

# MILL BRANCH STREAM RESTORATION PROJECT

## MONITORING REPORT (YEAR 1 OF 5)

Columbus County, North Carolina  
SCO Project Number 020611301A  
EEP Project Number 0251



Prepared for:  
North Carolina Ecosystem Enhancement Program  
1652 Mail Service Center  
Raleigh, NC 27699-1652



Status of Plan: Final  
Submission Date: August 2008

Monitoring and Design Firm:



---

**Stantec**

Stantec Consulting Services Inc  
801 Jones Franklin Road, Suite 300  
Raleigh, NC 27606

## **EXECUTIVE SUMMARY**

The Mill Branch Restoration Site is located on the James P. Jones property off Lebanon Church Road (SR 1141) 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 1 monitoring site visits were completed on October 4, 2007, November 11, 2007 and November 28, 2007. Year 1 vegetation monitoring was completed using the Carolina Vegetation Survey (CVS) – EEP protocol (Version 4.1). All of the 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.

There was no water in the channel at the time of the geomorphic assessment. 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. 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 should be re-assessed in subsequent monitoring years.

## Table of Contents

Executive Summary.....	i
1.0 Project Background.....	1
1.1 Project objectives .....	1
1.2 Project structure.....	1
1.3 Location and Setting.....	2
1.4 Project History and Background .....	5
1.5 Monitoring Plan View .....	6
2.0 Project Condition and Monitoring Results .....	13
2.1 Vegetation Assessment.....	13
2.1.1 Vegetation Problem Areas.....	13
2.1.2 Vegetation Problem Area Plan View .....	13
2.2 Stream Assessment.....	13
2.2.1 Hydrology.....	13
2.2.2 Bank Stability .....	14
2.2.3 Stream Problem Areas.....	14
2.2.4 Stream Problem Area Plan View.....	14
2.2.5 Stability Assessment.....	15
2.2.6 Quantitative Measures Summary .....	17
3.0 References .....	22
Appendix A. Vegetation Raw Data	
Appendix B. Geomorphologic Raw Data	
Appendix C. Wetland Data (N/A)	
Appendix D. Integrated Problem Area Plan Views	

## 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)**

<b>Reach ID</b>	<b>Existing Feet/Acres</b>	<b>Type</b>	<b>Approach</b>	<b>Footage or Acreage</b>	<b>Mitigation Ratio</b>	<b>Mitigation Units</b>	<b>Stationing</b>	<b>Comment</b>
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
<i>Restoration Summary</i>	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
<b>Mitigation Unit Summations</b>								
Stream (lf)	Riparian Wetland (ac)	Nonriparian Wetland (ac)	Total Wetland (ac)	Buffer (ac)	Comment			
<b>3857.5</b>	<b>7.2</b>	<b>0.3</b>	<b>7.5</b>	<b>0.0</b>				

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.

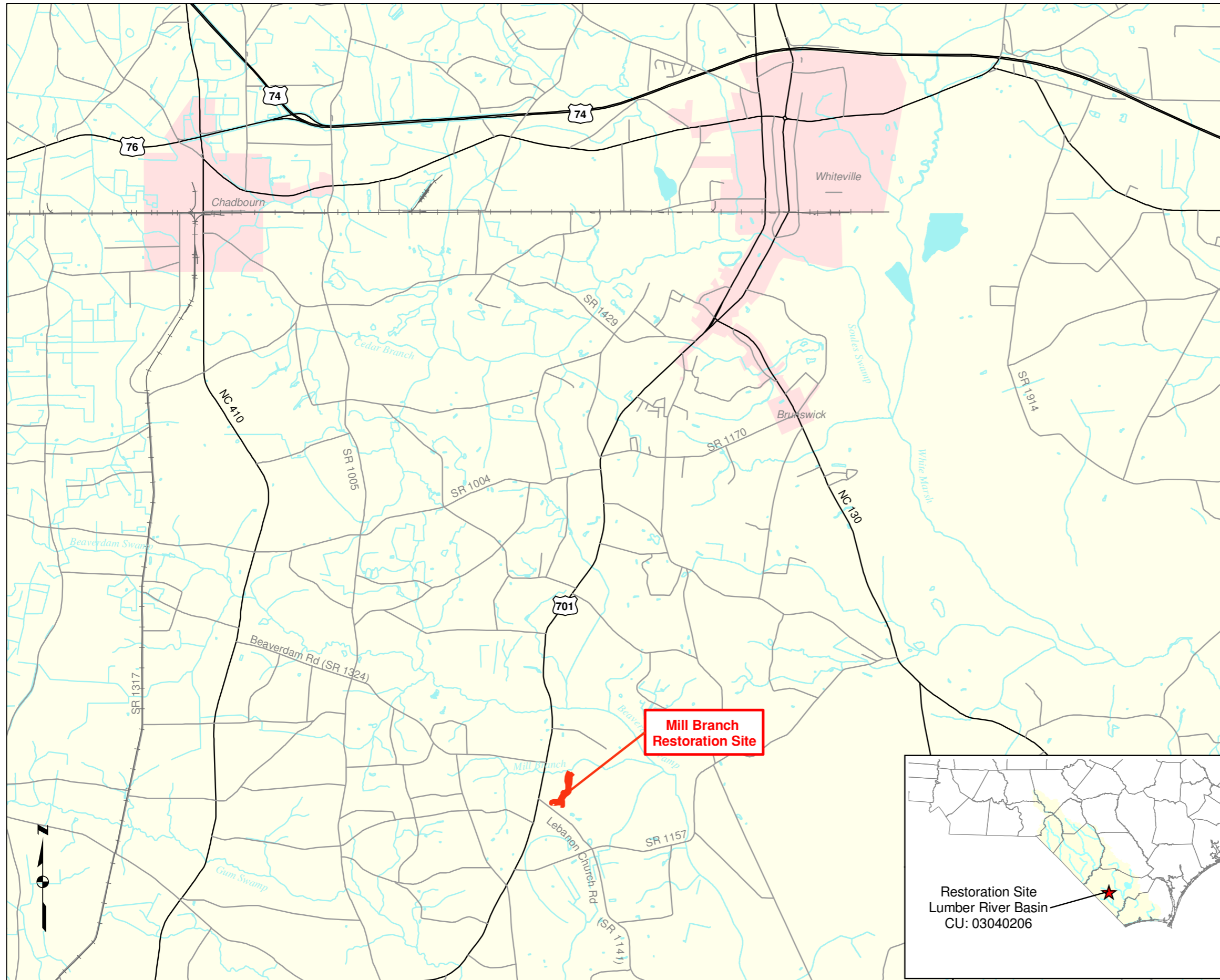







Figure 1.1 Location Map

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

Monitoring Report  
November 2007



-  1:24000 Hydrography
-  NCDOT Primary Roads
-  NCDOT Secondary Roads
-  Railroads
-  Mill Branch Project Site  
34.2222N, 78.7496W



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 project site is on the left just past Lebanon United Methodist Church.

Figure 1.2. Easement Map with preservation area to be provided by EEP.



## 1.4 PROJECT HISTORY AND BACKGROUND

<b>Exhibit Table II. Project Activity and Reporting History Mill Branch Stream Restoration - EEP Project No. 251</b>		
<b>Activity or Report</b>	<b>Data Collection Complete</b>	<b>Actual Completion or Delivery</b>
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	NA	NA
Year 3 Monitoring	NA	NA
Year 4 Monitoring	NA	NA
Year 5 Monitoring	NA	NA

<b>Exhibit Table III. Project Component Table Mill Branch Stream Restoration - EEP Project No. 251</b>	
<b>Designer</b>	Stantec Consulting Services, Inc. 801 Jones Franklin Road Suite 300 Raleigh, NC 27606
Primary project design POC	Brad Fairley, (919) 851-6866
<b>Construction Contractor</b>	North State Environmental, Inc 2889 Lowery St. Suite B Winston-Salem, NC 27101
Construction contractor POC	Darrell Westmoreland (336) 725-2405
<b>Planting Contractor</b>	North State Environmental, Inc 2889 Lowery St. Suite B Winston-Salem, NC 27101
Planting Contractor POC	Darrell Westmoreland (336) 725-2405
<b>Seeding Contractor</b>	North State Environmental, Inc 2889 Lowery St. Suite B Winston-Salem, NC 27101
Seeding Contractor POC	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
<b>Monitoring Performers (Year 0-1)</b>	Stantec Consulting Services, Inc. 801 Jones Franklin Road Suite 300 Raleigh, NC 27606
Stream Monitoring POC	Nate Jean (919)851-6866
Vegetation Monitoring POC	Amber Coleman (919)851-6866
Wetland Monitoring POC	NA

<b>Exhibit Table IV. Project Background Table Mill Branch Stream Restoration Site/EEP Project No. 0251</b>	
Project County	Columbus
Drainage Area	178 acres
Drainage impervious cover estimate (%)	< 1 percent
Stream Order (from Soil Survey)	1 <sup>st</sup> order: Western & Upper Reaches 2 <sup>nd</sup> order: Middle & Lower Reaches
Physiographic Region	Coastal Plain
Ecoregion	Atlantic Southern Loam Plains (651)
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.



**Stantec**

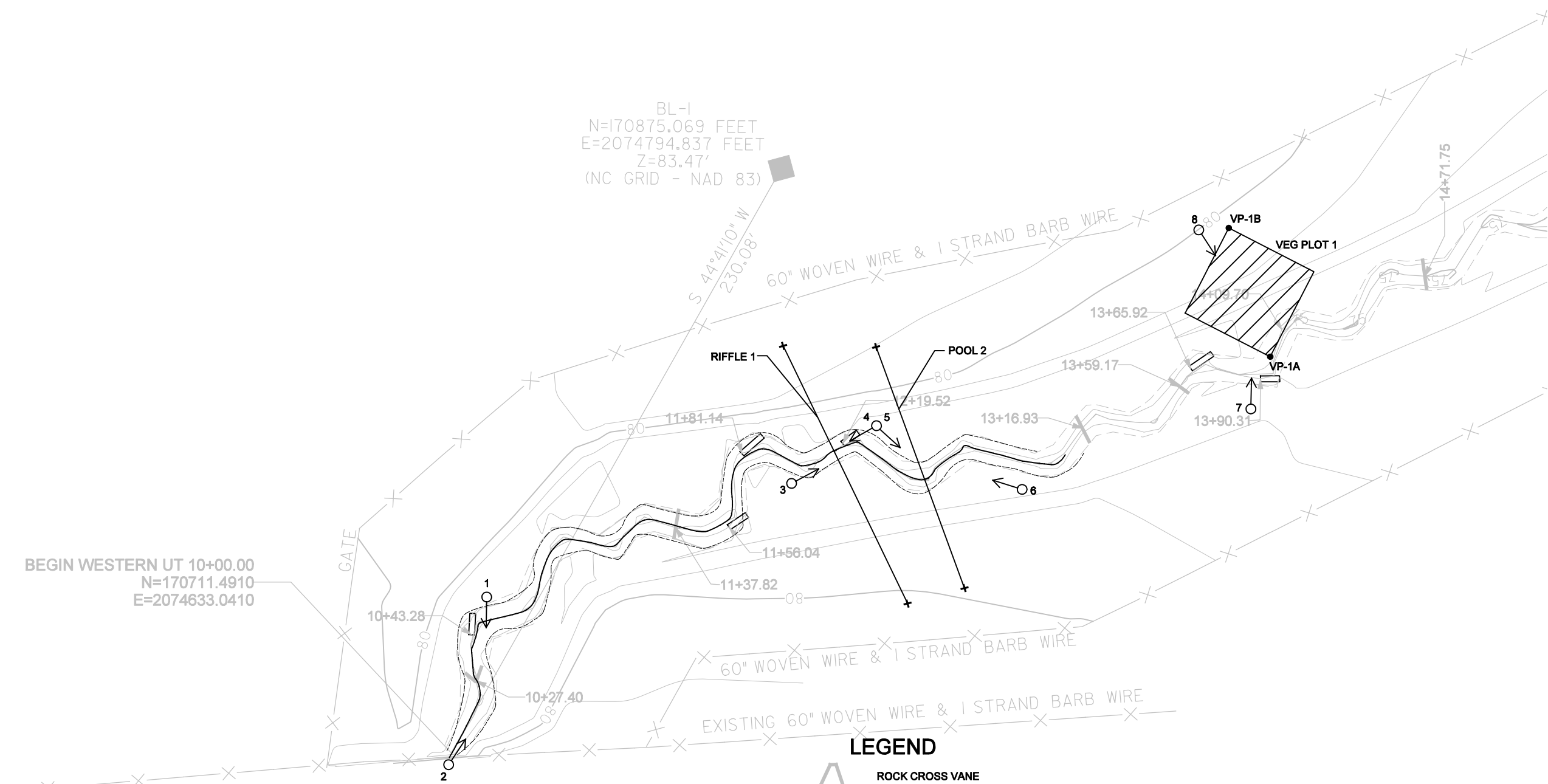
Stantec Consulting Services Inc.  
 Suite 300, 801 Jones Franklin Road  
 Raleigh, NC 27606  
 Tel. 919.851.6866  
 Fax. 919.851.7024  
 www.stantec.com

SEE FIGURE 3.2







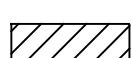
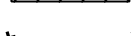



BL-1  
 N=170875.069 FEET  
 E=2074794.837 FEET  
 Z=83.47'  
 (NC GRID - NAD 83)

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

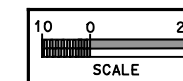
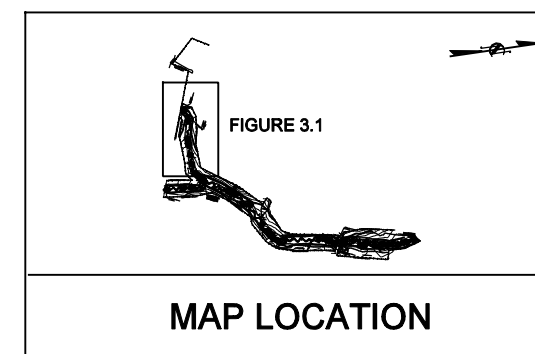


