-	-	-	-									
Pool Spacing (ft)	18	20	19	17	24	20	16	23	17									
Additional Reach Parameters																		
Valley Length (ft)	201			201			201											
Channel Length (ft)	243			243			243											
Sinousity	1.21			1.21			1.21											
Water Surface Slope (ft/ft)	0.0036			-			0.0025											
BF Slope (ft/ft)	0.0042			0.0042			0.0032											
Rosgen Classification	C5			C5			C5											
*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	cvs-eep-entrytool-v2.2.6.mdb
Database Location	C:\Documents and Settings\pstafford\Desktop\CVS Veg Data
Computer Name	STAFFORDP
Description Worksheets In This Document	
Metadata	This worksheet, wich 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	251
Project Name	Mill Branch
Description	Stream Restoration
River Basin	Lumber
Length (ft)	
Stream to Edge width (ft)	
Area (sq. m)	
Required Plots (calculated)	
Sampled Plots	4

Exhibit Table A2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing	Unknown
	Betula nigra	1			1		1	
	Carpinus caroliniana var. caroliniana		1		1		3	
	Cephalanthus occidentalis	1						
	Cornus amomum	1	2	1	1		3	
	Liriodendron tulipifera var. tulipifera		2					
	Platanus occidentalis var. occidentalis	1	2					
	Quercus laurifolia		1			1		
	Quercus lyrata		3	1			1	
	Quercus nigra		1				1	
	Quercus pagoda	1						
	Quercus phellos	1	4	1				
	Salix sericea			3	1		4	
TOT:	**12**	**6**	**16**	**6**	**4**	**1**	**13**	

Exhibit Table A3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Deer	Unknown
	Betula nigra	3	3		
	Carpinus caroliniana var. caroliniana	5	5		
	Cephalanthus occidentalis	1	1		
	Cornus amomum	9	7	1	1
	Liriodendron tulipifera var. tulipifera	2	2		
	Platanus occidentalis var. occidentalis	3	3		
	Quercus laurifolia	2	2		
	Quercus lyrata	5	5		
	Quercus nigra	2	2		
	Quercus pagoda	1	1		
	Quercus phellos	6	6		
	Salix sericea	8	7		1
TOT:	**12**	**47**	**44**	**1**	**2**

Exhibit Table A4. Vegetation Damage by Plot

	plot	All Damage Categories	(no damage)	Deer	Unknown
	E0251-ac-0001-year:2	11	11		
	E0251-ac-0002-year:2	13	12	1	
	E0251-ac-0003-year:2	9	7		2
	E0251-ac-0004-year:2	14	14		
TOT:	**4**	**47**	**44**	**1**	**2**

Exhibit Table A5. Stem Count by Plot and Species

	Species	Total Planted Stems	# plots	avg# stems	plot E0251-ac-0001-year:2	plot E0251-ac-0002-year:2	plot E0251-ac-0003-year:2	plot E0251-ac-0004-year:2
	Betula nigra	2	2	1	1	1		
	Carpinus caroliniana var. caroliniana	2	2	1	1			1
	Cephalanthus occidentalis	1	1	1				1
	Cornus amomum	5	3	1.67	1		3	1
	Liriodendron tulipifera var. tulipifera	2	1	2	2			
	Platanus occidentalis var. occidentalis	3	3	1	1	1	1	
	Quercus laurifolia	1	1	1				1
	Quercus lyrata	4	3	1.33	1	2	1	
	Quercus nigra	1	1	1				1
	Quercus pagoda	1	1	1				1
	Quercus phellos	6	3	2	2		1	3
	Salix sericea	4	2	2			1	3
TOT:	**12**	**32**	**12**	**1.33**	**9**	**4**	**7**	**12**

Exhibit Table A6. Stream Problem Areas

Feature Issue	Reach	Station Number	Suspected Cause	Photo Number
Bare Area	Upper	10+20	Poor planting/Drought	VPA 1
	Upper	11+55	Poor planting/Drought	
	Middle	12+20	Poor planting/Drought	
	Middle	20+50	Poor planting/Drought	
	Middle	20+60	Poor planting/Drought	
	Middle	22+50	Poor planting/Drought	
	Lower	15+40	Poor planting/Drought	
	Lower	16+50	Poor planting/Drought	
Cattails	All Reaches	Located throughout the project	Dry conditions that have allowed seeds to germinate	VPA 2

A.2 Vegetation Problem Areas (All pictures recorded on 11/6/08)

VPA 1 – Middle Reach – 20+50

VPA 2 – Throughout Project

All pictures recorded on 11/6/08

A.3 Vegetation Monitoring Plot Photos (All pictures recorded on 11/6/08)

Photo Station 7 - Vegetation Plot 1 - looking north

Photo Station 8 - Vegetation Plot 2 - looking south

All pictures recorded on 11/6/08

Photo Station 15 – Veg Plot 2 – looking northeast

Photo Station 16 – Veg Plot 2 – looking west

All pictures recorded on 11/6/08

Photo Station 21 – Veg Plot 3 – looking east

Photo Station 22 – Veg Plot 3 – looking west

All pictures recorded on 11/6/08

Photo Station 29 – Veg Plot 4 – looking northeast

Photo Station 20 Veg Plot 4 – looking southwest

All pictures recorded on 11/6/08

APPENDIX B

Appendix B. Geomorphologic Raw Data

B.1 Problem Area Plan View (Stream)

See the Integrated Problem Areas Plan View in Appendix D for stream problem areas.

B.2 Stream Problem Areas Table

Exhibit Table B.1 Stream Problem Areas Mill Branch Stream Restoration Site EEP Project No. 251				
Feature Issue	**Reach**	**Station Number**	**Suspected Cause**	**Photo Number**
Aggradation	Western	10+00 to 13+50	N/A	*
	Upper	10+00 to 12+50	N/A	*
Cattails	All	Throughout	Dry Conditions	VPA 2
Bare Ground	Middle Reach	20+30	Dry Conditions	VPA 1

**Pictures for aggradation areas were not taken due to vegetation growing in the channel and blocking the view*

Appendix B.3 Stream Problem Area Photos

See Integrated Problem Areas Plan View (Appendix D)

Exhibit Table B.2.1. Visual Morphological Stability Assessment Mill Branch Stream Restoration Site/EEP Project No. 0251 Western Reach						
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?	29	29	0.00	100.00	
	2. Armor stable (eg no displacement?)	NA	NA	NA	NA	
	3. Facet grade appears stable?	29	29	0.00	100.00	
	4. Minimal evidence of embedding/fining?	29	29	0.00	100.00	
	5. Length appropiate?	29	29	0.00	100.00	100
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	30	30	0.00	100.00	
	2. Sufficiently deep (Max Pool D:Mean Bkf > 1.6?)	30	30	0.00	100.00	
	3. Length appropriate?	30	30	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?	30	30	0.00	100.00	
	2. Of those eroding, # w/concomitant point bar formation?	30	30	0.00	100.00	
	3. Apparent Rc within spec?	30	30	0.00	100.00	
	4. Sufficient floodplain access and relief?	30	30	0.00	100.00	100
E. Bed General	1. General channel bed aggradation areas (bar formation)	1765	1765	0.00	100.00	
	2. Channel bed degradation - areas of increasing down-cutting or head-cutting?	1765	1765	0.00	100.00	0
F. Bank	1. Actively eroding, wasting, or slumping bank?	1765	1765	0.00	100.00	0
G. Vanes	1. Free of back or arm scour?	8	8	0.00	100.00	
	2. Height appropriate?	8	8	0.00	100.00	
	3. Angle and geometry appear appropriate?	8	8	0.00	100.00	
	4. Free of piping or other structural failures?	8	8	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.2.2. Visual Morphological Stability Assessment Mill Branch Stream Restoration Site/EEP Project No. 0251 Upper Reach						
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?	15	15	0.00	100.00	
	2. Armor stable (eg no displacement?)	NA	NA	0.00	NA	
	3. Facet grade appears stable?	15	15	0.00	100.00	
	4. Minimal evidence of embedding/fining?	15	15	0.00	100.00	
	5. Length appropiate?	15	15	0.00	100.00	100
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	15	15	0.00	100.00	
	2. Sufficiently deep (Max Pool D:Mean Bkf > 1.6?)	15	15	0.00	100.00	
	3. Length appropriate?	15	15	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?	15	15	0.00	100.00	
	2. Of those eroding, # w/concomitant point bar formation?	15	15	0.00	100.00	
	3. Apparent Rc within spec?	15	15	0.00	100.00	
	4. Sufficient floodplain access and relief?	15	15	0.00	100.00	100
E. Bed General	1. General channel bed aggradation areas (bar formation)	1439	1439	0.00	100.00	
	2. Channel bed degradation - areas of increasing down-cutting or head-cutting?	1439	1439	0.00	100.00	100
F. Bank	1. Actively eroding, wasting, or slumping bank?	1439	1439	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 Mill Branch Stream Restoration Site/EEP Project No. 0251 Middle Reach						
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	42	0	100.00	
	2. Armor stable (eg no displacement?)	NA	NA	NA	NA	
	3. Facet grade appears stable?	42	42	0	100.00	
	4. Minimal evidence of embedding/fining?	42	42	0	100.00	
	5. Length appropiate?	42	42	0	100.00	100
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?)	41	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?	41	42	1	97.62	
	2. Of those eroding, # w/concomitant point bar formation?	41	42	1	97.62	
	3. Apparent Rc within spec?	42	42	0	100.00	
	4. Sufficient floodplain access and relief?	39	42	3	92.86	97
E. Bed General	1. General channel bed aggradation areas (bar formation)	2535	2555	20	99.22	
	2. Channel bed degradation - areas of increasing down-cutting or head-cutting?	2540	2555	15	99.41	99
F. Bank	1. Actively eroding, wasting, or slumping bank?	2545	2555	10	99.61	100
G. Vanes	1. Free of back or arm scour?	19	20	1	95.00	
	2. Height appropriate?	18	20	2	90.00	
	3. Angle and geometry appear appropriate?	18	20	2	90.00	
	4. Free of piping or other structural failures?	17	20	3	85.00	90
H. Wads/Boulders	1. Free of scour?	1	1	0	100.00	
	2. Footing stable?	1	1	0	100.00	100

Exhibit Table B.2.4. Visual Morphological Stability Assessment Mill Branch Stream Restoration Site/EEP Project No. 0251 Lower Reach						
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?	19	19	0	100.00	
	2. Armor stable (eg no displacement?)	NA	NA	NA	NA	
	3. Facet grade appears stable?	19	19	0	100.00	
	4. Minimal evidence of embedding/fining?	19	19	0	100.00	
	5. Length appropiate?	19	19	0	100.00	100
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	18	18	0	100.00	
	2. Sufficiently deep (Max Pool D:Mean Bkf > 1.6?)	18	18	0	100.00	
	3. Length appropriate?	18	18	0	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?	17	18	1	94.44	
	2. Of those eroding, # w/concomitant point bar formation?	18	18	0	100.00	
	3. Apparent Rc within spec?	18	18	0	100.00	
	4. Sufficient floodplain access and relief?	16	18	2	88.89	96
E. Bed General	1. General channel bed aggradation areas (bar formation)	1748	1748	0	100.00	
	2. Channel bed degradation - areas of increasing down-cutting or head-cutting?	1748	1748	0	100.00	100
F. Bank	1. Actively eroding, wasting, or slumping bank?	1728	1748	20	98.86	99
G. Vanes	1. Free of back or arm scour?	16	17	1	94.12	
	2. Height appropriate?	15	17	2	88.24	
	3. Angle and geometry appear appropriate?	15	17	2	88.24	
	4. Free of piping or other structural failures?	17	17	0	100.00	93
H. Wads/Boulders	1. Free of scour?	1	1	0	100.00	
	2. Footing stable?	1	1	0	100.00	100

B.4 Stream Photo Station Photos (all photos recorded on November 6, 2008)