**LEGEND**

-  ROCK CROSS VANE
-  LOG SILL
-  LOG VANE
-  ROOT WAD
-  LOG VANE W/ ROCK SILL
-  VEG PLOT PINS
-  VEG PLOTS
-  CROSS-SECTIONS
-  PHOTO POINTS

VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-1A	2074939.6552	170768.7832
VP-1B	2074937.5346	170815.1209

CROSS-SECTION	CROSS-SECTION COORDINATES			
	LEFT		RIGHT	
	X	Y	X	Y
RIFFLE 1	2074779.4700	170816.2415	2074797.4519	170719.8073
POOL 2	2074810.1552	170807.4965	2074817.6790	170719.7804



**UT to Mill Branch**  
**SCO# : 02-06113-01A**

Monitoring  
 Columbus County, North Carolina

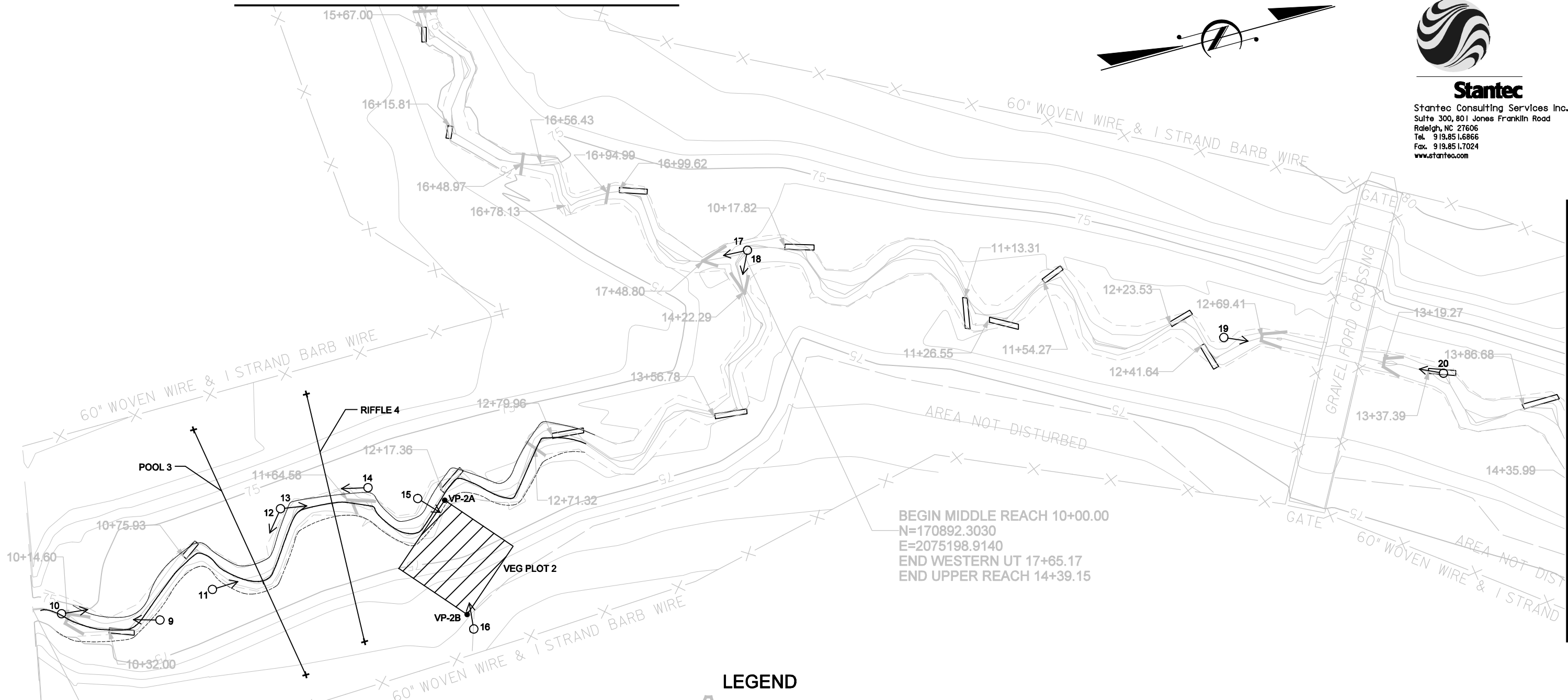
Monitoring Plan View  
 Figure 3.1

SEE FIGURE 3.1



**Stantec**

Stantec Consulting Services Inc.  
 Suite 300, 801 Jones Franklin Road  
 Raleigh, NC 27606  
 Tel. 919.851.6866  
 Fax. 919.851.7024  
 www.stantec.com







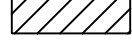




SEE FIGURE 3.3

BEGIN MIDDLE REACH 10+00.00  
 N=170892.3030  
 E=2075198.9140  
 END WESTERN UT 17+65.17  
 END UPPER REACH 14+39.15

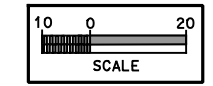
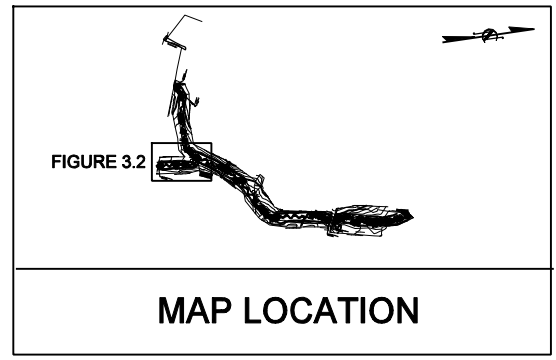
BEGIN UPPER REACH 10+00.00  
 N=170581.8130  
 E=2075261.4890

**LEGEND**

-  ROCK CROSS VANE
-  LOG SILL
-  LOG VANE
-  ROOT WAD
-  LOG VANE W/ ROCK SILL
-  VEG PLOT PINS
-  VEG PLOTS
-  CROSS-SECTIONS
-  PHOTO POINTS

VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-2A	2075262.6162	170751.6045
VP-2B	2075308.8812	170748.2524

CROSS-SECTION	CROSS-SECTION COORDINATES			
	LEFT		RIGHT	
	X	Y	X	Y
POOL 3	2075209.2535	170662.4179	2075315.2216	170679.9107
RIFFLE 4	2075207.3409	170709.5291	2075308.6113	170705.9738



**UT TO MILL BRANCH**  
**SCO# : 02-06113-01A**

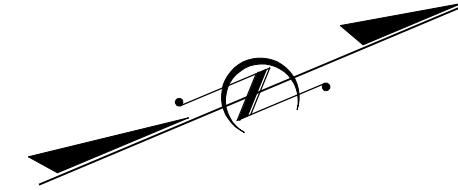
Monitoring  
 Columbus County, North Carolina

Monitoring Plan View  
 Figure 3.2



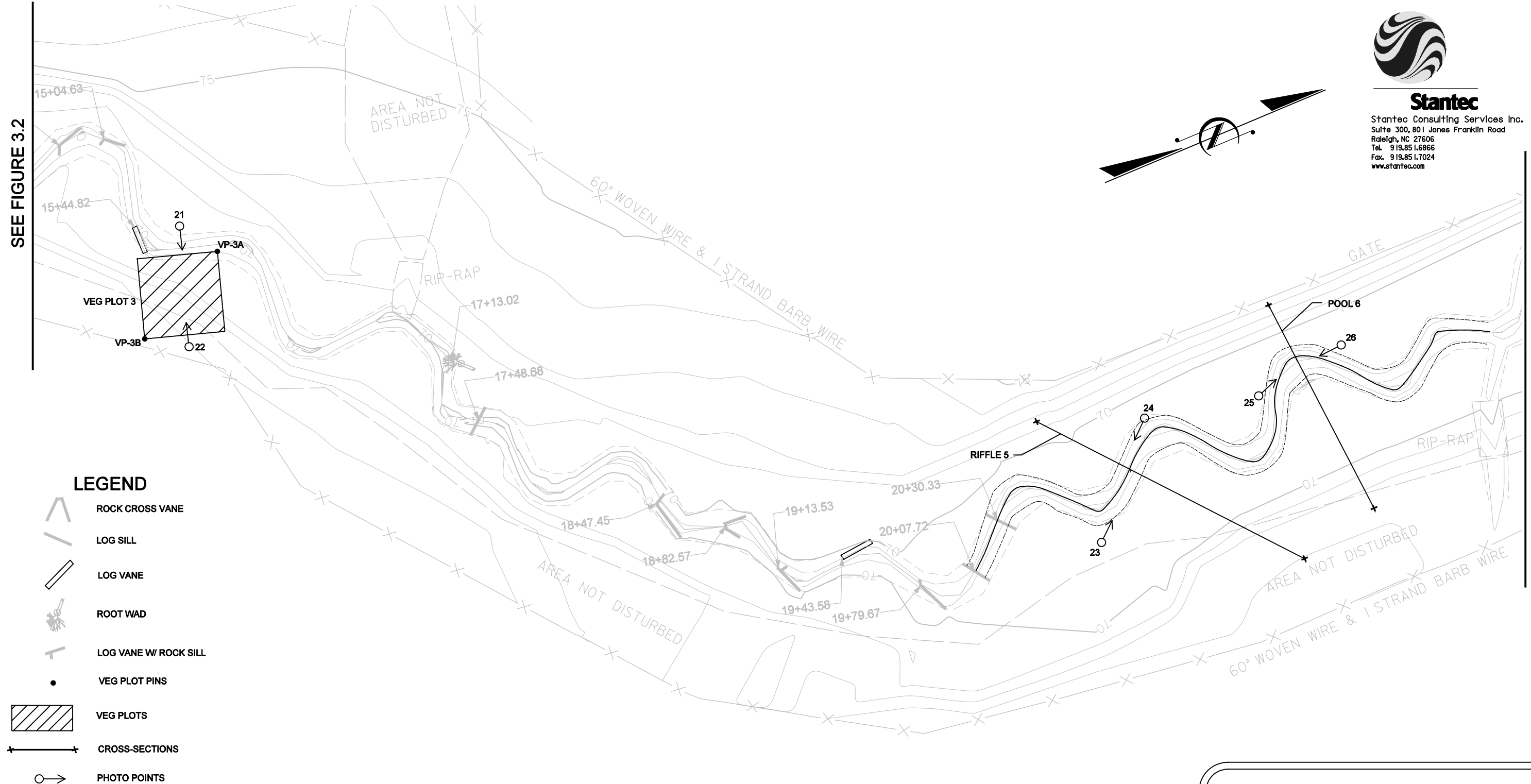
**Stantec**

Stantec Consulting Services Inc.  
 Suite 300, 801 Jones Franklin Road  
 Raleigh, NC 27606  
 Tel. 919.851.6866  
 Fax. 919.851.7024  
 www.stantec.com



SEE FIGURE 3.2

SEE FIGURE 3.4

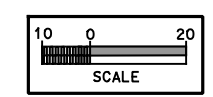
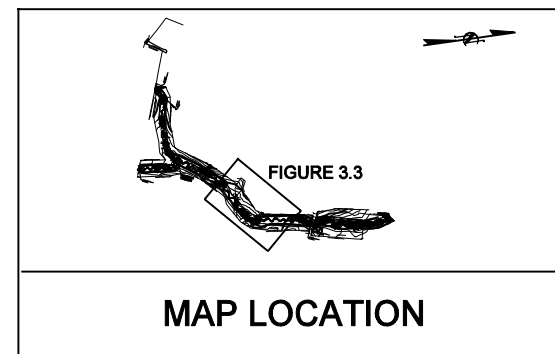


**LEGEND**

- ROCK CROSS VANE
- LOG SILL
- LOG VANE
- ROOT WAD
- LOG VANE W/ ROCK SILL
- VEG PLOT PINS
- VEG PLOTS
- CROSS-SECTIONS
- PHOTO POINTS

VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-3A	2075466.5710	171234.5650
VP-3B	2075445.3470	171275.3682

CROSS-SECTION	LEFT		RIGHT	
	X	Y	X	Y
RIFFLE 5	2075637.4170	171554.0230	2075730.5940	171632.4420
POOL 6	2075830.4130	171658.7970	2075722.6770	171666.2110



**UT TO Mill Branch**  
**SCO# : 02-06113-01A**

Monitoring  
 Columbus County, North Carolina

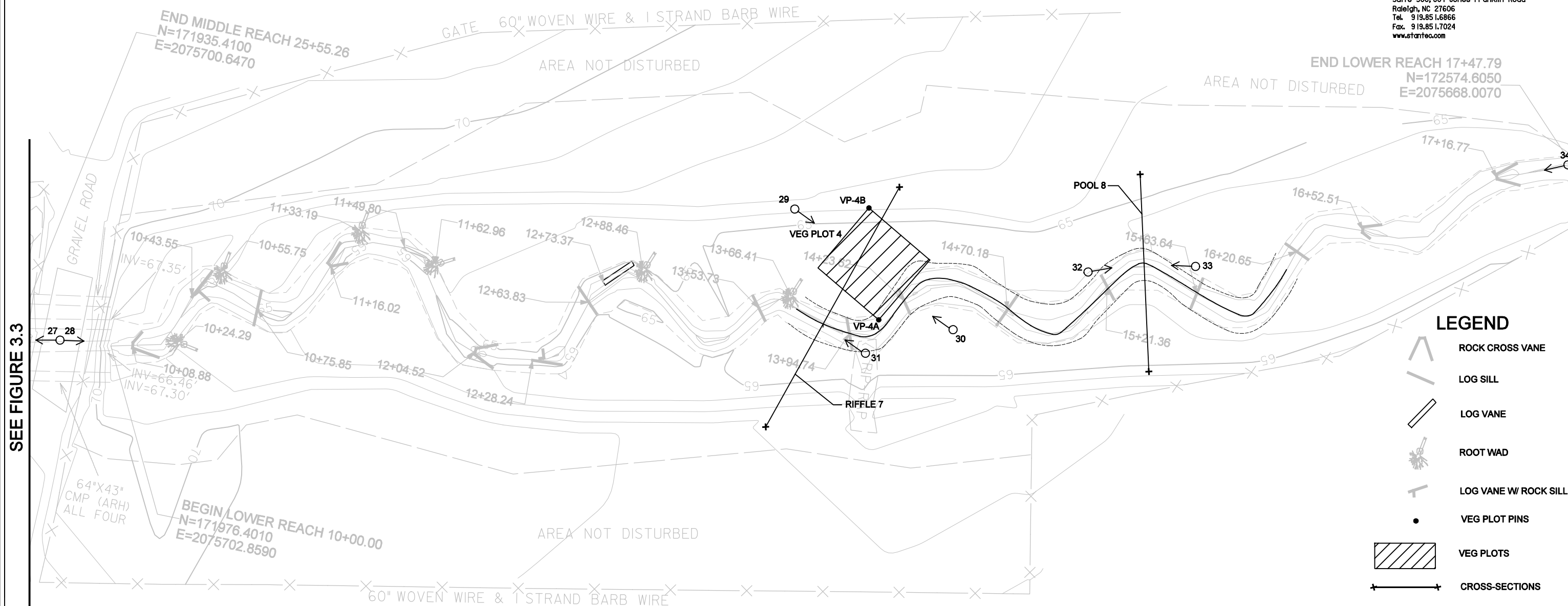
Monitoring Plan View

**Figure 3.3**



**Stantec**

Stantec Consulting Services Inc.  
Suite 300, 801 Jones Franklin Road  
Raleigh, NC 27606  
Tel. 919.851.6866  
Fax. 919.851.7024  
www.stantec.com