Photo Station 1. Beginning of Western Reach – Upstream

Photo Station 2. Beginning of Western Reach – Downstream

All photos recorded on November 6, 2008

Photo Station 3. Riffle Cross-section 1 – Downstream – Western Reach

Photo Station 4 Riffle Cross-section 1 – Upstream – Western Reach

All photos recorded on November 6, 2008

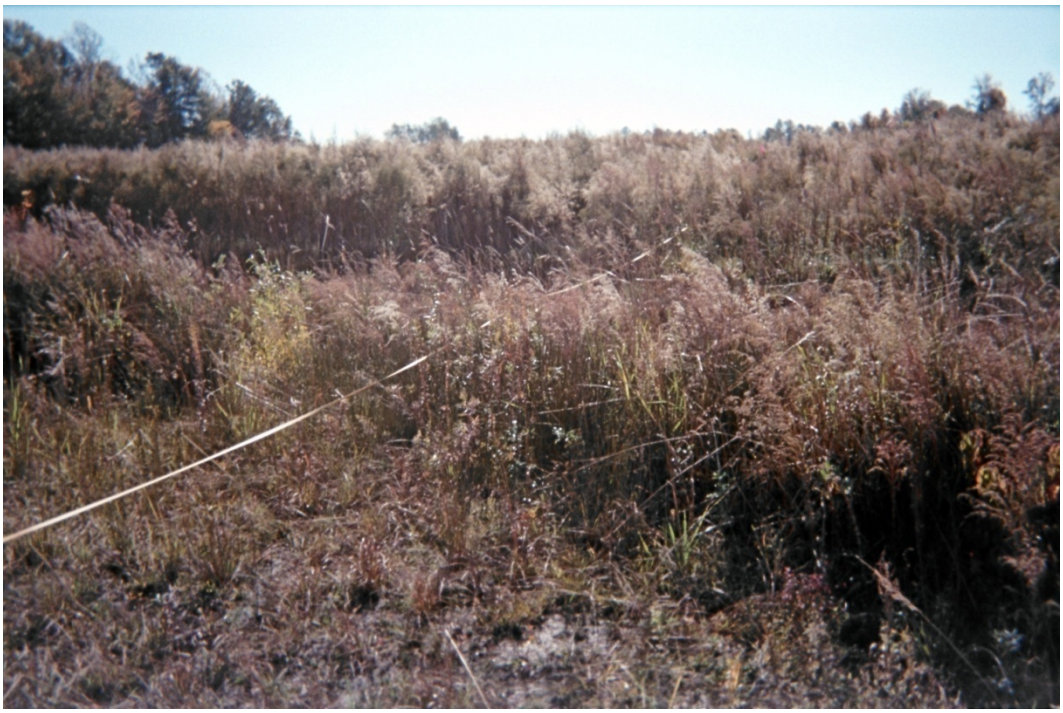


Photo Station 5. Pool Cross-section 2 - Downstream – Western Reach

Photo Station 6. Pool Cross-section – Upstream – Western Reach

All photos recorded on November 6, 2008

Photo Station 9. Beginning of Upper Reach – Upstream

Photo Station 10. Beginning of Upper Reach – Downstream

All photos recorded on November 6, 2008

Photo Station 11. Pool Cross-section 3 – Downstream – Upper Reach

Photo Station 12. Pool Cross-section 3 – Upstream – Upper Reach

All photos recorded on November 6, 2008

Photo Station 13. Riffle Cross-section 4 – Downstream – Upper Reach

Photo Station 14. Riffle Cross-section 4 – Upstream – Upper Reach

All photos recorded on November 6, 2008

Photo Station 17. Confluence of Western and Upper Reaches – Western Reach

Photo Station 18. Confluence of Western and Upper Reaches – Upper Reach

All photos recorded on November 6, 2008

Photo Station 19. Ford Crossing – Downstream – Middle Reach

Photo Station 20. Ford Crossing – Upstream – Middle Reach

All photos recorded on November 6, 2008

Photo Station 23. Riffle Cross-section 5 - Downstream – Middle Reach

Photo Station 24. Riffle Cross-section 5 - Upstream – Middle Reach

All photos recorded on November 6, 2008

Photo Station 25. Pool Cross-section 6 - Downstream – Middle Reach

Photo Station 26. Pool Cross-section 6 - Upstream – Middle Reach

All photos recorded on November 6, 2008

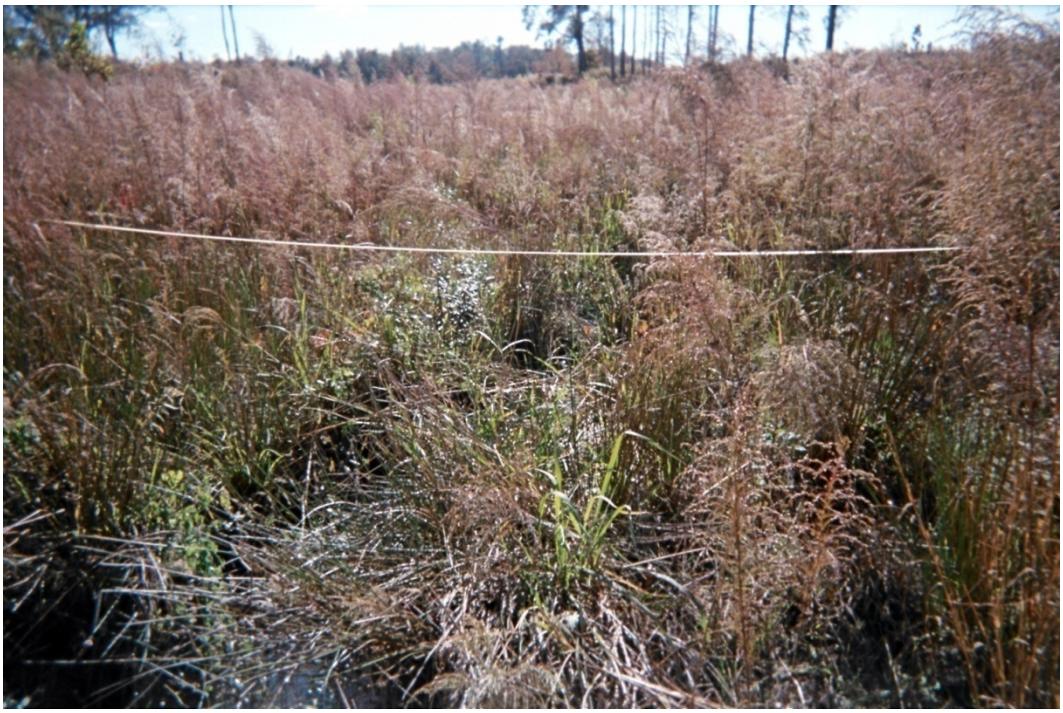


Photo Station 31. Riffle Cross-section 7 – Upstream – Lower Reach

Photo Station 32. Riffle Cross-section 7 – Downstream – Lower Reach

All photos recorded on November 6, 2008

Photo Station 33. Pool Cross-Section 8 – Upstream – Lower Reach

Photo Station 34. End of Project – Upstream – Lower Reach

All photos recorded on November 6, 2008

Photo 35 - Bankfull Event – Rack line in the flood plain

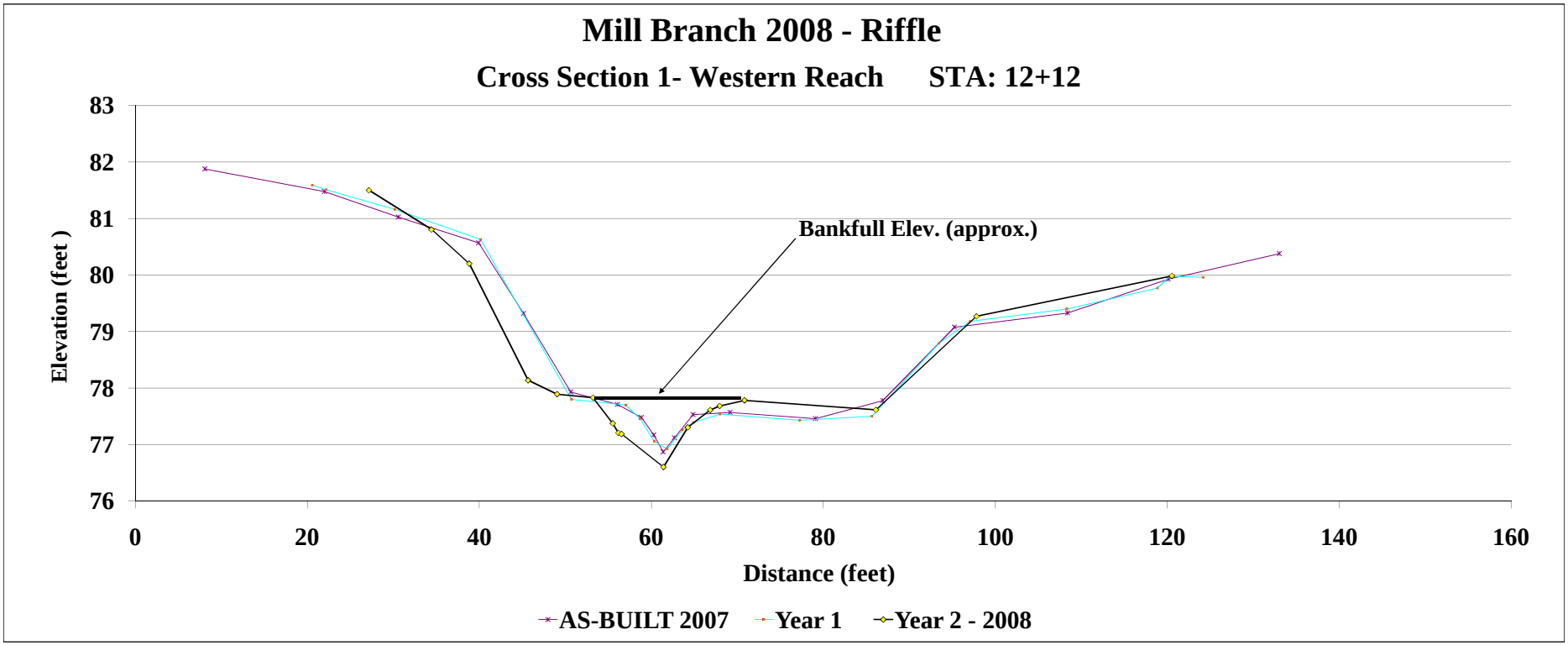
All photos recorded on November 6, 2008

Project Name	Mill Branch
Cross Section	Cross-Section 1 - Western Reach
Feature	Riffle
Date	10/15/08
Crew	Tutt, Stafford

Year 5 - 2012 2012 Survey			Year 4 - 2011 2011 Survey			Year 3 - 2010 2010 Survey			Year 2 - 2008 2008 Survey			Year 1 2007 Survey			AS-BUILT 2007 AS-BUILT Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
									27.2	81.5		20.54	81.59		8.1	81.9	
									34.4	80.8		22.12	81.51		22.0	81.5	LPIN
									38.8	80.2		30.12	81.16		30.6	81.03	
									45.7	78.1		40.13	80.63		39.9	80.6	
									49.0	77.9		50.7	77.8		45.1	79.3	
									53.2	77.8		57.01	77.7		50.6	77.9	
									55.5	77.4		58.64	77.46		56.1	77.7	
									56.2	77.2		60.3	77.06		58.9	77.5	LBKF
									56.5	77.2		61.85	76.92		60.3	77.2	
									61.4	76.6		63.6	77.26		61.4	76.9	
									64.2	77.3		64.88	77.39		62.7	77.1	
									66.8	77.6		67.97	77.54		64.8	77.5	RBKF
									67.9	77.7		77.23	77.43		69.1	77.6	
									70.8	77.8		85.63	77.5		79.1	77.5	
									86.1	77.6		93.42	78.79		86.9	77.8	
									97.8	79.3		97.04	79.18		95.2	79.1	
									120.5	80.0		108.31	79.4		108.4	79.33	
												118.85	79.77		120.1	79.9	RPIN
												120.29	79.98		133.0	80.4	
												124.16	79.96				

Photo of Cross-Section 1 - Looking Downstream @ STA 12+12

	Year 5 - 2012	Year 4 - 2011	Year 3 - 2010	Year 2 - 2008	Year 1	AS-BUILT 2007
Area				4.0	2.3	1.8
Width				19.5	8.7	6.0
Mean Depth				0.2	0.3	0.3
Max Depth				1.1	0.6	0.6
W/D				96.0	33.5	19.8