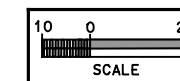
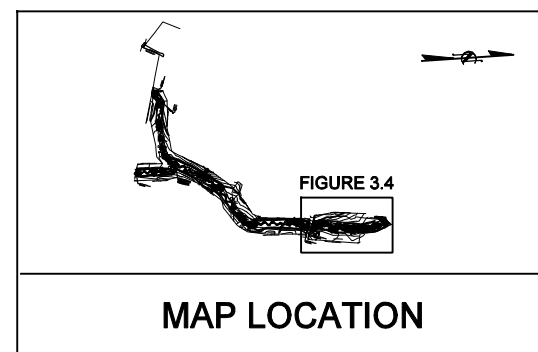
SEE FIGURE 3.3

**LEGEND**

- ROCK CROSS VANE
- LOG SILL
- LOG VANE
- ROOT WAD
- LOG VANE W/ ROCK SILL
- VEG PLOT PINS
- VEG PLOTS
- CROSS-SECTIONS
- PHOTO POINTS

VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-4A	2075668.9980	172287.9680
VP-4B	2075712.6850	172288.9580

CROSS-SECTION	CROSS-SECTION COORDINATES			
	LEFT		RIGHT	
	X	Y	X	Y
RIFFLE 7	2075659.3700	172300.9220	2075753.1770	172240.1770
POOL 8	2075660.5760	172399.0200	2075740.8880	172397.2830



**UT TO MILL BRANCH**  
**SCO# : 02-06113-01A**

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 100m<sup>2</sup> 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 October 4, 2007 the Year 1 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. All the vegetation plots are successful in Year 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. 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 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, Stantec did not measure flows with peak stage recorders. During the extreme drought this year it is unlikely that any of the reaches exhibited overbank flow. The streams have been dry during each monitoring visit.

<b>Exhibit Table V. Verification of Bankfull Events</b>			
<b>Mill Branch Stream Restoration Site/EEP Project No. 251</b>			
<b>Date of Data Collection</b>	<b>Date of Occurrence</b>	<b>Method</b>	<b>Photo*</b>
2007	None	NA	NA

### **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).

<b>Exhibit Table VI. BEHI and Sediment Export Estimates</b>
<b>Mill Branch Stream Restoration - EEP Project No. 251</b>
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: 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.

There was no water in the channel at the time of the geomorphic assessment. 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 Area Plan View in Appendix D.



2.2.5 Stability Assessment

<b>Exhibit Table VII-A. Categorical Stream Feature Visual Stability Assessment</b>						
<b>Mill Branch Stream Restoration Site/EEP Project No. 0251</b>						
Mill Branch Stream Restoration (3,507.5 l.f.)						
Western Reach						
<b>Feature</b>	<b>Initial</b>	<b>MY-01</b>	<b>MY-02</b>	<b>MY-03</b>	<b>MY-04</b>	<b>MY-05</b>
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				

<b>Exhibit Table VII-B. Categorical Stream Feature Visual Stability Assessment</b>						
<b>Mill Branch Stream Restoration Site/EEP Project No. 0251</b>						
Mill Branch Stream Restoration (3,507.5 l.f.)						
Upper Reach						
<b>Feature</b>	<b>Initial</b>	<b>MY-01</b>	<b>MY-02</b>	<b>MY-03</b>	<b>MY-04</b>	<b>MY-05</b>
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				

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

<b>Feature</b>	<b>Initial</b>	<b>MY-01</b>	<b>MY-02</b>	<b>MY-03</b>	<b>MY-04</b>	<b>MY-05</b>
A. Riffles	100%	100%				
B. Pools	100%	100%				
C. Thalweg	NA	NA				
D. Meanders	100%	96%				
E. Bed General	100%	100%				
F. Bank Condition	100%	99%				
G. Vanes / J Hooks, etc.	100%	93%				
H. Wads and Boulders	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		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																		
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)																0.093	0.1	0.097
d84 (mm)																0.27	0.4	0.335
Additional Reach																		
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			Cross Section 3			Cross Section 4			Cross Section 5			Cross Section 6		
Dimension	MY0	MY1		MY0	MY1		MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2
BF Width (ft)	6	8.7		11.7	11.2													
Floodprone Width (ft) (approx)	45	4.5		52	43													
BF Cross Sectional Area (ft <sup>2</sup> )	1.8	2.3		8.7	7.5													
BF Mean Depth (ft)	0.3	0.3		0.7	0.7													
BF Max Depth (ft)	0.6	0.6		1.7	1.3													
Width/Depth Ratio	33.5	19.80		15.7	16.7													
Entrenchment Ratio	7.5	5.2		4.4	3.8													
Wetted Perimeter (ft)	-	-		-	-													
Hydraulic radius (ft)	-	-		-	-													
<b>Substrate</b>																		
d50 (mm)		0.12			0.12													
d84 (mm)		0.26			0.26													
<b>Parameter</b>	<b>MY-00 (2007)</b>			<b>MY-01 (2007)</b>			<b>MY-02 (2008)</b>			<b>MY-03 (2009)</b>			<b>MY-04 (2010)</b>			<b>MY-05 (2011)</b>		
<b>Pattern</b>	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	16	26	20	15	25	19												
Radius of Curvature (ft)	8	15	11.3	7	16	11												
Meander Wavelength (ft)	32	42	36	31	44	37												
Meander Width Ratio	5.37	7.12	6.30	-	-	4.20												
<b>Profile</b>																		
Riffle Length (ft)	4	10	6	-	-	-												
Riffle Slope (ft)	0.0010	0.0100	0.0050	-	-	-												
Pool Length (ft)	8	23	12	-	-	-												
Pool Spacing (ft)	19	40	27	18	40	25												
<b>Additional Reach Parameters</b>																		
Valley Length (ft)		253.0																
Channel Length (ft)		304																
Sinosity		1.20																
Water Surface Slope (ft/ft)		0.00260																
BF Slope (ft/ft)		0.0027																
Rosgen Classification		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														
	MY0	MY1		MY0	MY1													
<b>Dimension</b>																		
BF Width (ft)	9.50	9.70		13.70	14.20													
Floodprone Width (ft) (approx)	88.00	93.00		77.00	75.00													
BF Cross Sectional Area (ft <sup>2</sup> )	5.20	5.10		15.50	16.60													
BF Mean Depth (ft)	0.60	0.50		1.10	1.20													
BF Max Depth (ft)	1.00	1.00		2.20	2.30													
Width/Depth Ratio	17.20	18.80		12.20	12.10													
Entrenchment Ratio	9.10	9.80		4.50	5.40													
Wetted Perimeter (ft)	-	-		-	-													
Hydraulic radius (ft)	-	-		-	-													
<b>Substrate</b>																		
d50 (mm)		0.09			0.09													
d84 (mm)		0.20			0.20													
Parameter	MY-00 (2007)			MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
<b>Pattern</b>																		
Channel Beltwidth (ft)	31	41	36	28	39	35												
Radius of Curvature (ft)	15	20	17	13	19	18												
Meander Wavelength (ft)	60	68	64	58	69	64												
Meander Width Ratio	8.00	4.00	6	-	-	7												
<b>Profile</b>																		
Riffle Length (ft)	7	17	13	-	-	-												
Riffle Slope (ft)	0.0010	0.0080	0.003	-	-	-												
Pool Length (ft)	10	23	18	-	-	-												
Pool Spacing (ft)	28	48	41	28	47	41.0												
<b>Additional Reach Parameters</b>																		
Valley Length (ft)		234			234													
Channel Length (ft)		299			299													
Sinosity		1.28			1.28													
Water Surface Slope (ft/ft)		0.00110			n/a													
BF Slope (ft/ft)		0.0011			0.0006													
Rosgen Classification		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														
	MY0	MY1		MY0	MY1													
<b>Dimension</b>																		
BF Width (ft)	10.80	11.80		17.00	16.90													
Floodprone Width (ft) (approx)	84.00	84.00		-	-													
BF Cross Sectional Area (ft <sup>2</sup> )	8.90	8.90		12.60	12.50													
BF Mean Depth (ft)	0.80	0.80		0.70	0.70													
BF Max Depth (ft)	1.80	1.70		2.20	2.20													
Width/Depth Ratio	13.60	15.60		22.90	22.80													
Entrenchment Ratio	7.80	7.20		-	-													
Wetted Perimeter (ft)	-	-		-	-													
Hydraulic radius (ft)	-	-		-	-													
<b>Substrate</b>																		
d50 (mm)		0.10			0.10													
d84 (mm)		0.23			0.23													
Parameter	MY-00 (2007)			MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
<b>Pattern</b>																		
Channel Beltwidth (ft)	37	37	37	35	39	38												
Radius of Curvature (ft)	17	24	20	17	24	20												
Meander Wavelength (ft)	77	86	82	75	85	82												
Meander Width Ratio	7.10	8.10	7.6	-	-	7.0												
<b>Profile</b>																		
Riffle Length (ft)	4	11	8	-	-	-												
Riffle Slope (ft)	0.0020	0.0100	0.004	-	-	-												
Pool Length (ft)	28	53	41	-	-	-												
Pool Spacing (ft)	18	20	19	17	24	20.0												
<b>Additional Reach Parameters</b>																		
Valley Length (ft)		201			201													
Channel Length (ft)		243			243													
Sinosity		1.21			1.21													
Water Surface Slope (ft/ft)		0.00360			-													
BF Slope (ft/ft)		0.0042			0.0042													
Rosgen Classification		C5			C5													
*Habitat Index																		
*Macrobenthos																		

### 3.0 References

---

Harrelson, C.C., C.L. Rawlins and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. United States Department of Agriculture, Fort Collins, CO.

NCEEP. 2006. Content, Format and Data Requirements for EEP Monitoring Reports. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, NC. Version 1.2 November 16, 2006.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.



## Appendix A. Vegetation Raw Data

### A.1 VEGETATION DATA TABLES

**EXHIBIT TABLE A1. VEGETATION METADATA**

<b>Report Prepared By</b>	Amber Coleman
<b>Date Prepared</b>	11/25/2007 17:42
<b>database name</b>	Stantec-Overhills_MillBranch-2007-A-v220-yr0-yr1.mdb
<b>database location</b>	U:\171300168
<b>computer name</b>	COLEMANA
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT</b>	
<b>Metadata</b>	This worksheet, which is a summary of the project and the project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems, for each year. This excludes live stakes and lists stems per acre.
<b>Proj, total stems</b>	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.
<b>Plots</b>	List of plots surveyed.
<b>Vigor</b>	Frequency distribution of vigor classes.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>Planted Stems by Plot and Spp</b>	Count of planted living stems of each species for each plot; dead and missing stems are excluded.
<b>PROJECT SUMMARY</b>	
<b>Project Code</b>	251
<b>project Name</b>	Mill Branch Stream Restoration
<b>Description</b>	Stream Restoration
<b>River Basin</b>	Lumber
<b>length(ft)</b>	
<b>stream-to-edge width (ft)</b>	
<b>area (sq m)</b>	
<b>Required Plots (calculated)</b>	
<b>Sampled Plots</b>	4

**EXHIBIT TABLE A2. VEGETATION VIGOR BY SPECIES**

	Species	4	3	2	1	0	Missing
	<i>Betula nigra</i>	1	1	1		3	
	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>		3	1	1	1	
	<i>Cephalanthus occidentalis</i>	1					
	<i>Cornus amomum</i>	2	4	3		3	
	<i>Liriodendron tulipifera</i> var. <i>tulipifera</i>			2		2	
	<i>Platanus occidentalis</i> var. <i>occidentalis</i>	1	1	1		1	
	<i>Quercus laurifolia</i>	1	1				
	<i>Quercus lyrata</i>	1	3	1			
	<i>Quercus nigra</i>	1					1
	<i>Quercus pagoda</i>		1				
	<i>Quercus phellos</i>		5			1	1
	<i>Salix sericea</i>		1	5	2	2	
	<i>Quercus</i> sp.					4	
<b>TOT:</b>	<b>13</b>	<b>8</b>	<b>20</b>	<b>14</b>	<b>3</b>	<b>17</b>	<b>2</b>

**EXHIBIT TABLE A3. VEGETATION DAMAGE BY SPECIES**

	Species	All Damage Categories (no damage)	Drought	Other/Unknown Animal	Unknown
	<i>Betula nigra</i>	6	2	4	
	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	6	3	3	
	<i>Cephalanthus occidentalis</i>	1	1		
	<i>Cornus amomum</i>	12	6	6	
	<i>Liriodendron tulipifera</i> var. <i>tulipifera</i>	4		4	
	<i>Platanus occidentalis</i> var. <i>occidentalis</i>	4	2	1	1
	<i>Quercus</i> sp.	4		4	
	<i>Quercus laurifolia</i>	2	2		
	<i>Quercus lyrata</i>	5	4	1	
	<i>Quercus nigra</i>	2	2		
	<i>Quercus pagoda</i>	1	1		
	<i>Quercus phellos</i>	7	5	1	1
	<i>Salix sericea</i>	10	1	7	1
<b>TOT:</b>	<b>13</b>	<b>64</b>	<b>29</b>	<b>31</b>	<b>2</b>