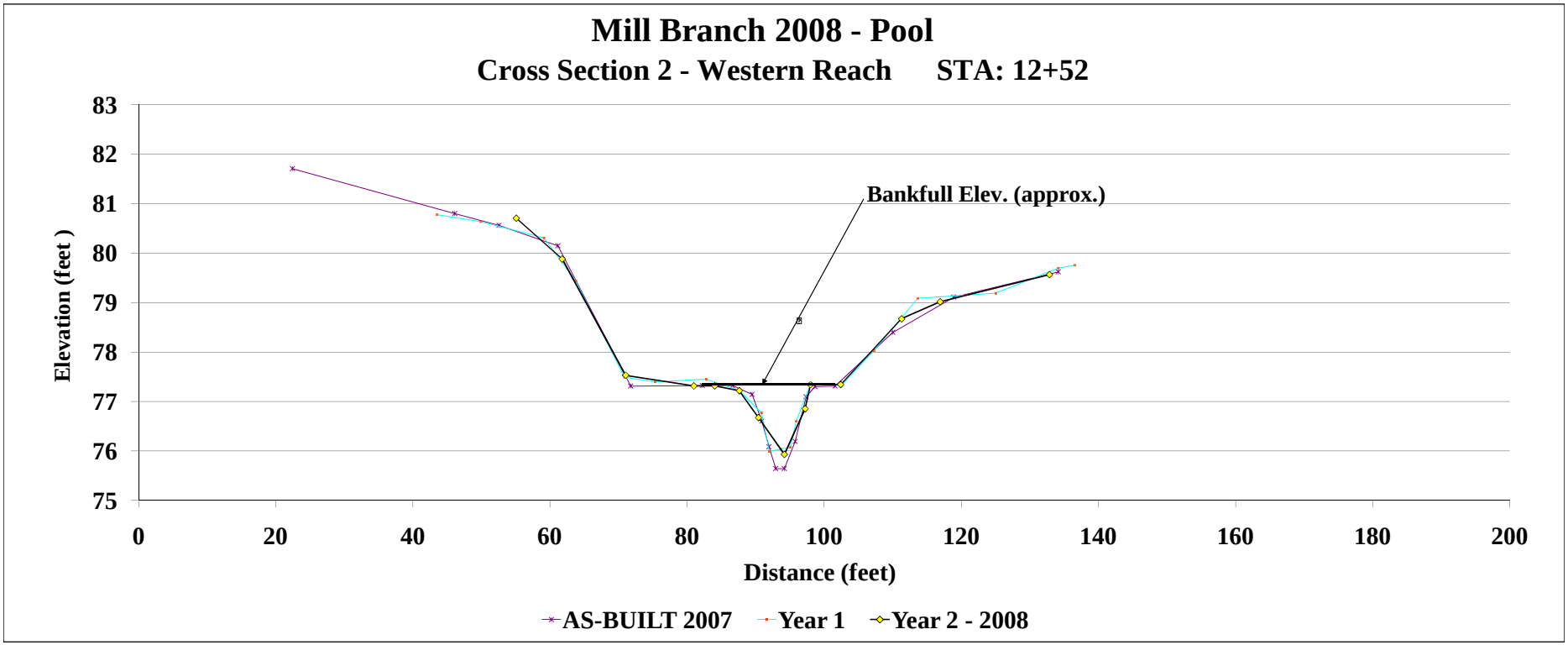


Project Name	Mill Branch
Cross Section	Cross-Section 2 - Western Reach
Feature	Riffle
Date	10/15/08
Crew	Tutt, Stafford

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 2007 Survey			AS-BUILT 2007 AS-BUILT Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
									55.10	80.71		43.56	80.78		22.5	81.7	
									61.79	79.88		49.95	80.64		46.1	80.8	LPIN
									71.05	77.53		59.14	80.31		52.6	80.56	
									80.99	77.31		63.79	79.44		61.2	80.2	
									84.05	77.32		70.9	77.49		71.8	77.3	
									87.63	77.22		75.34	77.4		82.3	77.3	LBKF
									90.42	76.67		82.81	77.45		86.7	77.3	
									94.20	75.93		87.69	77.22		89.5	77.1	
									97.23	76.85		90.87	76.77		90.9	76.6	
									97.99	77.34		92.02	75.99		92.0	76.1	
									102.41	77.34		93.64	76.04		92.9	75.6	
									111.29	78.67		95.07	76.07		94.2	75.6	
									116.92	79.02		95.93	76.6		95.8	76.2	
									132.86	79.57		98.1	77.37		97.4	77.1	
												102.53	77.32		98.7	77.3	
												107.26	78.03		101.6	77.31	RBKF
												113.67	79.09		110.0	78.4	
												125.03	79.19		118.9	79.1	
												134.13	79.7		134.2	79.6	RPIN
												136.53	79.76		150.8	80.1	

Photo of Cross-Section 2 - Looking Upstream @ STA 12+52

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1	AS-BUILT 2007
Area				8.2	7.5	8.7
Width				17.4	11.2	11.7
Mean Depth				0.5	0.7	0.7
Max Depth				1.3	1.3	1.7
W/D				37.1	16.7	15.7

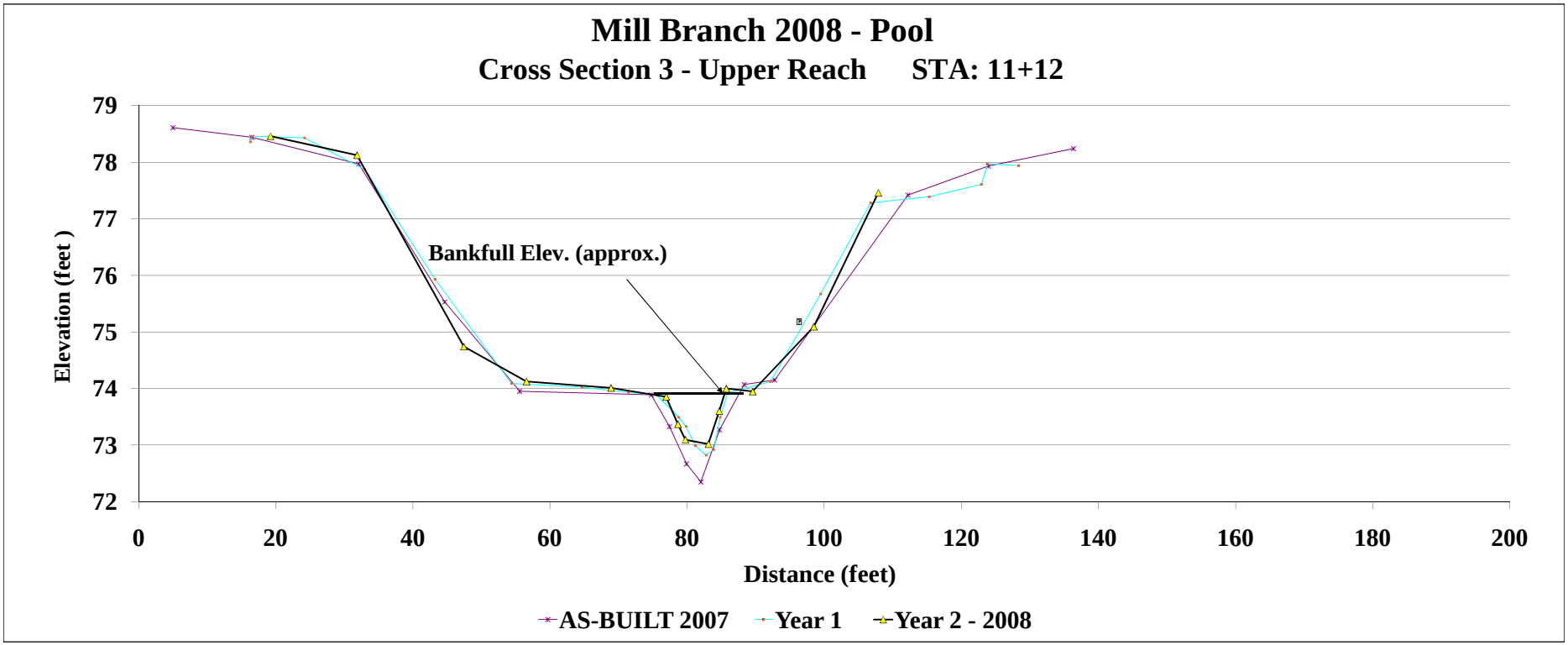


Project Name	Mill Branch
Cross Section	Cross-Section 3 - Upper Reach
Feature	Pool
Date	10/16/08
Crew	Tutt, Stafford

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 2007 Survey			AS-BUILT 2007 AS-BUILT Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
									19.25	78.46		16.37	78.36		5.0	78.6	
									31.88	78.12		16.57	78.46		16.5	78.4	LPIN
									47.44	74.74		24.25	78.43		32.1	77.97	
									56.58	74.13		33.02	77.87		44.7	75.5	
									68.91	74.01		43.29	75.93		55.6	74.0	
									76.96	73.85		54.4	74.09		74.8	73.9	LBKF
									78.67	73.37		64.66	74.02		77.4	73.3	
									79.76	73.09		71.46	73.93		79.9	72.7	
									83.12	73.02		75.54	73.89		82.0	72.4	
									84.69	73.60		78.79	73.49		84.8	73.3	
									85.72	74.00		79.85	73.33		88.3	74.1	RBKF
									89.58	73.95		81.23	72.99		92.8	74.2	
									98.49	75.09		82.8	72.82		112.2	77.4	
									107.90	77.46		83.89	72.92		123.9	77.9	RPIN
												84.85	73.49		136.4	78.2	
												85.92	73.92				
												92.18	74.12				
												99.48	75.67				
												106.77	77.28				
												115.33	77.39				
												122.93	77.61				
												123.83	77.97				
												128.35	77.94				

Photo of Cross-Section 3 - Looking Downstream @ STA 11+12

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1	AS-BUILT 2007
Area				2.0	5.8	9.8
Width				7.3	11.1	12.7
Mean Depth				0.3	0.5	0.8
Max Depth				1.0	1.1	1.5
W/D				26.9	21.2	16.6

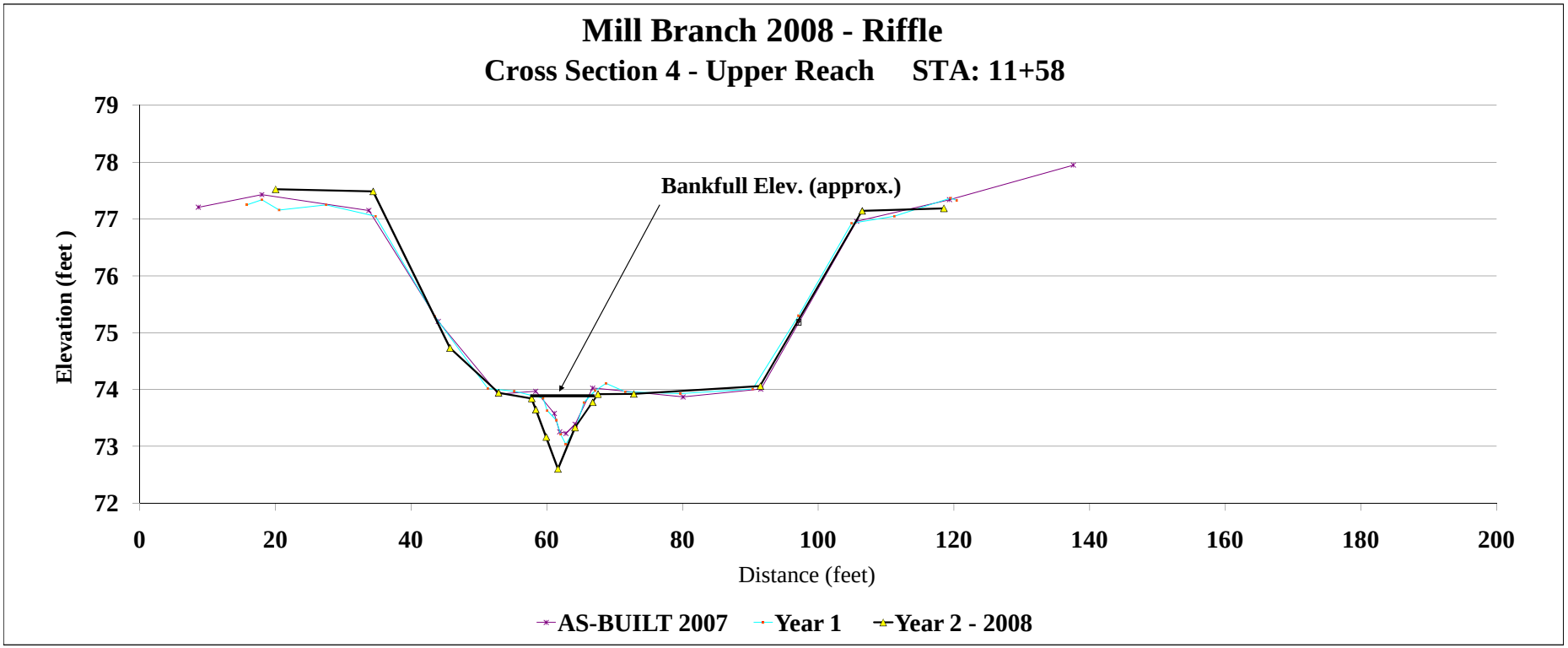


Project Name	Mill Branch
Cross Section	Cross-Section 4 - Upper Reach
Feature	Riffle
Date	10/16/08
Crew	Tutt Stafford

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 2007 Survey			AS-BUILT 2007 AS-BUILT Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
									20.00	77.53		15.71	77.26		8.63	77.21	
									34.38	77.49		15.74	77.25		18.00	77.43	LPIN
									45.71	74.73		17.97	77.34		33.76	77.15	
									52.87	73.95		20.51	77.16		43.99	75.20	
									57.74	73.85		27.45	77.25		52.83	73.92	
									58.36	73.65		34.71	77.05		58.36	73.97	LBKF
									59.89	73.17		43.48	75.29		61.09	73.58	
									61.62	72.61		51.28	74.02		61.89	73.26	
									64.14	73.33		55.19	73.97		62.82	73.23	
									66.74	73.78		59.44	73.85		64.17	73.39	
									67.52	73.92		60.02	73.63		66.74	74.03	RBKF
									72.80	73.92		61.39	73.46		80.08	73.87	
									91.46	74.06		62.01	73.21		91.55	74.01	
									106.47	77.15		62.76	73.04		105.64	76.96	
									118.51	77.19		64.31	73.33		119.34	77.34	RPIN
												65.45	73.77		137.60	77.95	
												67.1	73.98				
												68.7	74.11				
												71.52	73.96				
												79.67	73.93				
												90.3	74.0				
												97.1	75.30				
												104.9	76.9				
												111.2	77.1				
												119.5	77.4				
												120.4	77.3				

Photo of Cross-Section 1 - Looking Downstream @ STA 11+58

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1	AS-BUILT 2007
Area				2.4	3.7	3.2
Width				8.5	8.4	8.1
Mean Depth				0.3	0.4	0.4
Max Depth				1.3	0.9	0.7
W/D				30.6	18.9	20.6

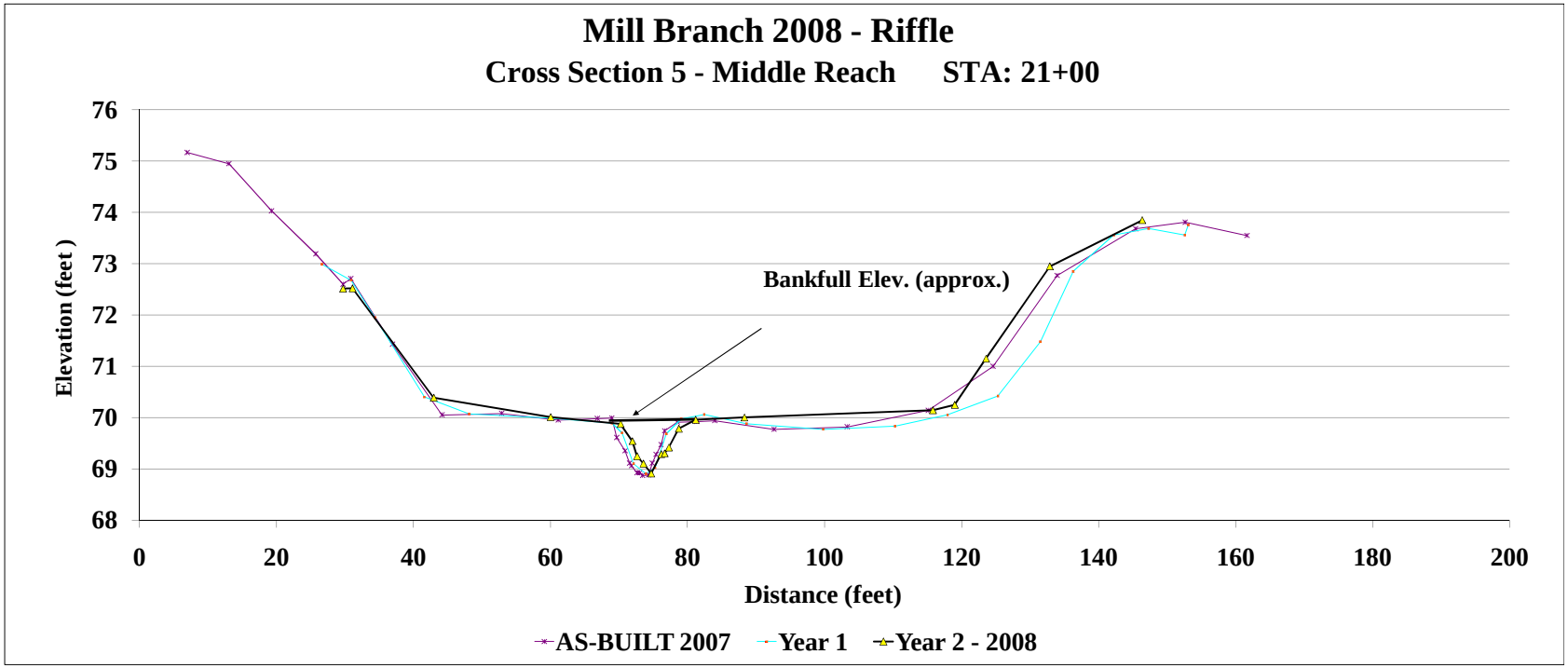


Project Name	Mill Branch
Cross Section	Cross-Section 5 - Middle Reach
Feature	Riffle
Date	10/16/08
Crew	Tutt, Stafford

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009Survey			Year 2 - 2008 2008 Survey			Year 1 2007 Survey			AS-BUILT 2007 AS-BUILT Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
									29.70	72.52		26.63	72.99		7.0	75.2	
									31.08	72.52		30.9	72.68		13.1	75.0	
									42.94	70.39		34.38	71.95		19.3	74.0	
									60	70.01		41.58	70.4		25.8	73.2	
									70.22	69.88		48.12	70.07		29.7	72.6	
									71.95	69.54		59.86	69.99		30.9	72.7	LPIN
									72.63	69.25		68.98	69.89		37.0	71.4	
									73.55	69.10		70.44	69.7		44.2	70.1	
									74.69	68.91		72.13	69.1		52.9	70.1	
									76.15	69.29		73.93	68.9		61.1	70.0	
									76.65	69.30		75.27	69.02		66.9	70.0	
									77.27	69.42		76.9	69.68		69.0	70.0	LBKF
									78.72	69.78		79.08	69.97		69.7	69.6	
									81.18	69.96		82.45	70.06		70.9	69.4	
									88.29	70.00		88.6	69.88		71.6	69.1	
									115.81	70.14		99.81	69.77		71.8	69.1	
									119	70.25		110.3	69.83		72.6	68.9	
									123.58	71.15		117.95	70.05		73.0	68.9	
									132.88	72.95		125.31	70.42		73.4	68.9	
									146.38	73.85		131.5	71.48		74.3	68.9	
												136.29	72.85		74.8	69.1	
												142.21	73.56		75.4	69.3	
												147.31	73.69		76.1	69.5	
												152.59	73.56		76.7	69.7	
												153.1	73.76		78.5	69.9	RBKF
															81.3	69.9	
															84.0	69.9	
															92.6	69.8	
															103.3	69.8	
															115.1	70.1	
															124.6	71.0	
															133.9	72.8	
															145.4	73.7	
															152.6	73.8	RPIN
															161.7	73.6	

Photo of Cross-Section 5 - Looking Downstream @ STA 21+00

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1	AS-BUILT 2007
Area				3.9	5.1	5.2
Width				8.6	9.7	9.5
Mean Depth				0.5	0.5	0.6
Max Depth				1.0	1.0	1.0
W/D				19.0	18.8	17.2

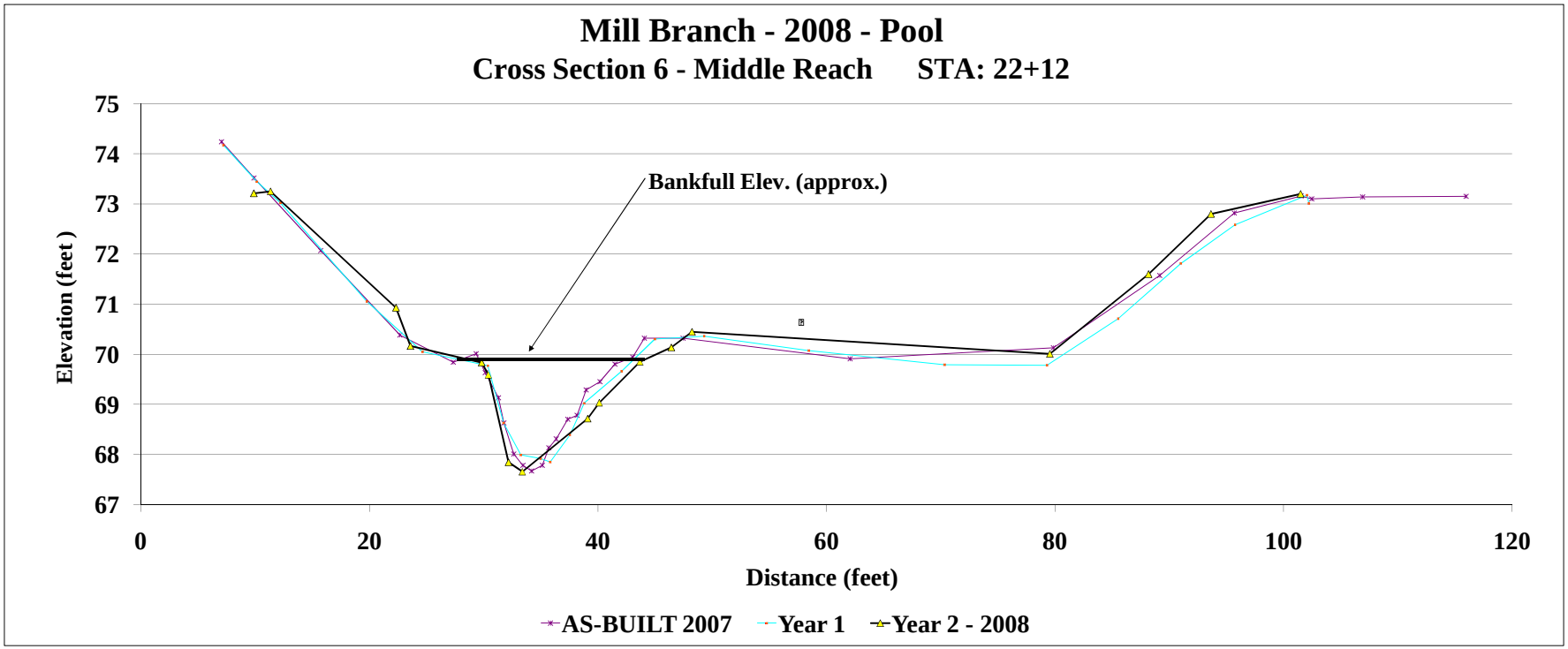


Project Name	Mill Branch
Cross Section	Cross-Section 6 - Middle Reach
Feature	Pool
Date	10/16/08
Crew	Tutt, Stafford

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009Survey			Year 2 - 2008 2008 Survey			Year 1 2007 Survey			AS-BUILT 2007 AS-BUILT Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
									9.90	73.21		7.23	74.17		7.1	74.24	
									11.37	73.25		10.15	73.44		9.9	73.52	LPIN
									22.34	70.93		12.22	73.02		15.8	72.07	
									23.60	70.17		19.78	71.05		22.7	70.38	
									29.84	69.84		24.65	70.05		27.3	69.84	
									30.42	69.59		30.36	69.77		29.4	70.01	LBKF
									32.19	67.85		31.75	68.63		30.2	69.63	
									33.39	67.66		33.25	67.99		31.3	69.13	
									39.12	68.72		34.99	67.92		31.8	68.63	
									40.12	69.04		35.82	67.85		32.6	68.01	
									43.68	69.85		37.55	68.39		33.4	67.78	
									46.44	70.14		38.81	69.02		34.2	67.67	
									48.24	70.45		42.08	69.66		35.1	67.78	
									79.56	70.01		44.99	70.3		35.7	68.13	
									88.20	71.60		49.3	70.36		36.4	68.31	
									93.65	72.80		58.47	70.07		37.4	68.70	
									101.50	73.20		70.35	69.79		38.2	68.78	
												79.29	69.78		39.0	69.29	
												85.54	70.71		40.2	69.45	
												91.02	71.81		41.5	69.80	
												95.76	72.58		43.1	69.94	RBKF
												102.06	73.17		44.1	70.32	
												102.23	73.01		47.5	70.32	
															62.1	69.91	
															79.9	70.13	
															89.2	71.57	
															95.7	72.82	
															101.5	73.16	RPIN
															102.5	73.10	
															106.9	73.14	
															116.0	73.15	

Photo of Cross-Section 6 - Looking Downstream @ STA 22+12

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1	AS-BUILT 2007
Area				14.8	16.6	15.5
Width				19.0	14.2	13.7
Mean Depth				0.8	1.2	1.1
Max Depth				2.5	2.2	2.3
W/D				24.4	12.2	12.1



Project Name	Mill Branch
Cross Section	Cross-Section 7 - Lower Reach
Feature	Riffle
Date	10/16/08
Crew	Tutt, Stafford