**EXHIBIT TABLE A4. VEGETATION DAMAGE BY PLOT**

Plot	All Damage Categories				Other/Unknown	Animal
	(no damage)	Drought	Unknown			
Mill Branc-ac-0001-year:1	14	8	6			
Mill Branc-ac-0002-year:1	16	5	10	1		
Mill Branc-ac-0003-year:1	18	6	9	1	2	
Mill Branc-ac-0004-year:1	16	10	6			
<b>TOT: 4</b>	<b>64</b>	<b>29</b>	<b>31</b>	<b>2</b>	<b>2</b>	

**EXHIBIT TABLE A5-A. STEM COUNT BY PLOT AND SPECIES**

Species	Total Planted Stems		avg# stems	plot	Mill Branc-ac-0001-year:1	plot	Mill Branc-ac-0002-year:1	plot	Mill Branc-ac-0003-year:1	plot	Mill Branc-ac-0004-year:1
	# plots										
<i>Betula nigra</i>	3	3	1	1	1	1					
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	5	3	1.67	2	1						2
<i>Cephalanthus occidentalis</i>	1	1	1								1
<i>Cornus amomum</i>	9	4	2.25	2	2	4					1
<i>Liriodendron tulipifera</i> var. <i>tulipifera</i>	2	1	2	2							
<i>Platanus occidentalis</i> var. <i>occidentalis</i>	3	3	1	1	1	1					
<i>Quercus laurifolia</i>	2	2	1		1						1
<i>Quercus lyrata</i>	5	3	1.67	1	3	1					
<i>Quercus nigra</i>	1	1	1								1
<i>Quercus pagoda</i>	1	1	1								1
<i>Quercus phellos</i>	5	2	2.5	2							3
<i>Salix sericea</i>	8	3	2.67		3	1					4
<b>TOT: 12</b>	<b>45</b>	<b>12</b>		<b>11</b>	<b>12</b>	<b>8</b>	<b>14</b>				

**Exhibit Table A5-B. As-Built and Year 1 Stem Counts by Plot  
Mill Branch Stream Restoration Project (0251)**

Common Name	Scientific Name	Source	Year 0 number	Year 1 number	Common Name	Scientific Name	Source	Year 0 number	Year 1 number
<b>Plot 1 (Western)</b>					<b>Plot 3 (Middle)</b>				
Silky dogwood	<i>Cornus amomum</i>	L	4	2	Silky dogwood	<i>Cornus amomum</i>	L	4	4
River Birch	<i>Betula nigra</i>	R	1	1	Silky willow	<i>Salix sericea</i>	R	3	1
Ironwood	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	R	2	2	River Birch	<i>Betula nigra</i>	R	4	1
Tulip Poplar	<i>Liriodendron tulipifera</i> var. <i>tulipifera</i>	R	2	2	Sycamore	<i>Platanus occidentalis</i> var. <i>occidentalis</i>	R	1	1
Sycamore	<i>Platanus occidentalis</i> var. <i>occidentalis</i>	R	1	1	Overcup Oak	<i>Quercus lyrata</i>	R	1	1
Overcup Oak	<i>Quercus lyrata</i>	R	1	1	Willow Oak	<i>Quercus phellos</i>	R	2	0
Willow Oak	<i>Quercus phellos</i>	R	2	2	Oak	<i>Quercus</i> sp.	R	3	0
Oak	<i>Quercus</i> sp.	R	1	0					
<b>Total Stems</b>			<b>14</b>	<b>11</b>	<b>Total Stems</b>			<b>18</b>	<b>8</b>
<b>Density (Stems / Acre)</b>			<b>567</b>	<b>445</b>	<b>Density (Stems / Acre)</b>			<b>728</b>	<b>324</b>
<b>Plot 2 (Upper)</b>					<b>Plot 4 (Lower)</b>				
Silky dogwood	<i>Cornus amomum</i>	L	2	2	Silky dogwood	<i>Cornus amomum</i>	L	2	1
Silky willow	<i>Salix sericea</i>	L	3	3	Silky willow	<i>Salix sericea</i>	L	4	4
River Birch	<i>Betula nigra</i>	R	1	1	Ironwood	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	R	3	2
Ironwood	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	R	1	1	Green Ash	<i>Fraxinus pennsylvanica</i>	R	1	1
Tulip Poplar	<i>Liriodendron tulipifera</i> var. <i>tulipifera</i>	R	2	0	Willow Oak	<i>Quercus phellos</i>	R	3	3
Sycamore	<i>Platanus occidentalis</i> var. <i>occidentalis</i>	R	2	1	Water Oak	<i>Quercus nigra</i>	R	1	1
Water Oak	<i>Quercus nigra</i>	R	1	0	Cherrybark Oak	<i>Quercus pagoda</i>	R	1	1
Overcup Oak	<i>Quercus lyrata</i>	R	4	4	Oak	<i>Quercus</i> sp.	R	1	1
<b>Total Stems</b>			<b>16</b>	<b>12</b>	<b>Total Stems</b>			<b>16</b>	<b>14</b>
<b>Density (Stems / Acre)</b>			<b>647</b>	<b>486</b>	<b>Density (Stems / Acre)</b>			<b>647</b>	<b>567</b>

\* Source: L = live stake; R = bare root

**Exhibit Table A6. Stream Problem Areas**  
**Mill Branch Stream Restoration Site/EEP Project No. 0251**  
 Mill Branch Stream Restoration (3,507.5 l.f.)

<b>Feature Issue</b>	<b>Reach</b>	<b>Station Number</b>	<b>Suspected Cause</b>	<b>Photo Number</b>
<b>Bare Area</b>	Upper	10+20	Poor planting/drought	VPA1, VPA2
	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	

## A.2 VEGETATION PROBLEM AREA PHOTOS



Photo VPA1: Bare area on left bank near Vegetation Plot 2



Photo VPA2: Bare area on floodplain near Middle Reach STA 20+30



### A.3 VEGETATION MONITORING PLOT PHOTOS



Photo Station 7 - Veg Plot 1 – looking north



Photo Station 8 - Veg Plot 1 – looking south





Photo Station 15 - Veg Plot 2 – looking northeast (October 4, 2007)



Photo Station 16 - Veg Plot 2 – looking west (November 28, 2007)





Photo Station 21 - Veg Plot 3 – looking east



Photo Station 22 - Veg Plot 3 – looking west





Photo Station 29 - Veg Plot 4 – looking northeast



Photo Station 30 - Veg Plot 4 – looking southwest

## Appendix B. Geomorphologic Raw Data

---

### B.1 PROBLEM AREA PLAN VIEW (STREAM)

Please see the Integrated Problem Area Plan View in Appendix D for stream problem areas.

### B.2 STREAM PROBLEM AREAS TABLE

<b>Exhibit Table B.1. Stream Problem Areas</b> <b>Mill Branch Stream Restoration Site/EEP Project No. 0251</b> Mill Branch Stream Restoration (3,507.5 l.f.)				
<b>Feature Issue</b>	<b>Reach</b>	<b>Station Number</b>	<b>Suspected Cause</b>	<b>Photo Number</b>
<b>Aggradation</b>	Middle	15+04	Too many structures in Pool	NA
<b>Scour</b>	Middle	24+61	Poor Structure Placement	SP1
	Lower	10+76	Too big of a drop across sill	
	Lower	11+16	Vane arm does not tie into bankfull	
	Lower	12+64	Too big of a drop across sill/placement	
	Lower	13+54	Too big of a drop across sill/placement	
<b>Floodplain rill erosion</b>	Lower	12+85	Floodplain Grading	SP2
<b>Piping</b>	Middle	17+49	Too big of a drop across sill	SP3
	Middle	24+88	Poor Structure Installation	



### B.3 REPRESENTATIVE STREAM PROBLEM AREAS PHOTOS



SP 1. Example of scour (STA 12+63)



SP 2. Rill erosion (left bank STA 12+88)



SP 3. Example of piping around a structure (STA 17+48)



#### B.4 STREAM PHOTO STATION PHOTOS



Photo Station 1. Beginning of Western Reach – Upstream  
*(Note: Locations of stations are shown in section 1.5)*



Photo Station 2. Beginning of Western Reach – Downstream



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



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





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



Photo Station 6. Pool Cross-section 2 – Upstream – Western Reach





Photo Station 9. Beginning of Upper Reach - Upstream



Photo Station 10. Beginning of Upper Reach - Downstream





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



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





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



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





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



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





Photo Station 19. Ford Crossing – Downstream – Middle Reach



Photo Station 20. Ford Crossing – Upstream – Middle Reach





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



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





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



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





Photo Station 27. Road Crossing – Upstream – Looking at Middle Reach



Photo Station 28. Road Crossing – Downstream – Looking at Lower Reach





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



Photo Station 32. Pool Cross-section 8 – Downstream – Lower Reach





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



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

## B.5 QUALITATIVE VISUAL STABILITY ASSESSMENT

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 appropriate?	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	100
F. Bank	1. Actively eroding, wasting, or slumping bank?	1765	1765	0.00	100.00	100
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 appropriate?	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 appropriate?	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 appropriate?	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

# B6. CROSS SECTION PLOTS

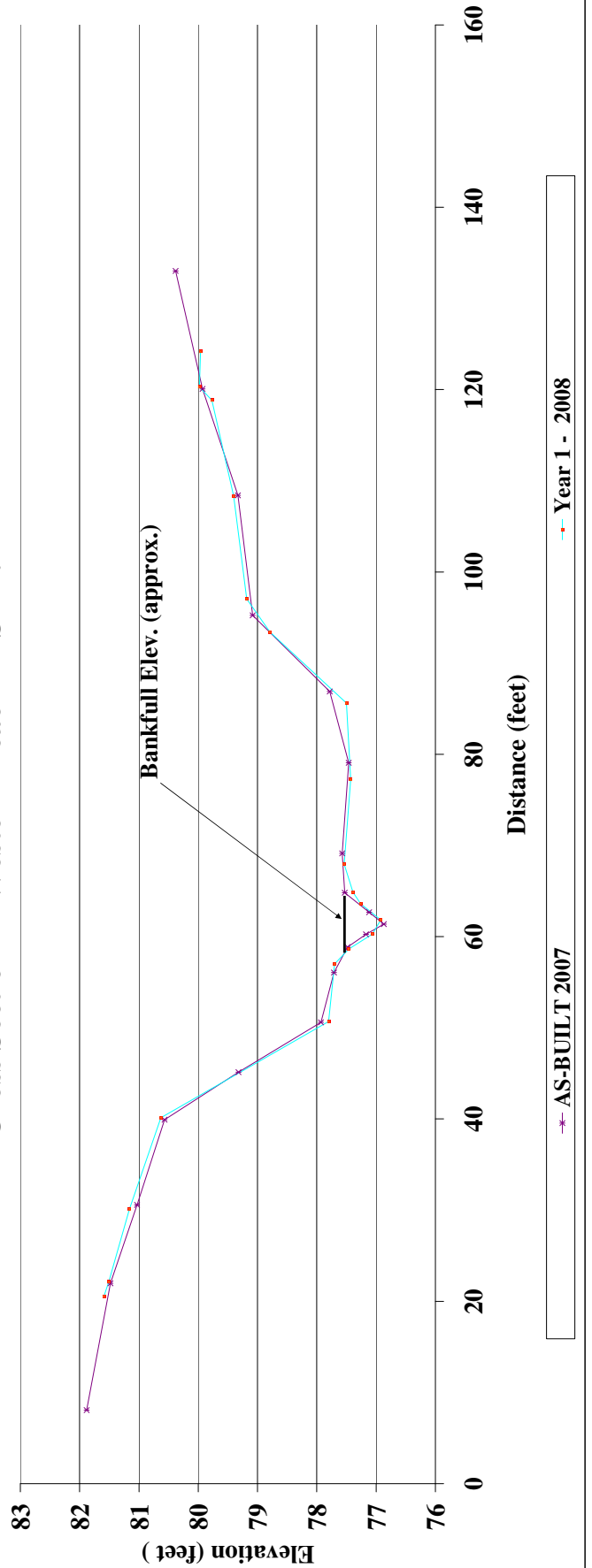
Project Name Mill Branch Cross-Section 1 - Western Reach		Year 4 - 2011 Station      Elevation      Notes		Year 3 - 2010 Station      Elevation      Notes		Year 2 - 2009 Station      Elevation      Notes		Year 1 - 2008 Station      Elevation      Notes		AS-BUILT 2007 Station      Elevation      Notes	
Feature Riffle	Date 3/27/07										
Crew Jean, Green, Myers											



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

Area	Year 5 - 2012	Year 4 - 2011	Year 3 - 2010	Year 2 - 2009	Year 1 - 2008	AS-BUILT 2007
Width					8.7	6.6
Mean Depth					0.3	0.3
Max Depth					0.6	0.6
W/D					33.5	19.8

## Mill Branch 2007 - Riffle Cross Section 1- Western Reach STA: 12+12









Project Name: Mill Branch  
 Cross Section: Cross-Section 3 - Upper Reach  
 Feature: Pool  
 Date: 3/27/07  
 Crew: Jean, Green, Myers