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 2007 Survey			AS-BUILT 2007 AS-BUILT Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
									36.40	66.85		29.01	67.23		15.7	67.5	
									49.36	65.21		31.77	67.31		31.2	67.4	LPIN
									72.83	64.91		32.93	67.17		37.6	67.00	
									83.97	64.95		37.21	66.93		41.4	66.0	
									87.54	65.08		43.28	65.72		48.8	65.3	
									88.83	64.51		50.94	65.1		57.6	64.8	
									91.22	64.51		59.6	64.88		64.9	64.9	
									91.70	64.06		66.87	64.89		72.4	64.9	
									92.57	63.95		76.08	64.9		81.7	65.0	
									94.80	62.93		84.71	65		86.6	65.0	
									96.06	64.12		88.86	64.93		88.7	65.1	
									96.88	64.32		90.3	64.45		89.7	64.8	
									97.28	64.51		93.6	64.08		91.0	64.4	
									98.90	64.65		94.34	63.13		92.9	64.2	LBKF
									100.16	64.97		95.31	63.18		93.4	64.0	
									105.74	64.95		96.29	63.24		93.6	63.2	
									118.90	65.13		97.89	64.41		94.4	63.08	
									122.66	65.27		100.96	64.9		94.5	63.1	
									133.88	67.75		105.06	65		95.1	63.4	
									141.91	68.45		112.02	65.02		95.9	63.4	
												121.33	65.14		96.5	63.6	
												125.49	65.94		96.7	63.6	
												131.95	67.02		97.0	63.9	
												137.94	68.29		97.0	64.2	RBKF
												143.52	68.58		98.1	64.4	
												144.78	68.58		101.0	64.9	
															103.7	64.8	
															113.9	65.0	
															121.9	65.1	
															124.0	65.8	
															130.3	66.9	
															136.8	68.1	
															143.0	68.7	RPIN
															146.6	68.5	
															154.6	68.8	

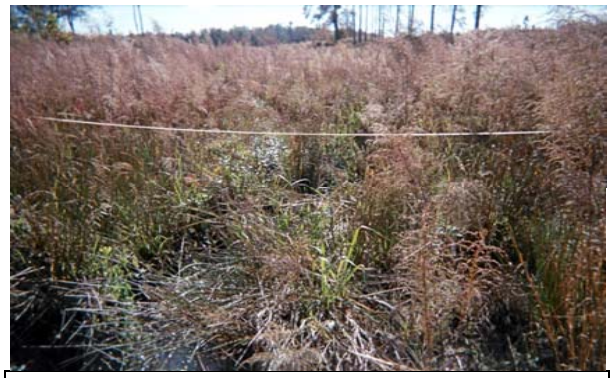
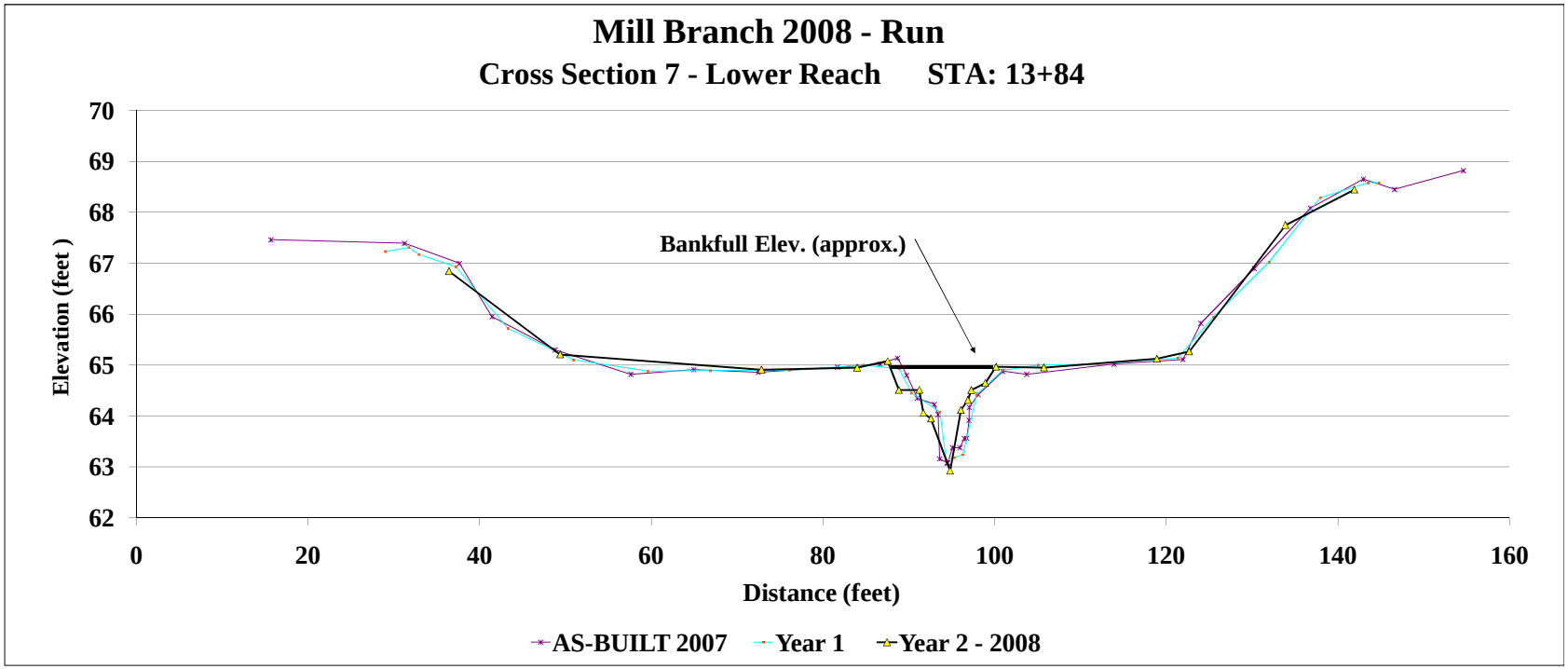


Photo of Cross-Section 7 - Looking Upstream @ STA 13+84

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1	AS-BUILT 2007
Area				8.4	8.9	8.9
Width				14.7	11.8	10.8
Mean Depth				0.6	0.8	0.8
Max Depth				2.0	1.7	1.8
W/D				25.1	15.6	13.1

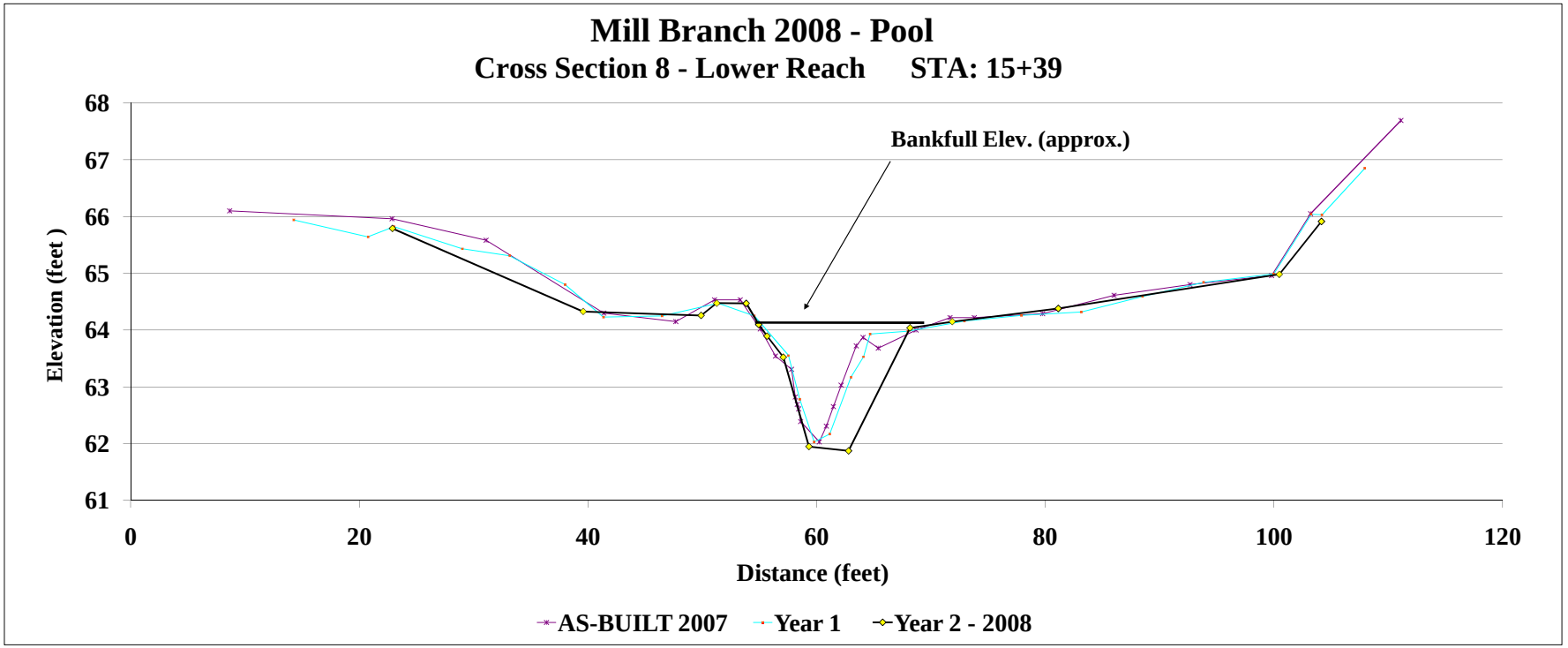


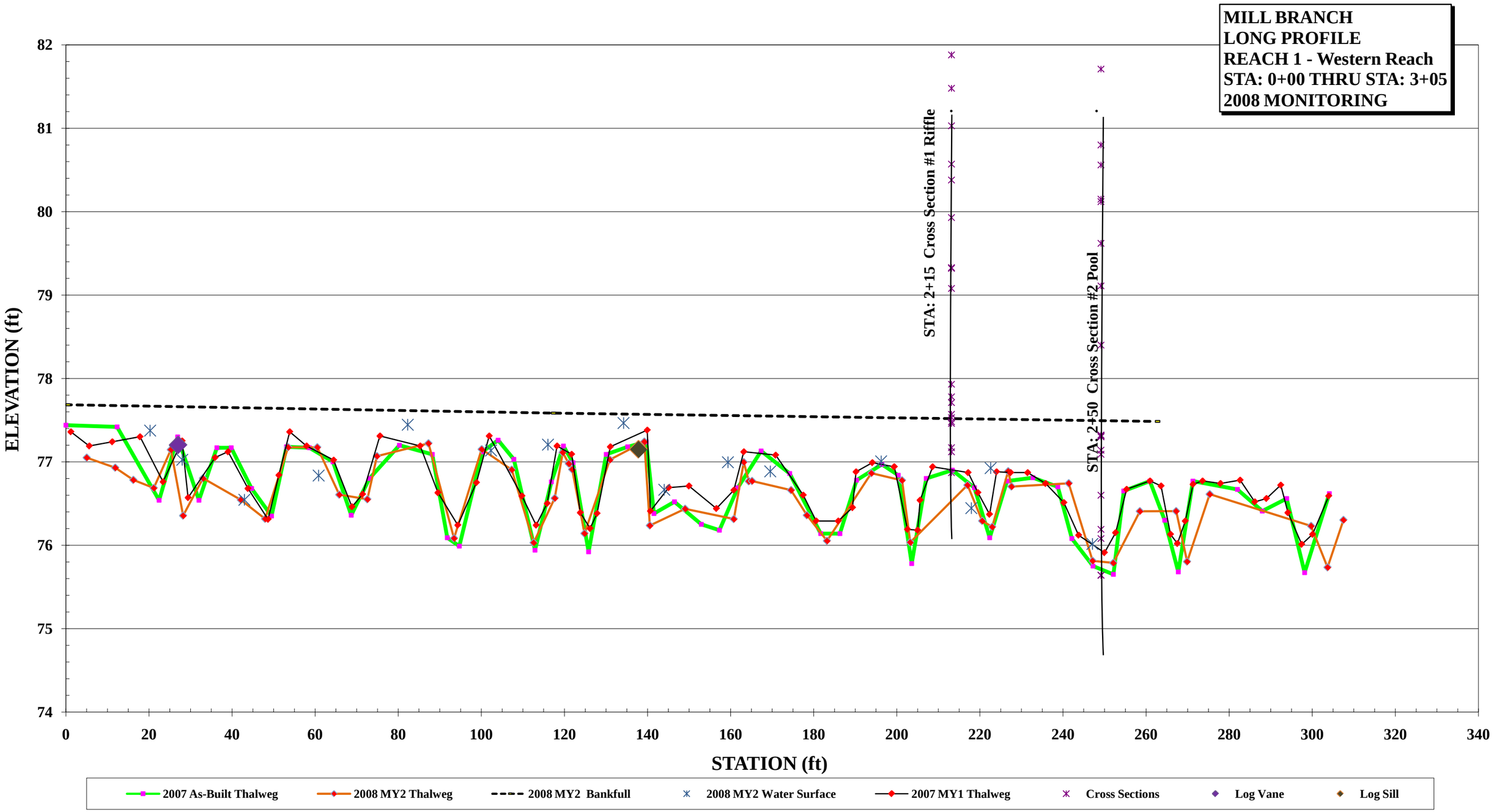
Project Name	Mill Branch
Cross Section	Cross-Section 8 - Lower Reach
Feature	Pool
Date	10/16/08
Crew	Tutt, Stafford

Year 5 - 2011 2011 Survey			Year 4 - 2010 2010 Survey			Year 3 - 2009 2009 Survey			Year 2 - 2008 2008 Survey			Year 1 2007 Survey			AS-BUILT 2007 AS-BUILT Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
									22.90	65.79		14.25	65.94		8.7	66.1	
									39.58	64.33		20.74	65.64		22.9	66.0	LPIN
									49.89	64.26		23.03	65.82		31.1	65.58	
									51.26	64.47		29	65.43		41.4	64.3	
									53.84	64.47		33.14	65.31		47.7	64.2	
									54.93	64.10		38	64.8		51.1	64.5	
									55.66	63.89		41.35	64.23		53.3	64.5	
									57.08	63.52		46.47	64.25		55.1	64.0	
									59.33	61.95		51.39	64.47		56.4	63.5	LBKF
									62.79	61.87		54.54	64.25		57.8	63.3	
									68.17	64.04		57.52	63.55		58.1	62.8	
									71.86	64.15		58.51	62.78		58.3	62.7	
									81.13	64.38		59.77	62.03		58.4	62.6	
									100.46	64.98		61.13	62.17		58.6	62.4	
									104.15	65.91		63	63.17		60.2	62.0	
												64.09	63.53		60.8	62.31	
												64.67	63.93		61.5	62.7	
												67.97	63.98		62.1	63.0	
												72.93	64.16		63.5	63.7	RBKF
												77.92	64.26		64.1	63.9	
												83.14	64.32		65.4	63.7	
												88.51	64.59		68.7	64.0	
												93.85	64.84		71.6	64.2	
												99.97	64.99		73.8	64.2	
												103.26	66.04		79.7	64.3	
												104.2	66.03		86.0	64.6	
												107.95	66.85		92.7	64.8	
															99.8	65.0	
															103.2	66.1	RPIN
															111.1	67.7	

Photo of Cross-Section 8 - Looking Downstream @ STA 15+39

	Year 5 - 2011	Year 4 - 2010	Year 3 - 2009	Year 2 - 2008	Year 1	AS-BUILT 2007
Area				8.7	12.5	12.6
Width				11.2	16.9	17.0
Mean Depth				0.8	0.7	0.7
Max Depth				2.6	2.2	2.2
W/D				14.5	22.8	22.9




MILL BRANCH
LONG PROFILE
REACH 1 - Western Reach
STA: 0+00 THRU STA: 3+05
2008 MONITORING
STA: 2+15 Cross Section #1 Riffle
STA: 2+50 Cross Section #2 Pool
ELEVATION (ft)
82
81
80
79
78
77
76
75
74
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
STATION (ft)
2007 As-Built Thalweg
2008 MY2 Thalweg
2008 MY2 Bankfull
2008 MY2 Water Surface
2007 MY1 Thalweg
Cross Sections
Log Vane
Log Sill

MILL BRANCH
LONG PROFILE
REACH 2 - Upper Reach
STA: 0+00 THRU STA: 2+90
2008 MONITORING

ELEVATION (ft)

79
78
77
76
75
74
73
72
71

STA: 1+07 Cross Section #3 Pool

STA: 1+53 Cross Section #4 Riffle

0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340

STATION (ft)

2007 As-Built Thalweg
2008 MY2 Thalweg
2008 MY2 Bankfull
2008 MY2 Water Surface
2007 MY1 Thalweg
Cross Sections

MILL BRANCH
LONG PROFILE
REACH 3 - Middle Reach
STA: 0+00 THRU STA: 3+00
2008 MONITORING

ELEVATION (ft)

75
73
71
69
67
65

0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340

STATION (ft)

STA: 0+94 Cross Section #5 Riffle

STA: 2+06 Cross Section #6 Pool

2007 As-Built Thalweg
2008 MY2 Thalweg
2008 MY2 Bankfull
2008 MY2 Water Surface
2007 MY1 Thalweg
Cross Sections
Log Vane

MILL BRANCH
LONG PROFILE
REACH 4 -Lower Reach
STA: 0+00 THRU STA: 2+45
2008 MONITORING

ELEVATION (ft)

70
69
68
67
66
65
64
63
62
61
60

STA: 0+12 Cross Section #7 Riffle

STA: 1+71 Cross Section #8 Pool

0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340

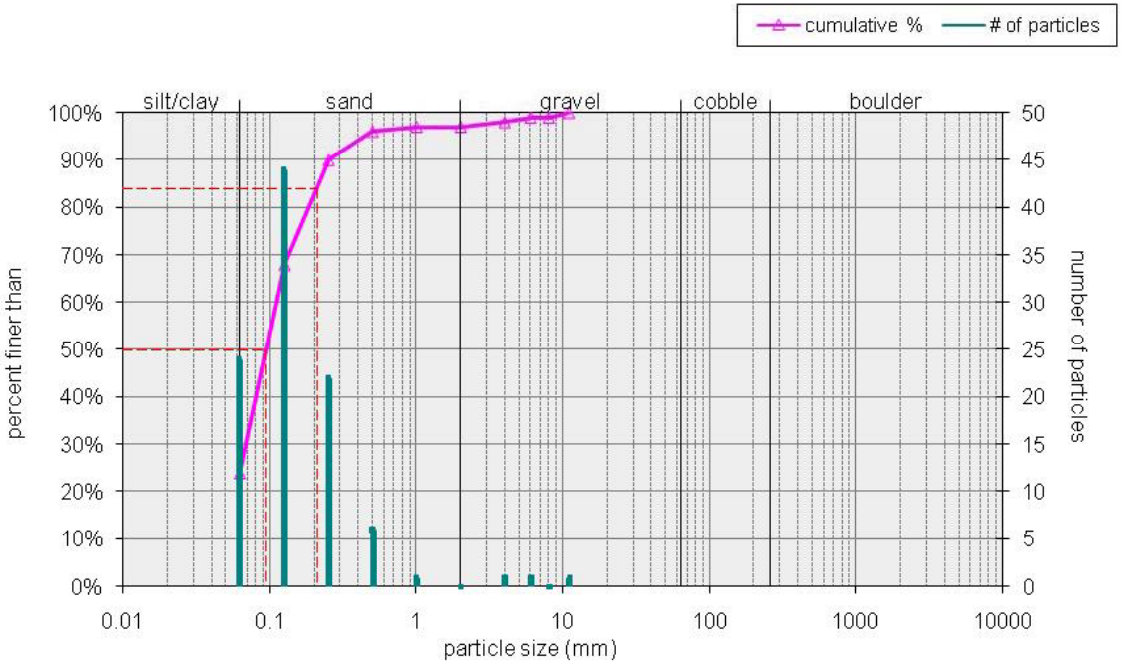
STATION (ft)

2007 As- Built Thalweg | 2008 MY2 Thalweg | 2008 MY2 BankFull | 2008 MY2 Water Surface | 2007 MY1 Thalweg | Cross Sections | Log Sill

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	24
very fine sand	0.062 - 0.125	44
fine sand	0.125 - 0.25	22
medium sand	0.25 - 0.5	6
coarse sand	0.5 - 1	1
very coarse sand	1 - 2	0
very fine gravel	2 - 4	1
fine gravel	4 - 6	1
fine gravel	6 - 8	0
medium gravel	8 - 11	1
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: Lower Reach Mill Branch

Mill Branch Pebble Count Lower Reach



Size (mm)	
D16	0.062
D35	0.062
D50	0.067
D65	0.11
D84	0.21
D95	0.45

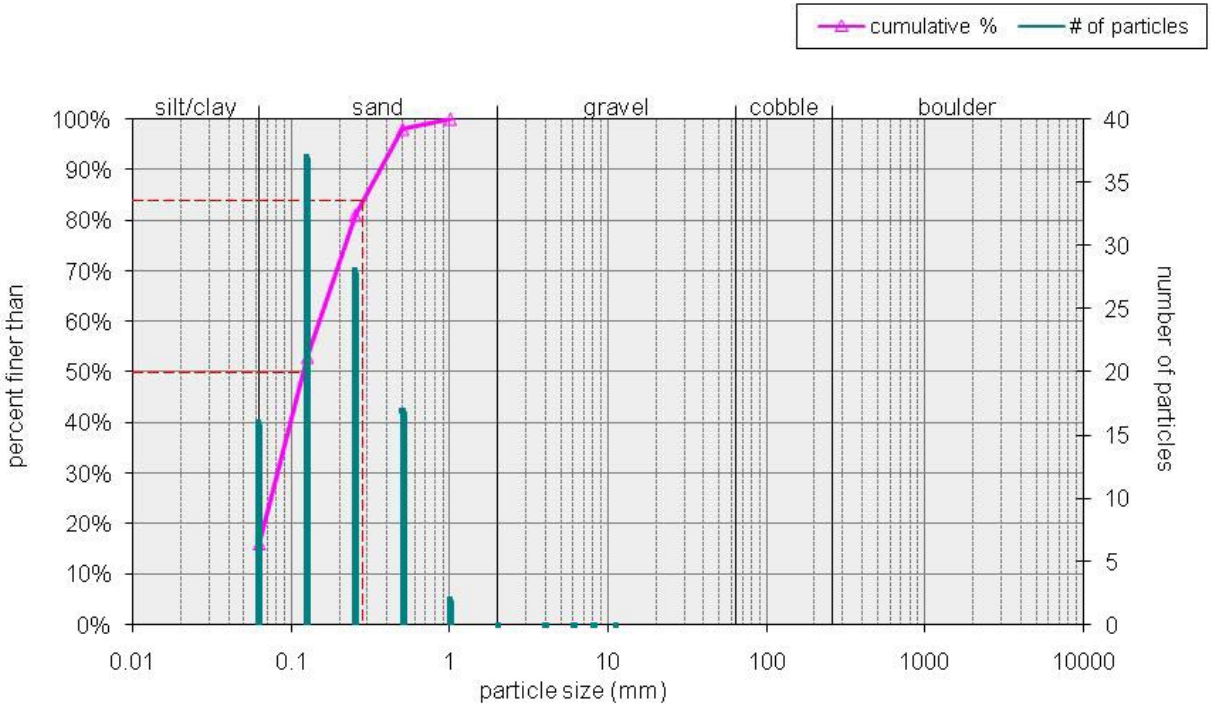
Size Distribution	
mean	0.114105
dispersion	2.107487
skewness	0.317671

Type	
silt/clay	0.24
sand	0.73
gravel	0.03
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	16
very fine sand	0.062 - 0.125	37
fine sand	0.125 - 0.25	28
medium sand	0.25 - 0.5	17
coarse sand	0.5 - 1	2
very coarse sand	1 - 2	0
very fine gravel	2 - 4	0
fine gravel	4 - 6	0
fine gravel	6 - 8	0
medium gravel	8 - 11	0
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: Western Reach Mill Branch

Mill Branch Pebble Count Western Reach



Size (mm)	
D16	0.062
D35	0.069
D50	0.11
D65	0.17
D84	0.28
D95	0.44

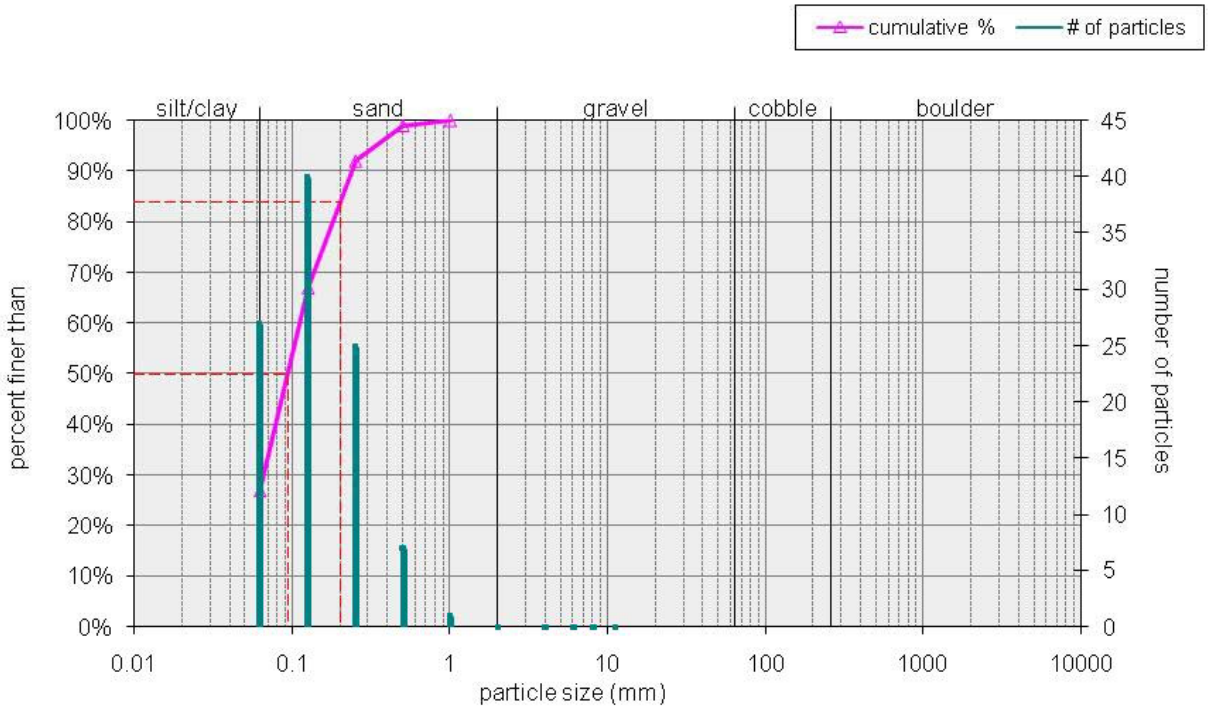
Size Distribution	
mean	0.131757
dispersion	2.159824
skewness	0.096867