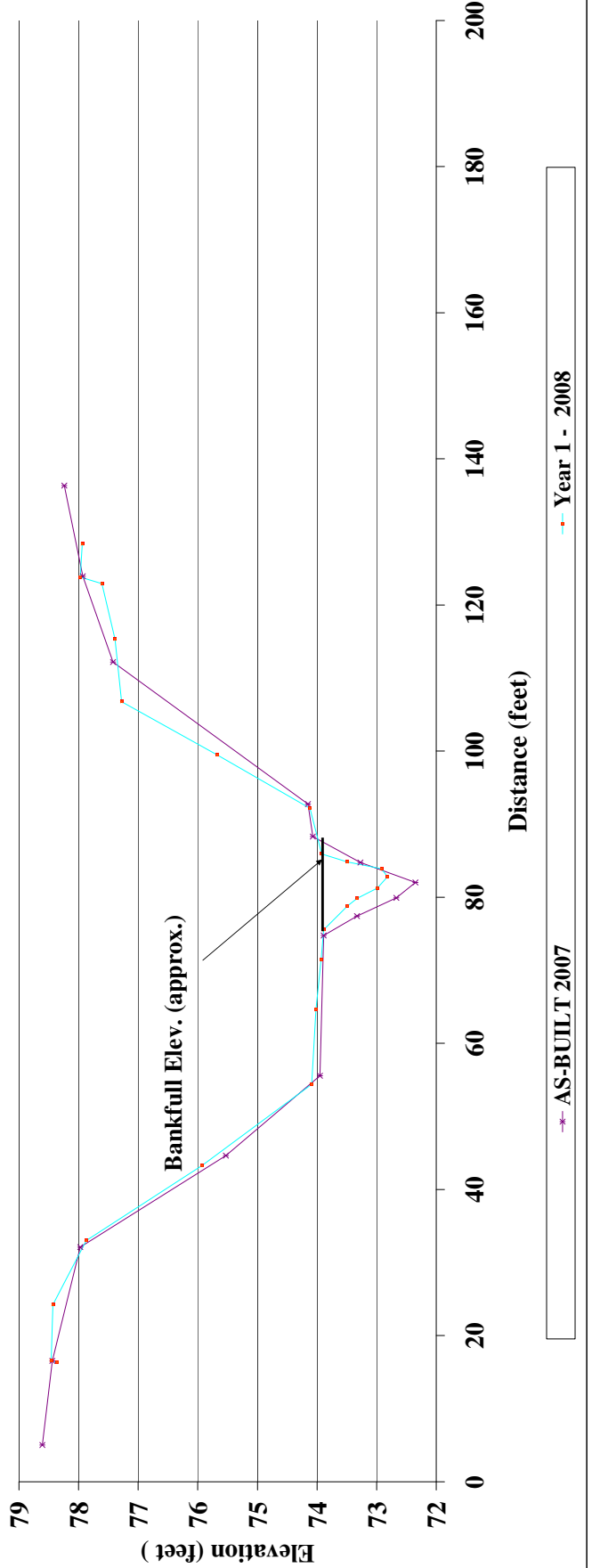
Year 5 - 2012	Year 4 - 2011	Year 3 - 2010	Year 2 - 2009	Year 1 - 2008	AS-BUILT 2007
Station	Station	Station	Station	Station	Station
Elevation	Elevation	Elevation	Elevation	Elevation	Elevation
Notes	Notes	Notes	Notes	Notes	Notes
16.37	16.37	16.37	16.37	16.37	5.0
78.36	78.36	78.36	78.36	78.36	78.6
78.46	78.46	78.46	78.46	78.46	78.5
78.84	78.84	78.84	78.84	78.84	79.07
77.87	77.87	77.87	77.87	77.87	75.5
75.93	75.93	75.93	75.93	75.93	74.0
74.09	74.09	74.09	74.09	74.09	73.9
74.02	74.02	74.02	74.02	74.02	73.3
73.89	73.89	73.89	73.89	73.89	72.4
73.49	73.49	73.49	73.49	73.49	72.7
73.33	73.33	73.33	73.33	73.33	72.4
73.89	73.89	73.89	73.89	73.89	73.3
74.1	74.1	74.1	74.1	74.1	73.3
74.2	74.2	74.2	74.2	74.2	73.3
75.89	75.89	75.89	75.89	75.89	73.3
72.8	72.8	72.8	72.8	72.8	73.3
72.92	72.92	72.92	72.92	72.92	73.3
73.49	73.49	73.49	73.49	73.49	73.3
73.92	73.92	73.92	73.92	73.92	73.3
74.12	74.12	74.12	74.12	74.12	73.3
75.67	75.67	75.67	75.67	75.67	73.3
77.28	77.28	77.28	77.28	77.28	73.3
77.39	77.39	77.39	77.39	77.39	73.3
77.61	77.61	77.61	77.61	77.61	73.3
77.97	77.97	77.97	77.97	77.97	73.3
77.94	77.94	77.94	77.94	77.94	73.3



Photo of Cross-Section 1 - Looking Downstream @ STA 11+12

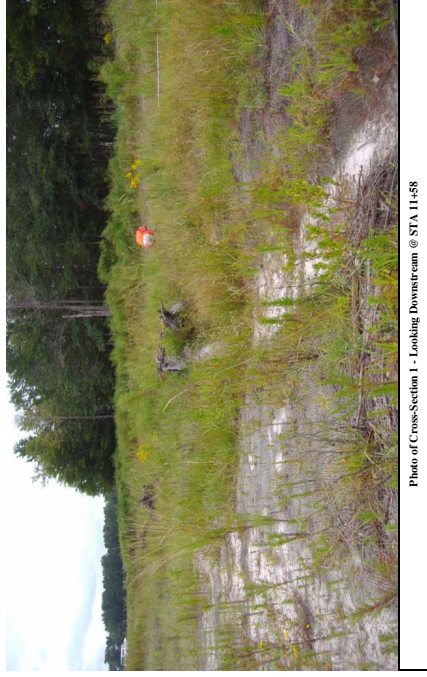
Year 5 - 2012	Year 4 - 2011	Year 3 - 2010	Year 2 - 2009	Year 1 - 2008	AS-BUILT 2007
Area	1.4	1.4	1.4	1.4	1.4
Width	1.1	1.1	1.1	1.1	1.27
Mean Depth	0.5	0.5	0.5	0.5	0.8
Max Depth	1.1	1.1	1.1	1.1	1.5
W/D	21.2	21.2	21.2	21.2	16.6

## Mill Branch 2007 - Pool Cross Section 3 - Upper Reach STA: 11+12



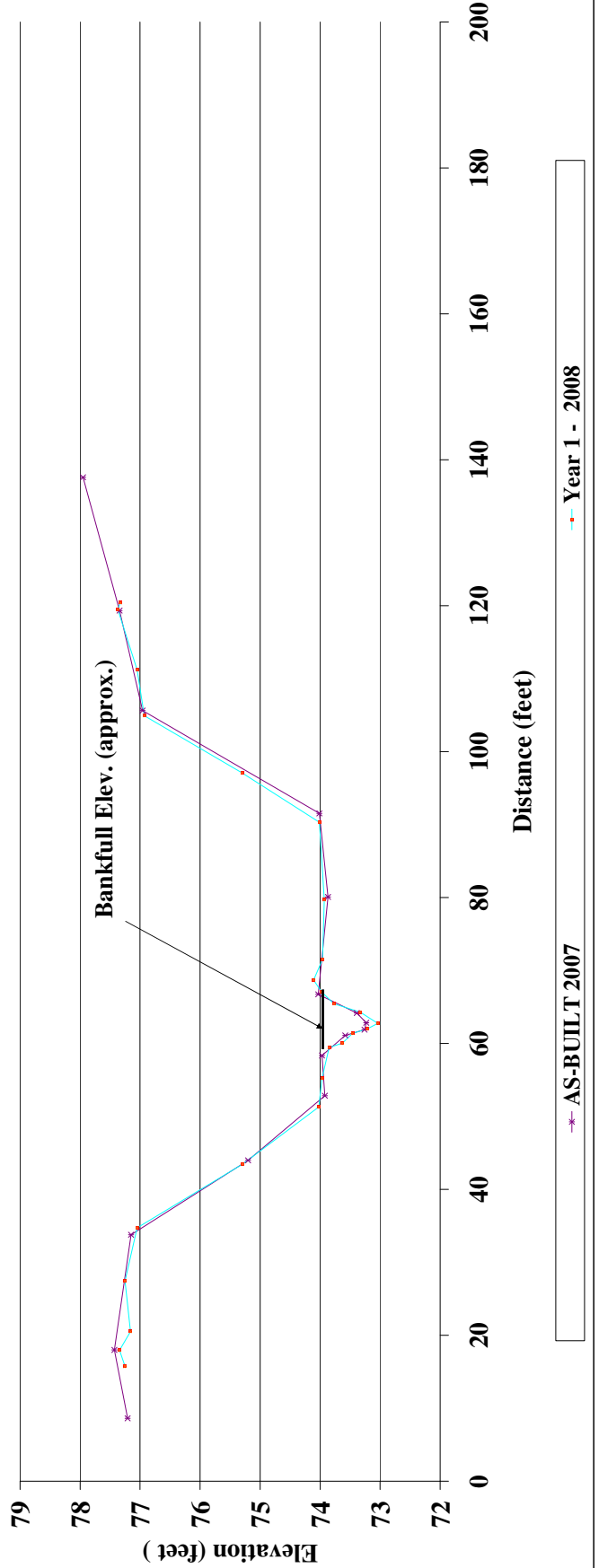
Project Name: Mill Branch  
 Cross Section: Cross-Section 4 - Upper Reach  
 Feature: Riffle  
 Date: 3/27/07  
 Crew: Jean, Green, Myers

Year 5 - 2012	Year 4 - 2011	Year 3 - 2010	Year 2 - 2009	Year 1 - 2008	AS-BUILT 2007
Station	Station	Station	Station	Station	Station
Elevation	Elevation	Elevation	Elevation	Elevation	Elevation
Notes	Notes	Notes	Notes	Notes	Notes
8.63	15.71	17.26	17.26	17.26	77.21
33.76	17.67	17.67	17.67	17.67	LPN
43.99	20.51	20.51	20.51	20.51	
52.83	27.45	27.45	27.45	27.45	
58.36	34.71	34.71	34.71	34.71	LBRKF
61.09	43.48	43.48	43.48	43.48	
61.89	51.28	51.28	51.28	51.28	
62.82	55.19	55.19	55.19	55.19	
64.17	59.44	59.44	59.44	59.44	
66.74	60.02	60.02	60.02	60.02	RBRKF
67.40	61.89	61.89	61.89	61.89	
68.01	62.01	62.01	62.01	62.01	
68.55	62.76	62.76	62.76	62.76	
68.55	64.31	64.31	64.31	64.31	RPN
68.55	65.45	65.45	65.45	65.45	
68.55	67.1	67.1	67.1	67.1	
68.55	68.7	68.7	68.7	68.7	
68.55	71.52	71.52	71.52	71.52	
68.55	73.96	73.96	73.96	73.96	
68.55	79.67	79.67	79.67	79.67	
68.55	90.3	90.3	90.3	90.3	
68.55	97.1	97.1	97.1	97.1	
68.55	104.9	104.9	104.9	104.9	
68.55	112.4	112.4	112.4	112.4	
68.55	119.5	119.5	119.5	119.5	
68.55	120.4	120.4	120.4	120.4	
68.55	74.0	74.0	74.0	74.0	



AS-BUILT 2007	Year 1 - 2008	Year 2 - 2009	Year 3 - 2010	Year 4 - 2011	Year 5 - 2012
Mean Width	8.2				
Mean Depth	8.4				
Max Depth	0.4				
W/D	0.9				
	18.9				
	20.6				

## Mill Branch 2007 - Riffle Cross Section 4 - Upper Reach STA: 11+58









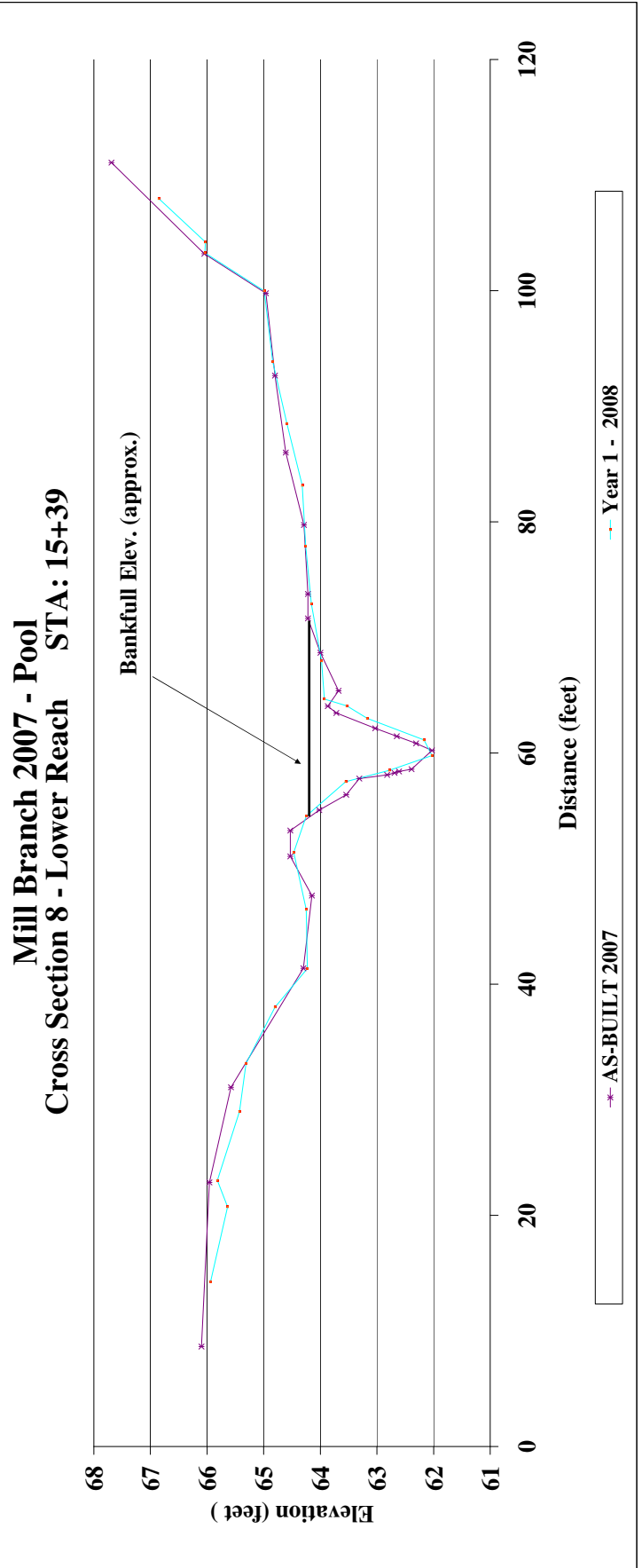
Project Name Mill Branch Cross Section 8 - Lower Reach	
Feature Pool	Date 3/27/07
Crew Jean, Greene, Myers	
Year 5 - 2012 2011 Survey Station Elevation Notes	Year 4 - 2011 2010 Survey Station Elevation Notes
Year 1 - 2008 2007 Survey Station Elevation Notes	Year 2 - 2009 2008 Survey Station Elevation Notes
Year 3 - 2010 2009 Survey Station Elevation Notes	Year 4 - 2011 2010 Survey Station Elevation Notes
Year 5 - 2012 2011 Survey Station Elevation Notes	Year 6 - 2012 2011 Survey Station Elevation Notes