Type	
silt/clay	0.16
sand	0.84
gravel	0
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	27
very fine sand	0.062 - 0.125	40
fine sand	0.125 - 0.25	25
medium sand	0.25 - 0.5	7
coarse sand	0.5 - 1	1
very coarse sand	1 - 2	0
very fine gravel	2 - 4	0
fine gravel	4 - 6	0
fine gravel	6 - 8	0
medium gravel	8 - 11	0
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: Middle Reach Mill Branch

Mill Branch Pebble Count Middle Reach



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.11
D84	0.2
D95	0.34

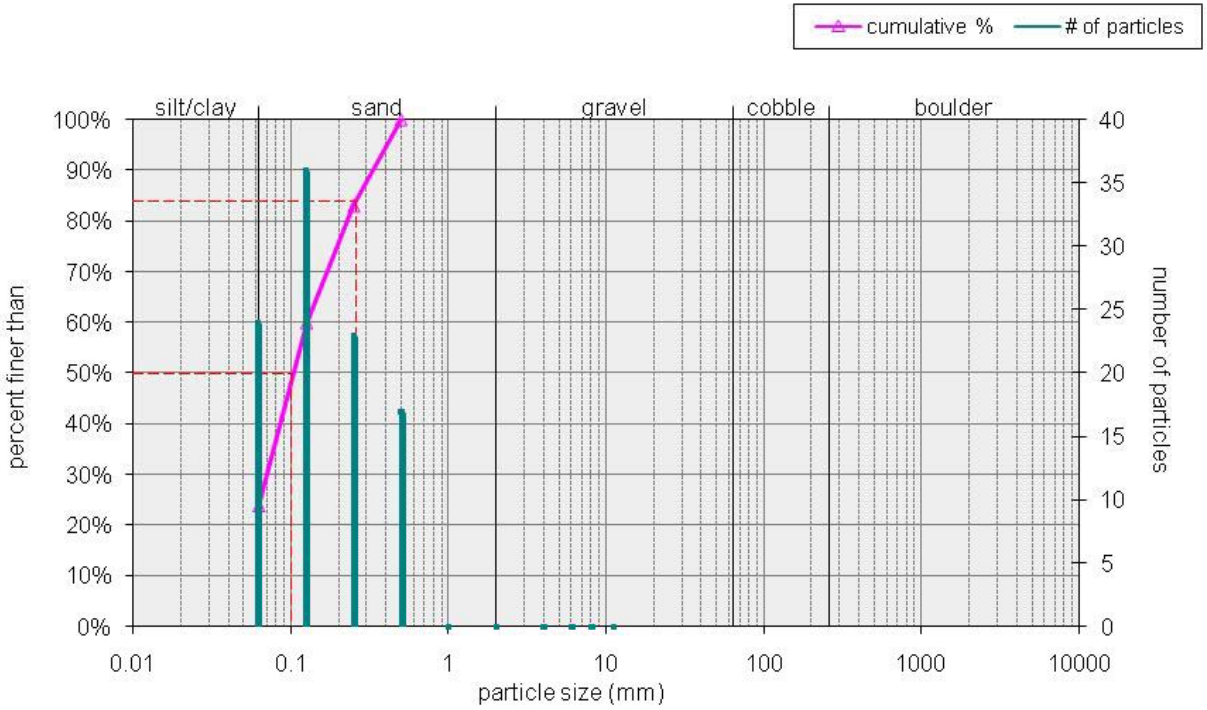
Size Distribution	
mean	0.111355
dispersion	2.112903
skewness	0.356594

Type	
silt/clay	0.27
sand	0.73
gravel	0
cobble	0
boulder	0

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	24
very fine sand	0.062 - 0.125	36
fine sand	0.125 - 0.25	23
medium sand	0.25 - 0.5	17
coarse sand	0.5 - 1	0
very coarse sand	1 - 2	0
very fine gravel	2 - 4	0
fine gravel	4 - 6	0
fine gravel	6 - 8	0
medium gravel	8 - 11	0
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: Upper Reach Mill Branch

Mill Branch Pebble Count Upper Reach



Size (mm)	
D16	0.062
D35	0.062
D50	0.07
D65	0.15
D84	0.26
D95	0.41

Size Distribution	
mean	0.126965
dispersion	2.421659
skewness	0.327721

Type	
silt/clay	0.24
sand	0.76
gravel	0
cobble	0
boulder	0

Appendix C. Wetland Raw Data

Wetlands were not restored as part of this project

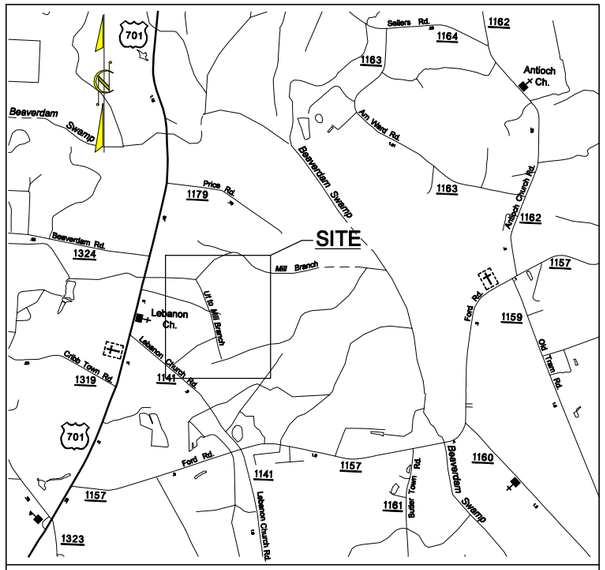
Appendix D. Integrated Problem Areas Plan View

STATE	EEP SCO# NO.	SHEET NO.	TOTAL SHEETS
N.C.	02-06113-01A	1	7

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

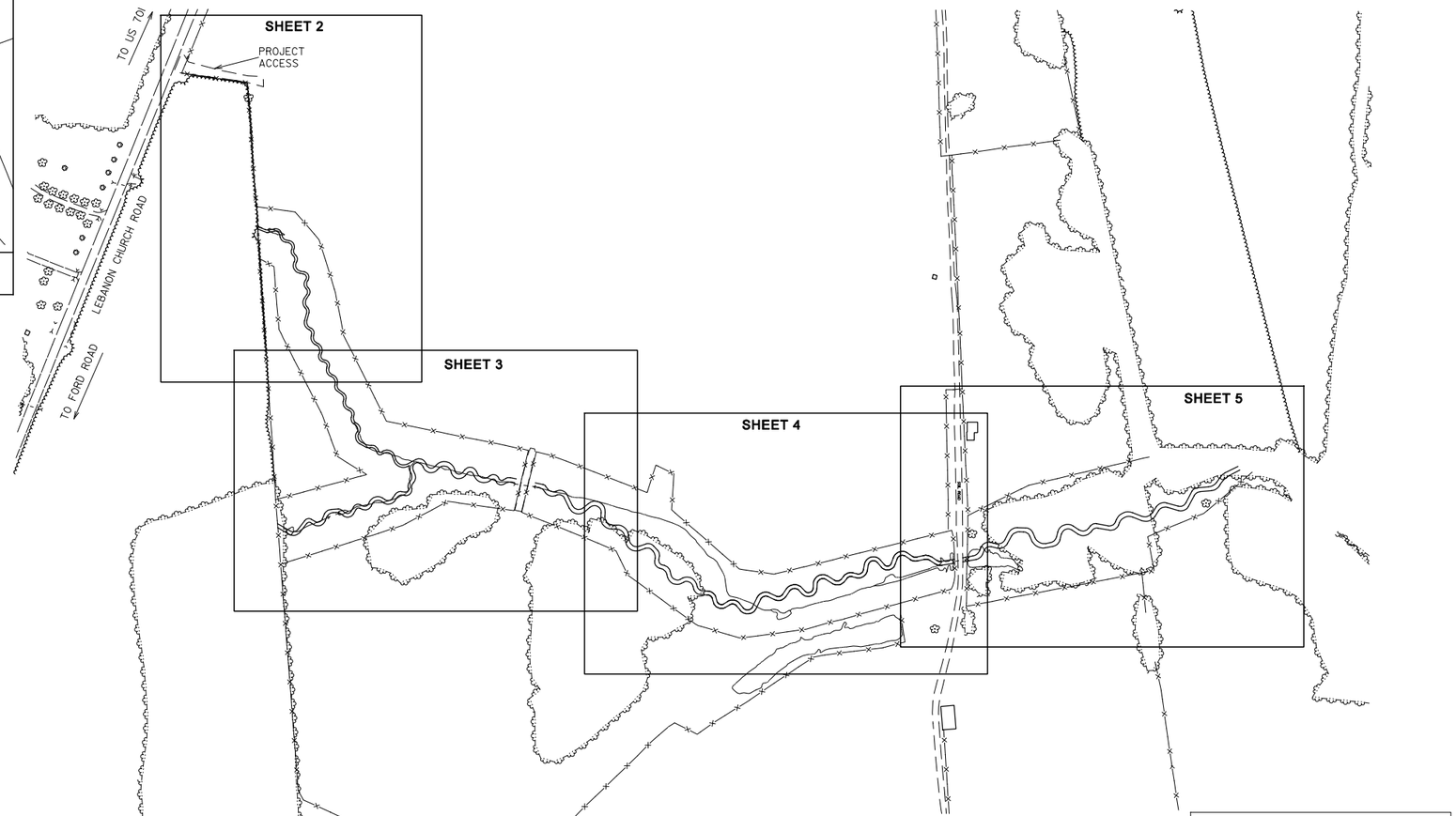
UNNAMED TRIBUTARY TO MILL BRANCH

LOCATION: COLUMBUS COUNTY, NORTH CAROLINA
TYPE OF WORK: AS-BUILT DRAWINGS
SCO# 02-06113-01A



VICINITY MAP

Columbus County, NC



INDEX OF SHEETS

GRAPHIC SCALES

50 25 0 50 100
PLANS

50 25 0 50 100
PROFILE (HORIZONTAL)

5 2.5 0 5 10
PROFILE (VERTICAL)

Prepared In the Office of:
Stantec Consulting Services Inc.
Suite 300, 801 Jones Franklin Road
Raleigh, NC 27606
Tel. 919.851.6866 Fax. 919.851.7024
www.stantec.com

SIGNATURE

PROJECT: 17030983

6/25/2007
10:30:09 AM
U:\17\30\167\em\design\plan\Asbuilts_design_overlay\17300167_EM_ASBUILTDESIGNOVERLAY_sheet1.dgn

PROJECT NO.	SHEET NO.
SCO# 02-06113-01A	2
PROJECT ENGINEER	

Stantec
Stantec Consulting Services Inc.
Suite 300, 801 Jones Franklin Road
Raleigh NC 27606
Tel: 9 9.85 .6866
Fax: 9 9.85 .7024
www.stantec.com

VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-1A	2074939.6552	170798.7832
VP-1B	2074937.5348	170815.1209

CROSS-SECTION COORDINATES				
CROSS-SECTION	LEFT		RIGHT	
	X	Y	X	Y
RIFFLE 1	2074779.4700	170816.2415	2074797.4519	170719.8073
POOL 2	2074810.1662	170807.4966	2074817.6790	170719.7804

NOTE: ALL STATIONS REFERENCE THALWEG LOCATED FOR AS-BUILT SURVEY

NC GRID
NAD 83/2001

Problem Areas

- AGGRADATION
- CATTAILS
- BARE GROUND
- RILL EROSION

BEGIN WESTERN UT 10+00.00
N=170711.4910
E=2074633.0410

BL 1
N=170875.069 FEET
E=2074794.857 FEET
Z=83.47'
(NC GRID - NAD 83)

S 44°46'05" W
230.68'

60' WOVEN WIRE & 1 STRAND BARB WIRE

CONSERVATION EASEMENT / WOVEN WIRE FENCE

GATE

RIFFLE 1

POOL 2

VP-1B
VEG PLOT 1

VP-1A

10+43.28
10+27.40
11+37.82
11+56.04
11+81.14
12+18.52
13+16.93
13+59.17
13+85.92
13+90.31
14+09.70

EXISTING 60' WOVEN WIRE & 1 STRAND BARB WIRE

GRAVEL ACCESS ROAD

EXISTING 60' WOVEN WIRE & 1 STRAND BARB WIRE

GATE

INV=79.59'

INV=77.34'

MATCH LINE - SEE SHEET 3

LEGEND

AS-BUILT ROCK CROSS VANE	DESIGN ROCK CROSS VANE
AS-BUILT LOG VANE WITH ROCK SILL	DESIGN LOG VANE
	DESIGN LOG SILL
AS-BUILT LOG SILL	INV INVERT
AS-BUILT LOG VANE	FENCE LINE
AS-BUILT THALWEG	LIMITS OF DISTURBANCE
AS-BUILT BANKFULL	VEG PLOT PINS
	VEG PLOTS
DESIGN BANKFULL	CROSS-SECTIONS
	PHOTO POINTS
MONITORING LONGITUDINAL PROFILE	

Ecosystem Enhancement PROGRAM

25 0 50
SCALE

SITE LOCATED OFF HIGHWAY 701 AND LEBANON CHURCH ROAD SOUTH OF WHITEVILLE

SCO# 02-06113-01A COLUMBUS

CSM

NEI

MATCH LINE - SEE SHEET 2

PROJECT NO.	SHEET NO.
SCO# 02-06113-01A	3
PROJECT ENGINEER	

Stantec
Stantec Consulting Services Inc.
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Raleigh, NC 27606
Tel 919.85 .6866
Fax 919.85 .7024
www.stantec.com

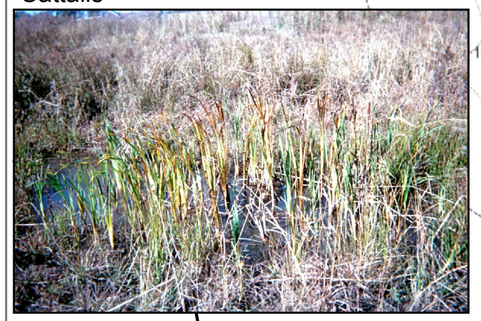
NC GRID NAD 83/2001

NOTE: ALL STATIONS REFERENCE THALWEG LOCATED FOR AS-BUILT SURVEY

Problem Areas

- AGGRADATION
- CATTAILS
- BARE GROUND
- RILL EROSION

Cattails



14+71.75
15+80.79
15+67.00
15.81
16+56.43
16+94.99
16+98.62
16+48.97
16+78.13
10+17.82
17+48.80
14+22.29
11+13.31
12+23.53
12+68.41
13+19.27
13+86.68
11+26.55
11+64.27
12+41.64
13+37.39
15+04.63
14+84.55
14+36.99
15+44.82
13+66.78
12+79.96
11+64.58
12+17.36
12+71.82
10+75.93
10+14.60
10+32.00
60" WOVEN WIRE & 1 STRAND BARB WIRE
CONSERVATION EASEMENT / WOVEN WIRE FENCE
AREA NOT DISTURBED
CREEK / YARD CROSSING
GATE
RIFFLE 4
POOL 3
VP-3A
VP-2B
VEG PLOT 2
VEG PLOT 3

BEGIN MIDDLE REACH 10+00.00
N=170892.3030
E=2075198.9140
END WESTERN UT 17+65.17
END UPPER REACH 14+38.15

BEGIN UPPER REACH 10+00.00
N=170561.8130
E=2075261.4890

VEG PLOT PIN COORDINATES

PIN	X	Y
VP-3A	2075282.6162	170761.6045
VP 2B	2075308.8612	170748.2524

CROSS-SECTION COORDINATES

CROSS-SECTION	LEFT		RIGHT	
	X	Y	X	Y
POOL 3	2075299.2535	170662.4175	2075315.2216	170679.9107
RIFFLE 4	2075297.3409	170708.5291	2075338.9113	170705.9738

LEGEND

- AS-BUILT ROCK CROSS VANE
- AS-BUILT LOG VANE WITH ROCK SILL
- AS-BUILT LOG SILL
- AS-BUILT LOG VANE
- AS-BUILT THALWEG
- AS-BUILT BANKFULL
- DESIGN BANKFULL
- MONITORING LONGITUDINAL PROFILE
- DESIGN ROCK CROSS VANE
- DESIGN LOG VANE
- DESIGN LOG SILL
- INV INVERT
- FENCE LINE
- LIMITS OF DISTURBANCE
- VEG PLOT PINS
- VEG PLOTS
- CROSS-SECTIONS
- PHOTO POINTS

Ecosystem Enhancement PROGRAM

25 0 50
SCALE

SITE LOCATED OFF HIGHWAY 701 AND LEBANON CHURCH ROAD SOUTH OF WHITEVILLE
SCO# 02-06113-01A COLUMBUS
DRAWN BY: CGM
DESIGN BY: NEI

MATCH LINE - SEE SHEET 4

PROJECT NO.	SHEET NO.
SCO# 02-06113-01A	4
PROJECT ENGINEER	

VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-3A	2075400.6710	171234.5660
VP-3B	2075446.3470	171276.3682

CROSS-SECTION COORDINATES				
CROSS-SECTION	LEFT		RIGHT	
	X	Y	X	Y
RIFFLE 5	2076637.4173	171684.0230	2075730.5940	171632.4420
POOL 5	2076630.4133	171658.7970	2075722.9770	171606.2110

LEGEND

- AS-BUILT ROCK CROSS VANE
- DESIGN ROCK CROSS VANE
- AS-BUILT LOG VANE WITH ROCK SILL
- DESIGN LOG VANE
- DESIGN LOG SILL
- AS-BUILT LOG SILL
- INV INVERT
- AS-BUILT LOG VANE
- FENCE LINE
- AS-BUILT THALWEG
- LIMITS OF DISTURBANCE
- AS-BUILT BANKFULL
- VEG PLOT PINS
- VEG PLOTS
- DESIGN BANKFULL
- CROSS-SECTIONS
- MONITORING LONGITUDINAL PROFILE
- PHOTO POINTS

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NC GRID NAD 83/2001

Bare Ground

CONSERVATAION EASEMENT / WOVEN WIRE FENCE

MATCH LINE - SEE SHEET 3

MATCH LINE - SEE SHEET 5

AREA NOT DISTURBED

50' WOVEN WIRE & 1 STRAND BARB WIRE

RIP-RAP

17+13.02

17+48.68

18+47.45

18+82.57

19+13.53

19+43.58

19+79.87

20+07.72

20+30.33

RIFFLE 6

POOL 6

GATE

23+80.82

24+22.26

24+61.21

24+87.77

25+30.26

INV=66.58'

INV=67.40'

Problem Areas

- AGGRADATION
- CATTAILS
- BARE GROUND
- RILL EROSION

NOTE: ALL STATIONS REFERENCE THALWEG LOCATED FOR AS-BUILT SURVEY

25 0 50

SCALE

Ecosystem Enhancement PROGRAM

LOCATION: SITE LOCATED OFF HIGHWAY 701 AND LEBANON CHURCH ROAD SOUTH OF WHITEVILLE

PROJECT NO. SCO# 02-06113-01A COUNTY: COLUMBUS

DESIGNED BY: DRAWN BY: CGM

CHECKED BY: DATE: NEI

Problem Areas

- AGGRADATION
- CATTAILS
- BARE GROUND
- RILL EROSION

NC GRID NAD 83/2001

NOTE: ALL STATIONS REFERENCE THALWEG LOCATED FOR AS-BUILT SURVEY

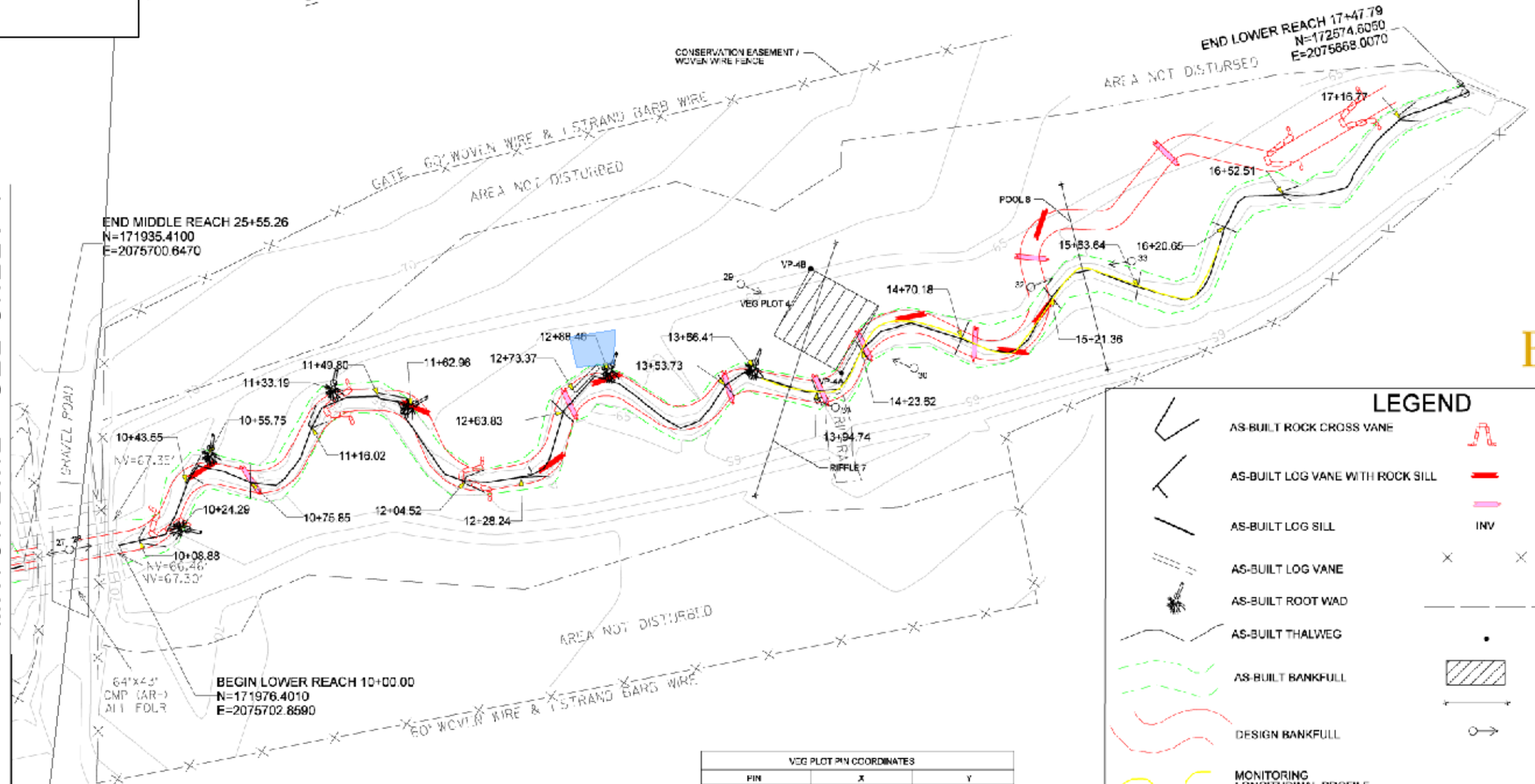
Stantec

Stantec Consulting Services Inc.
Suite 400, 801 Jones Franklin Road
Raleigh, NC 27606
Tel: 919.851.6866
Fax: 919.851.7021
www.stantec.com

SCO#: 02-06113-01A | 5

PROJECT ENGINEER

MATCH LINE - SEE SHEET 4



VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-4A	2075699.9960	172287.9960
VP-4B	2075712.3950	172268.9580

CROSS-SECTION COORDINATES				
CROSS-SECTION	LEFT		RIGHT	
	X	Y	X	Y
RIFFLE 7	2075669.3700	172300.9220	2075763.1770	172240.1770
POOL 8	2075660.5760	172309.0200	2075740.8880	172267.2830

Ecosystem Enhancement PROGRAM

LEGEND

AS-BUILT ROCK CROSS VANE		DESIGN ROCK CROSS VANE
AS-BUILT LOG VANE WITH ROCK SILL		DESIGN LOG VANE
		DESIGN LOG SILL
AS-BUILT LOG SILL	INV	INVERT
AS-BUILT LOG VANE	X X	FENCE LINE
AS-BUILT ROOT WAD		LIMITS OF DISTURBANCE
AS-BUILT THALWEG	•	VEG PLOT PINS
AS-BUILT BANKFULL		VEG PLOTS
		CROSS-SECTIONS
DESIGN BANKFULL		PHOTO POINTS
MONITORING LONGITUDINAL PROFILE		

25 0 50

SCALE

SITE LOCATED OFF HIGHWAY 701 AND LEBANON CHURCH ROAD SOUTH OF WHITEVILLE

SCO# 02-06113-01A | COLUMBUS

CGM

NEI