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

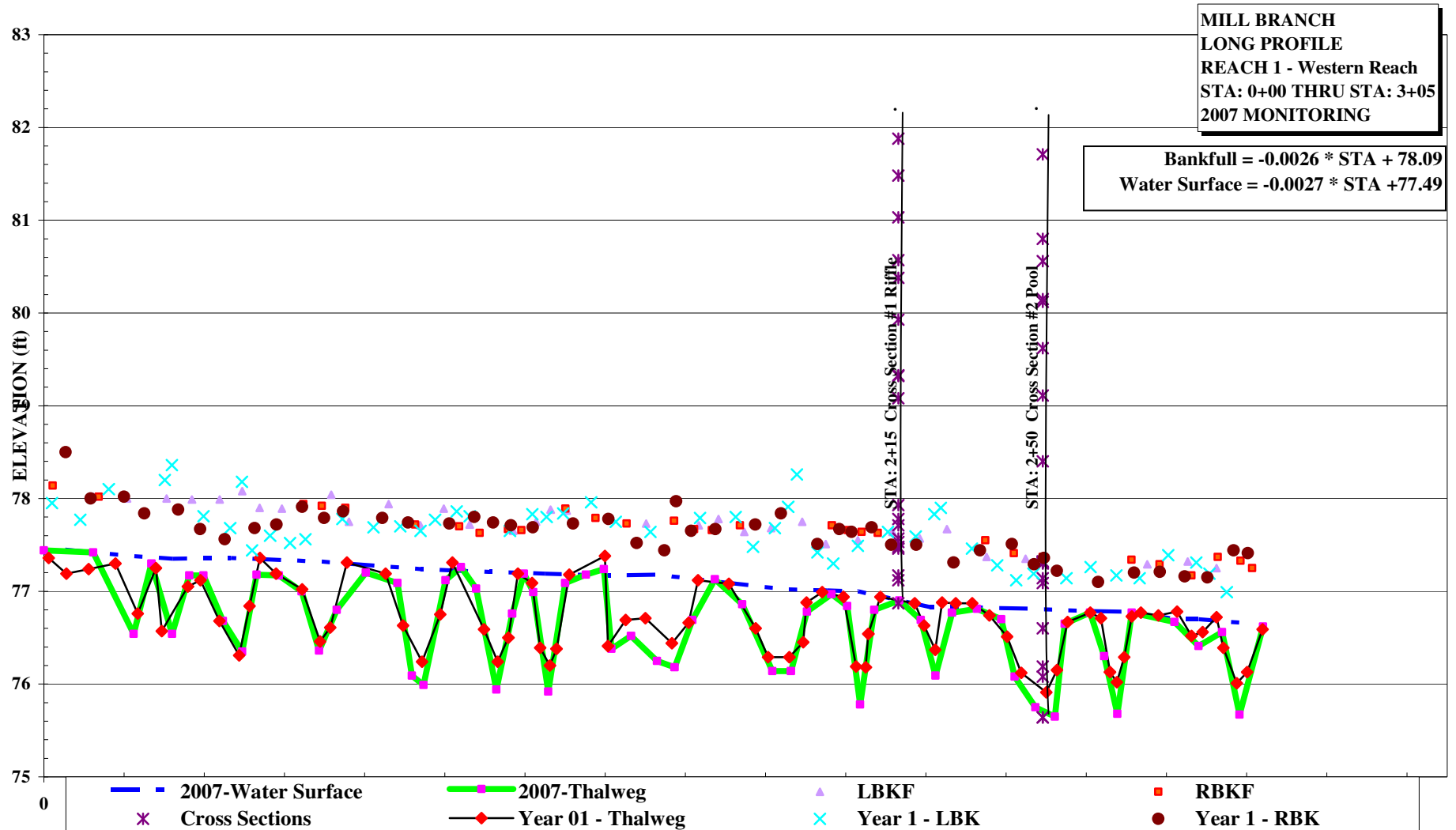
Area	Year 5 - 2012	Year 4 - 2011	Year 3 - 2010	Year 2 - 2009	Year 1 - 2008	AS-BUILT 2007
Width					12.5	12.6
Mean Depth					16.9	17.0
Max Depth					2.2	2.2
W/D					22.8	22.9

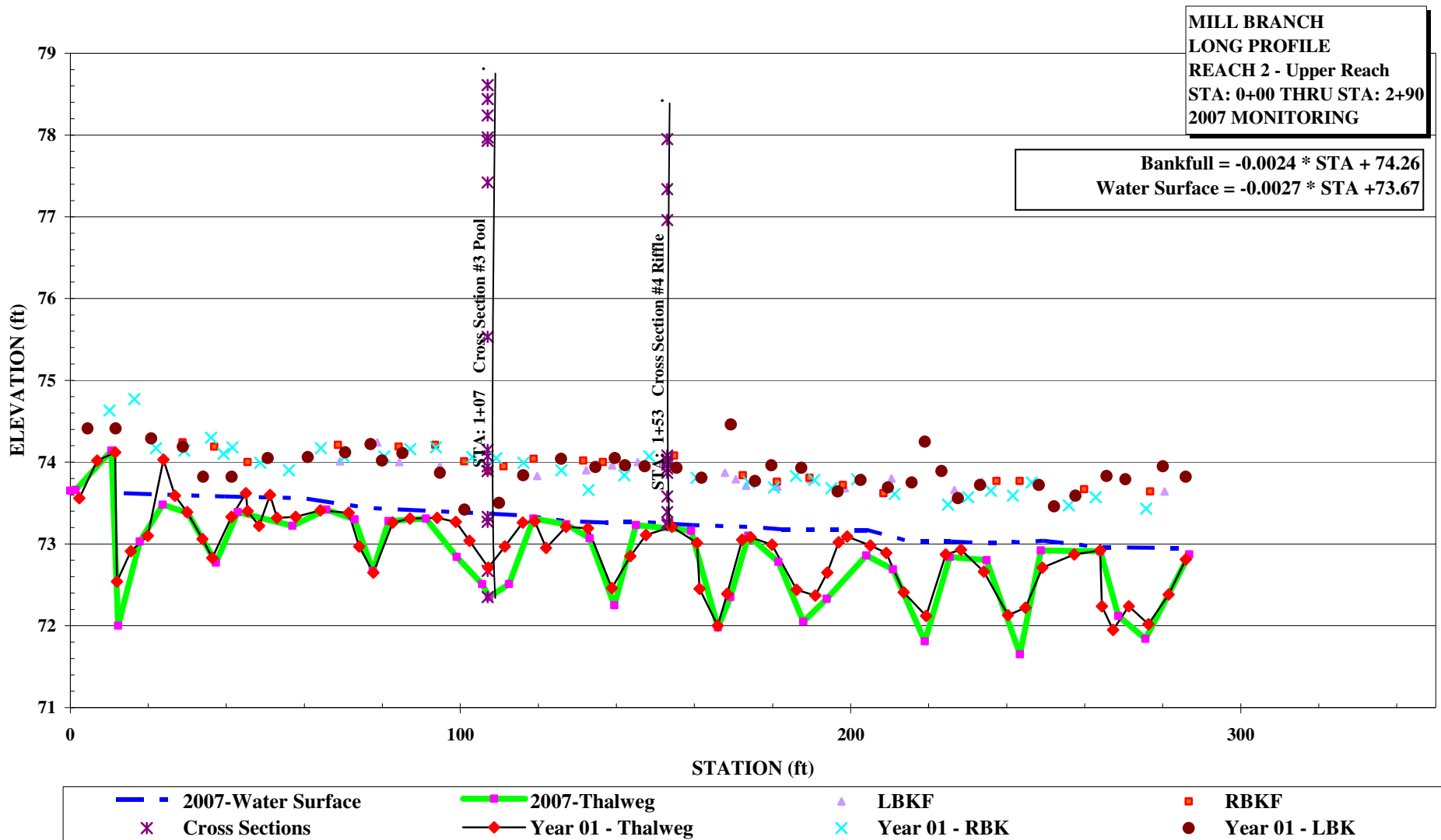
Year 1 - 2008 2007 Survey Station Elevation Notes	Year 2 - 2009 2008 Survey Station Elevation Notes	Year 3 - 2010 2009 Survey Station Elevation Notes	Year 4 - 2011 2010 Survey Station Elevation Notes	AS-BUILT 2007 AS-BUILT Survey Station Elevation Notes
14.25 65.94	14.25 65.94			8.7 66.0
20.74 65.64	20.74 65.64			22.9 66.0
23.03 65.82	23.03 65.82			31.1 65.58
29 65.43	29 65.43			41.4 64.3
33.14 65.31	33.14 65.31			47.7 64.2
38 64.8	38 64.8			51.1 64.5
41 64.2	41 64.2			53.5 64.2
46.47 64.25	46.47 64.25			55.1 64.0
51.39 64.47	51.39 64.47			56.4 63.5
54.54 64.25	54.54 64.25			57.8 63.3
57.52 63.55	57.52 63.55			58.1 62.8
58.51 62.78	58.51 62.78			58.3 62.7
59.77 62.03	59.77 62.03			58.4 62.6
61.15 61.7	61.15 61.7			60.2 62.0
63 63.17	63 63.17			60.2 62.0
64.09 63.53	64.09 63.53			60.8 62.31
64.67 63.93	64.67 63.93			61.5 62.7
67.97 63.88	67.97 63.88			62.1 63.0
72.93 64.16	72.93 64.16			63.5 63.7
77.92 64.26	77.92 64.26			64.1 63.9
83.14 64.32	83.14 64.32			65.4 63.7
85.51 64.3	85.51 64.3			65.7 63.0
89.85 64.84	89.85 64.84			71.6 64.2
99.97 64.89	99.97 64.89			73.8 64.2
103.26 66.04	103.26 66.04			79.7 64.3
104.2 66.03	104.2 66.03			86.0 64.6
107.95 66.85	107.95 66.85			92.7 64.8
				99.8 65.0
				105.2 66.1
				111.1 67.7



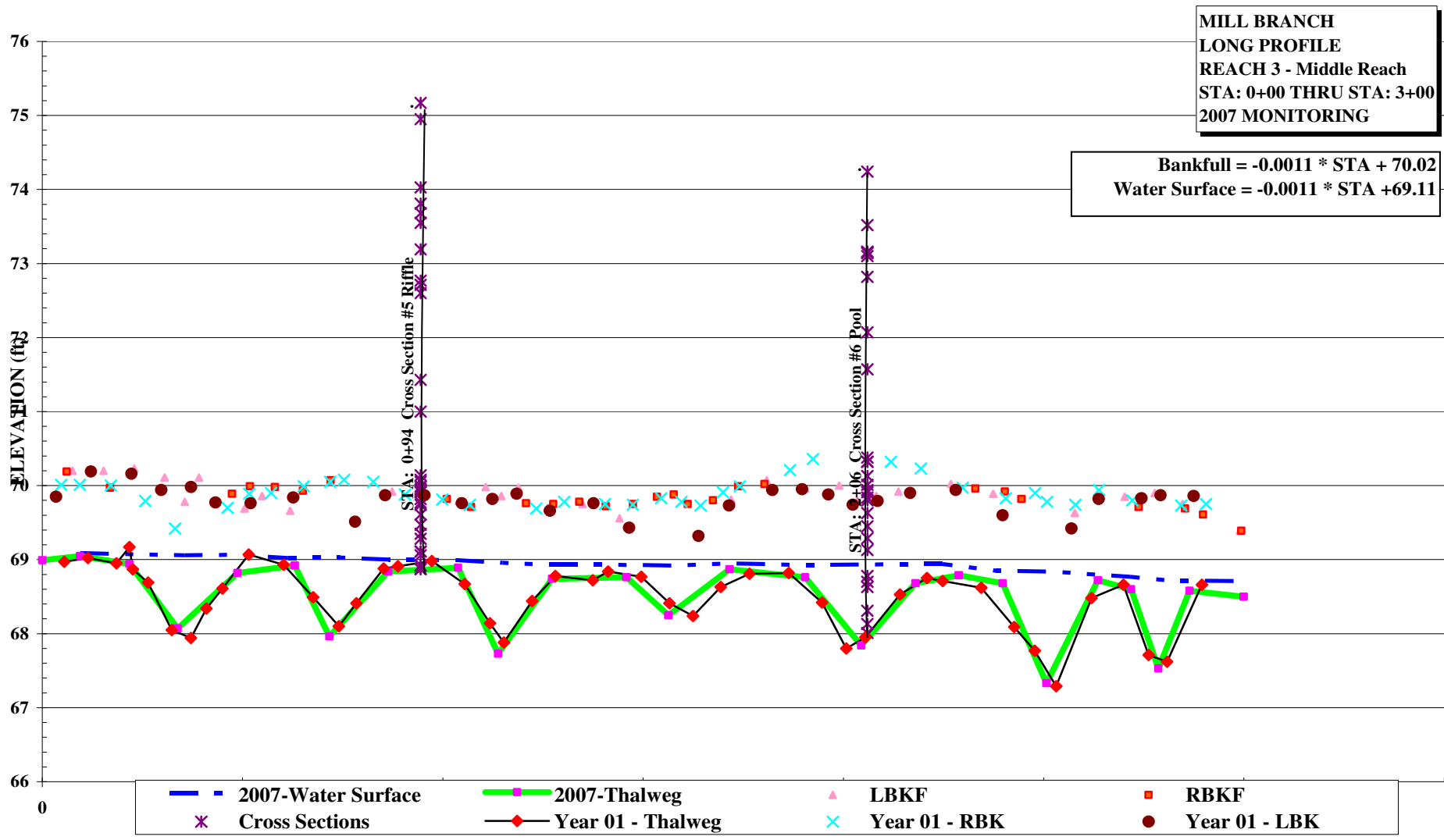


## B.7 LONGITUDINAL PLOTS



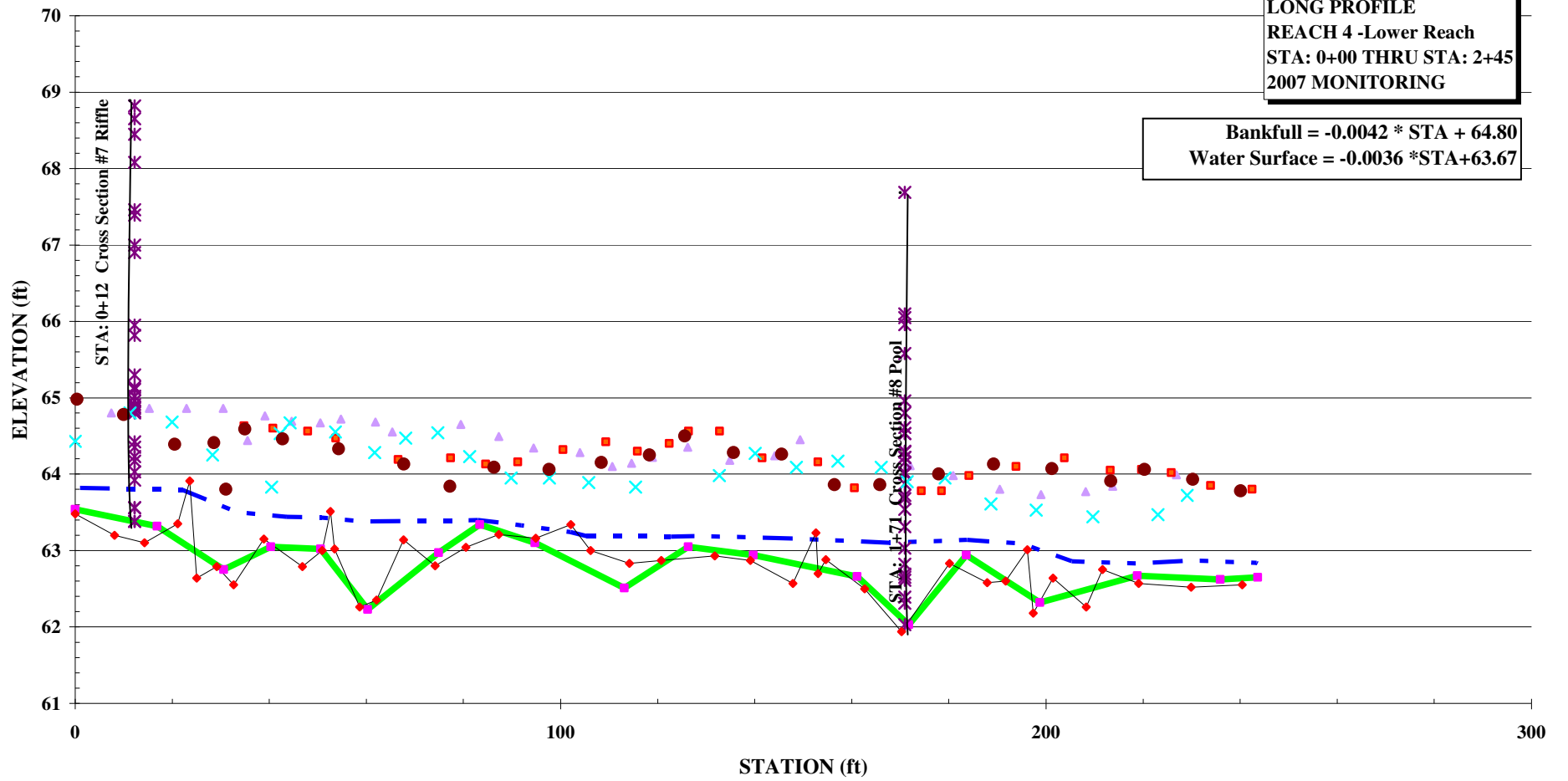






**MILL BRANCH  
LONG PROFILE  
REACH 4 -Lower Reach  
STA: 0+00 THRU STA: 2+45  
2007 MONITORING**

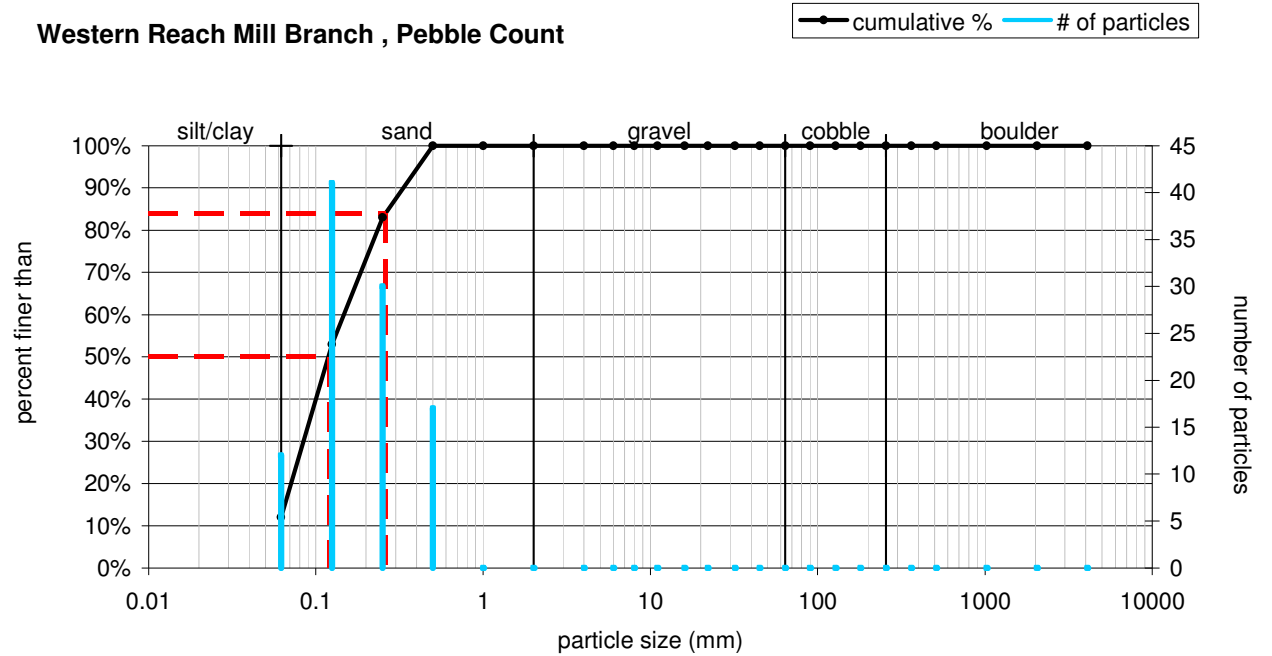
**Bankfull =  $-0.0042 * STA + 64.80$   
Water Surface =  $-0.0036 * STA + 63.67$**



## B.8 PEBBLE COUNT DISTRIBUTION

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	12
very fine sand	0.062 - 0.125	41
fine sand	0.125 - 0.25	30
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	0
coarse gravel	16 - 22	0
coarse gravel	22 - 32	0
very coarse gravel	32 - 45	0
very coarse gravel	45 - 64	0
small cobble	64 - 90	0
medium cobble	90 - 128	0
large cobble	128 - 180	0
very large cobble	180 - 256	0
small boulder	256 - 362	0
small boulder	362 - 512	0
medium boulder	512 - 1024	0
large boulder	1024 - 2048	0
very large boulder	2048 - 4096	0
total particle count:		100
bedrock	-----	
clay hardpan	-----	
detritus/wood	-----	
artificial	-----	
total count:		100
Note: Western Reach Mill Branch		

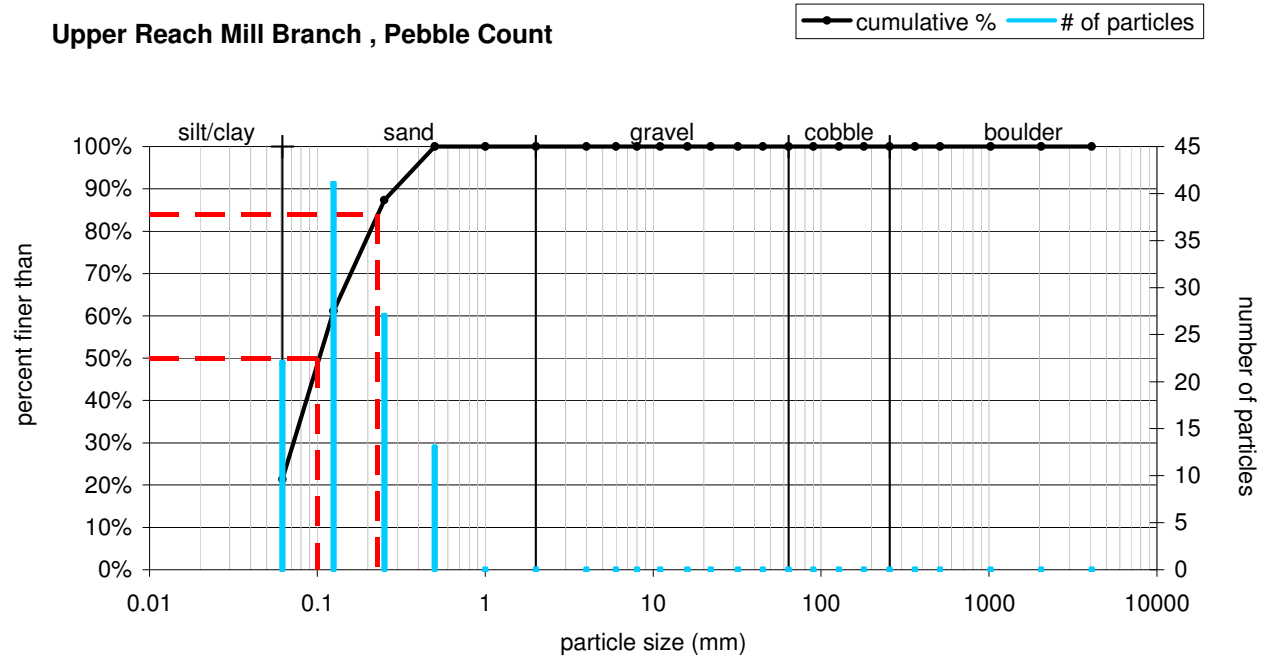
Western Reach Mill Branch , Pebble Count



Size (mm)		Size Distribution		Type	
D16	0.066	mean	0.1	silt/clay	12%
D35	0.092	dispersion	2.0	sand	88%
D50	0.12	skewness	0.05	gravel	0%
D65	0.16			cobble	0%
D84	0.26			boulder	0%
D95	0.41				

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	22
very fine sand	0.062 - 0.125	41
fine sand	0.125 - 0.25	27
medium sand	0.25 - 0.5	13
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	0
coarse gravel	16 - 22	0
coarse gravel	22 - 32	0
very coarse gravel	32 - 45	0
very coarse gravel	45 - 64	0
small cobble	64 - 90	0
medium cobble	90 - 128	0
large cobble	128 - 180	0
very large cobble	180 - 256	0
small boulder	256 - 362	0
small boulder	362 - 512	0
medium boulder	512 - 1024	0
large boulder	1024 - 2048	0
very large boulder	2048 - 4096	0
total particle count:		103
bedrock	-----	
clay hardpan	-----	
detritus/wood	-----	
artificial	-----	
total count:		103
Note: Upper Reach Mill Branch		

Upper Reach Mill Branch , Pebble Count

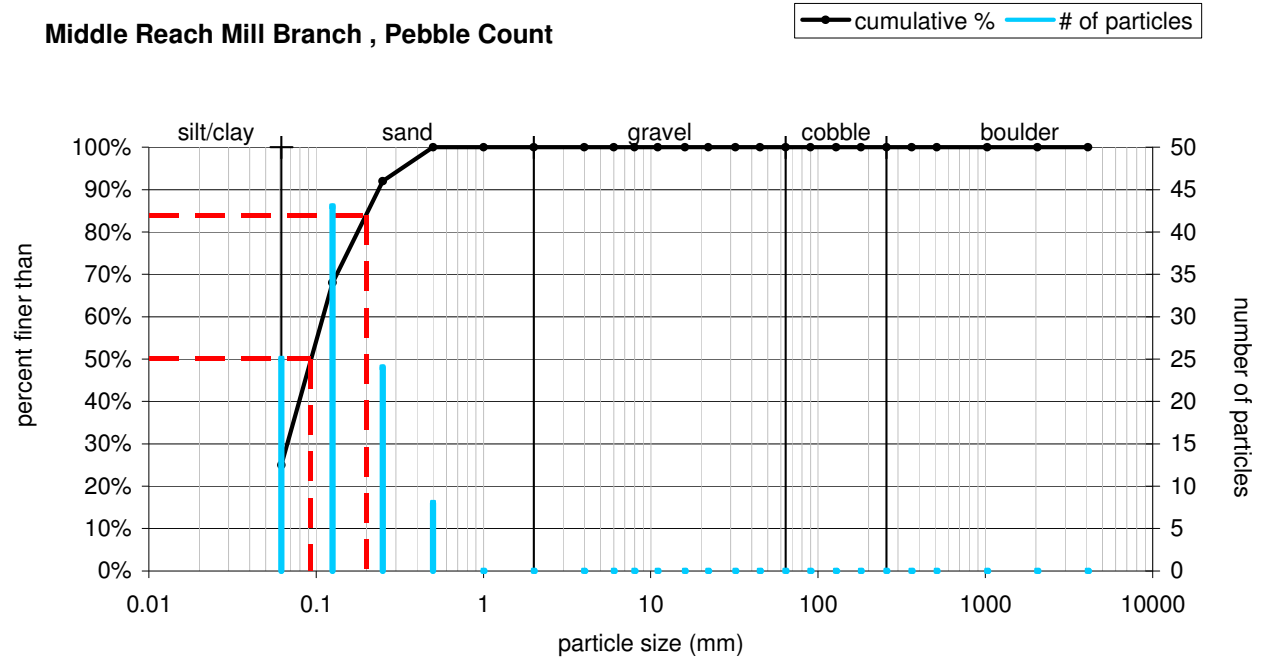


Size (mm)		Size Distribution		Type	
D16	0.062	mean	0.1	silt/clay	21%
D35	0.079	dispersion	2.0	sand	79%
D50	0.1	skewness	0.10	gravel	0%
D65	0.14			cobble	0%
D84	0.23			boulder	0%
D95	0.38				



Material	Size Range (mm)	Count
silt/clay	0 - 0.062	25
very fine sand	0.062 - 0.125	43
fine sand	0.125 - 0.25	24
medium sand	0.25 - 0.5	8
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	0
coarse gravel	16 - 22	0
coarse gravel	22 - 32	0
very coarse gravel	32 - 45	0
very coarse gravel	45 - 64	0
small cobble	64 - 90	0
medium cobble	90 - 128	0
large cobble	128 - 180	0
very large cobble	180 - 256	0
small boulder	256 - 362	0
small boulder	362 - 512	0
medium boulder	512 - 1024	0
large boulder	1024 - 2048	0
very large boulder	2048 - 4096	0
total particle count:		100
bedrock	-----	
clay hardpan	-----	
detritus/wood	-----	
artificial	-----	
total count:		100
Note: Middle Reach Mill Branch		

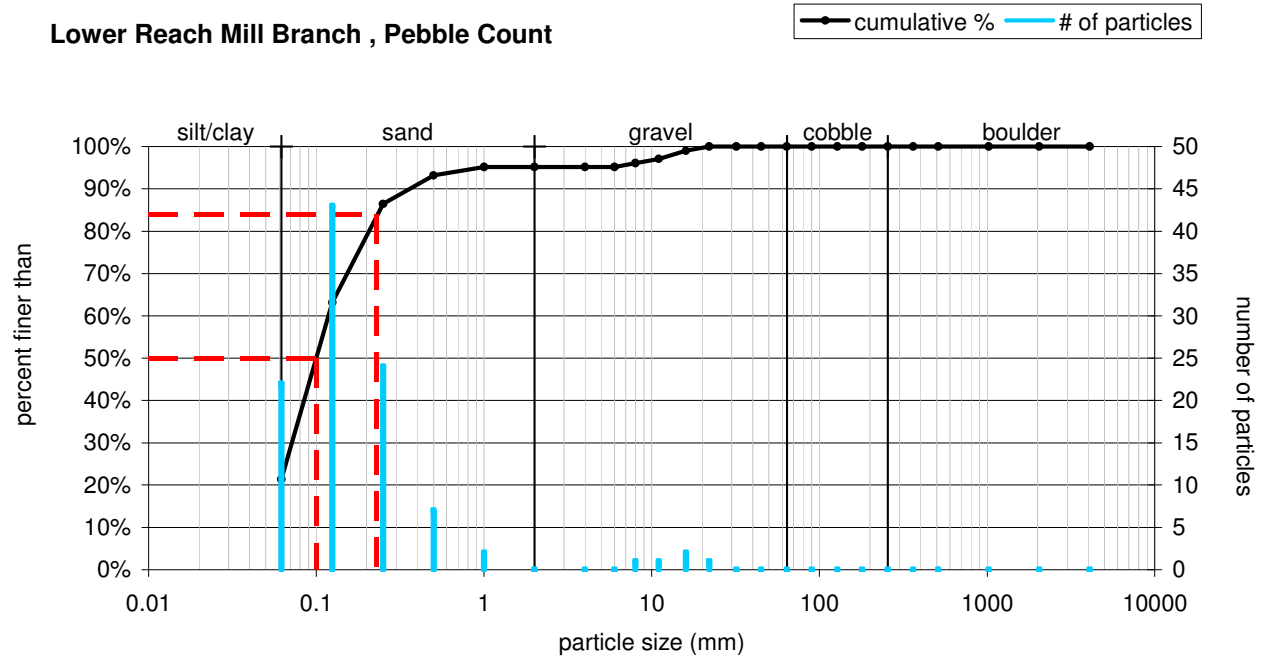
**Middle Reach Mill Branch , Pebble Count**



Size (mm)		Size Distribution		Type	
D16	0.062	mean	0.1	silt/clay	25%
D35	0.073	dispersion	1.8	sand	75%
D50	0.093	skewness	0.11	gravel	0%
D65	0.12			cobble	0%
D84	0.2			boulder	0%
D95	0.32				

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	22
very fine sand	0.062 - 0.125	43
fine sand	0.125 - 0.25	24
medium sand	0.25 - 0.5	7
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	1
medium gravel	8 - 11	1
medium gravel	11 - 16	2
coarse gravel	16 - 22	1
coarse gravel	22 - 32	0
very coarse gravel	32 - 45	0
very coarse gravel	45 - 64	0
small cobble	64 - 90	0
medium cobble	90 - 128	0
large cobble	128 - 180	0
very large cobble	180 - 256	0
small boulder	256 - 362	0
small boulder	362 - 512	0
medium boulder	512 - 1024	0
large boulder	1024 - 2048	0
very large boulder	2048 - 4096	0
total particle count:		103
bedrock	-----	
clay hardpan	-----	
detritus/wood	-----	
artificial	-----	
total count:		103
Note: Lower Reach Mill Branch		

Lower Reach Mill Branch , Pebble Count



Size (mm)		Size Distribution		Type	
D16	0.062	mean	0.1	silt/clay	21%
D35	0.078	dispersion	2.0	sand	74%
D50	0.1	skewness	0.10	gravel	5%
D65	0.13			cobble	0%
D84	0.23			boulder	0%
D95	0.95				

## **Appendix C. Wetland Raw Data (N/A)**

---

Wetlands were not restored at the Mill Branch Stream Restoration Site.

## **Appendix D. Integrated Problem Area Plan View**

---







**Stantec**

Stantec Consulting Services Inc.  
 Suite 300, 801 Jones Franklin Road  
 Raleigh, NC 27606  
 Tel. 919.851.6866  
 Fax. 919.851.7024  
 www.stantec.com

**MILL BRANCH  
 STREAM RESTORATION  
 EEP PROJECT # 251**

**APPENDIX D  
 INTEGRATED PROBLEM  
 AREA PLAN VIEW**

VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-1A	2074939.6552	170768.7832
VP-1B	2074937.5346	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	2074810.1552	170807.4965	2074817.6790	170719.7804

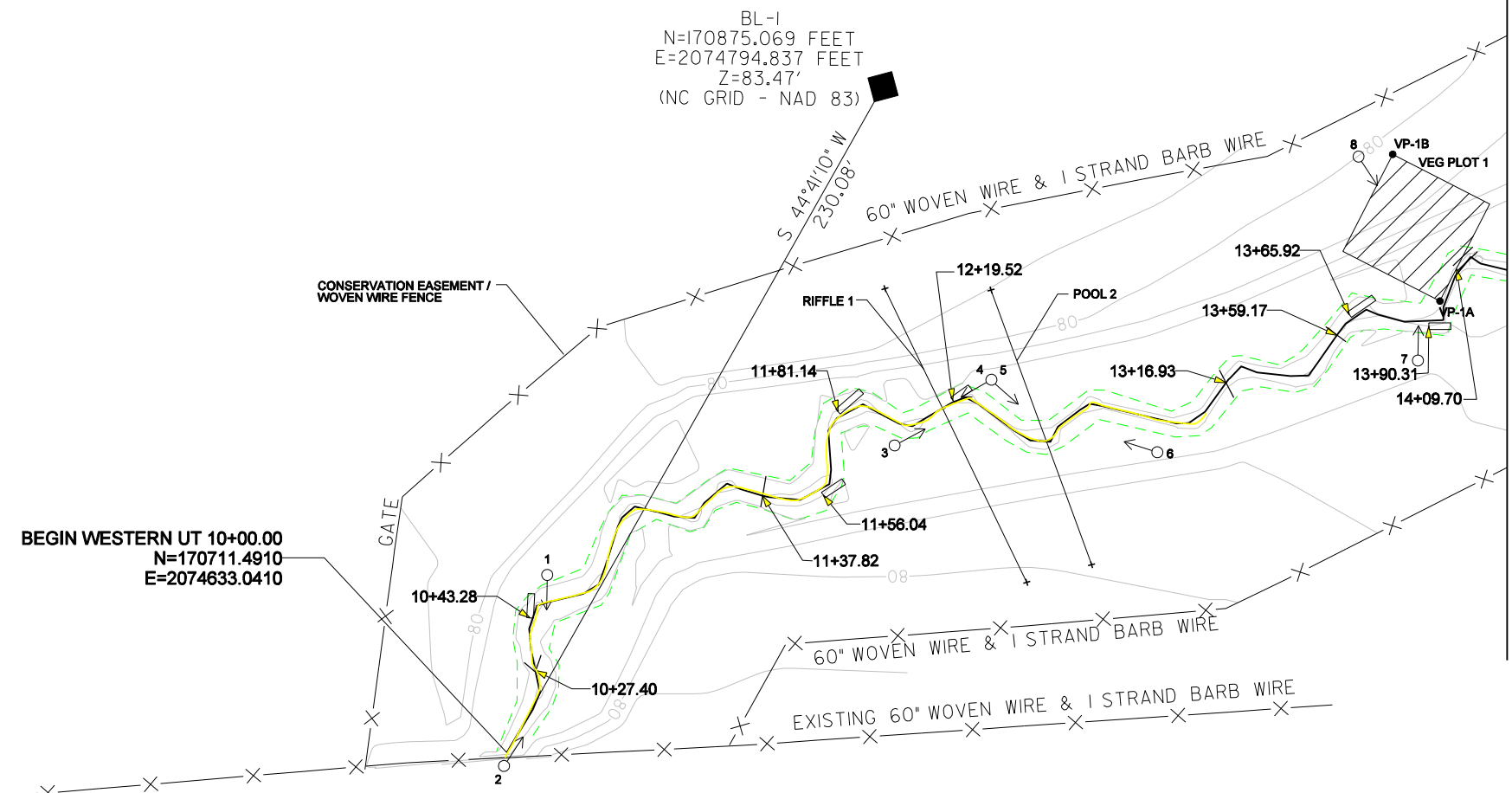
NOTE: ALL STATIONS REFERENCE THALWEG LOCATED FOR AS-BUILT SURVEY

\* ALL VEG PLOTS MEET SUCCESS CRITERIA IN MONITORING YEAR 1



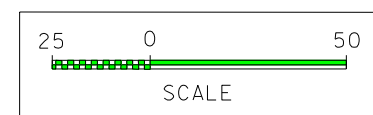
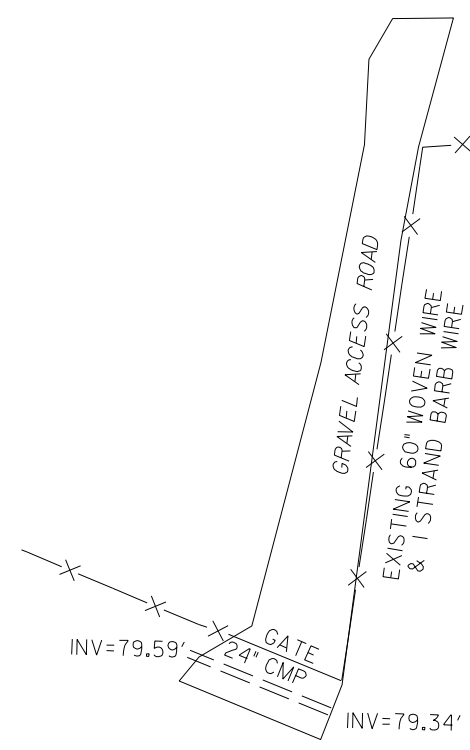
**PROBLEM AREA  
 COLOR KEY**

- AGGRADATION
- BARE GROUND
- SCOUR
- RILL EROSION
- PIPING



MATCH LINE - SEE SHEET 3

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
	INVERT
	FENCE LINE
	LIMITS OF DISTURBANCE
	VEG PLOT PINS
	VEG PLOTS
	CROSS-SECTIONS
	PHOTO POINTS



LOCATION: SITE LOCATED OFF HIGHWAY 701 AND LEBANON CHURCH ROAD SOUTH OF WHITEVILLE	
PROJECT NO: SCO# 02-06113-01A	COUNTY: COLUMBUS
DESIGNED BY: NEJ	DRAWN BY: CGM
CHECKED BY:	DATE:

4/1/2008  
 G:\100000\design\asbuilt\design\overlays\millbranch\problemarea\_sheet2.dgn

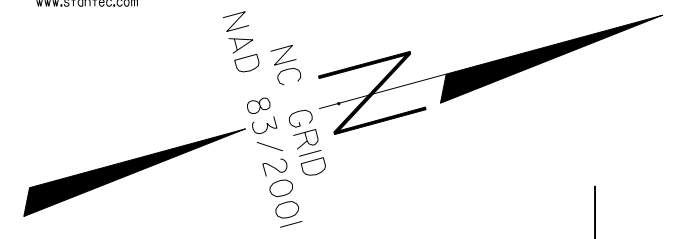


**MILL BRANCH  
STREAM RESTORATION  
EEP PROJECT # 251**

**APPENDIX D  
INTEGRATED PROBLEM  
AREA PLAN VIEW**



**Stantec**  
Stantec Consulting Services Inc.  
Suite 300, 801 Jones Franklin Road  
Raleigh, NC 27606  
Tel. 919.851.6866  
Fax. 919.851.7024  
www.stantec.com



VEG PLOT PIN COORDINATES		
PIN	X	Y
VP-3A	2075466.5710	171234.5650
VP-3B	2075445.3470	171275.3682

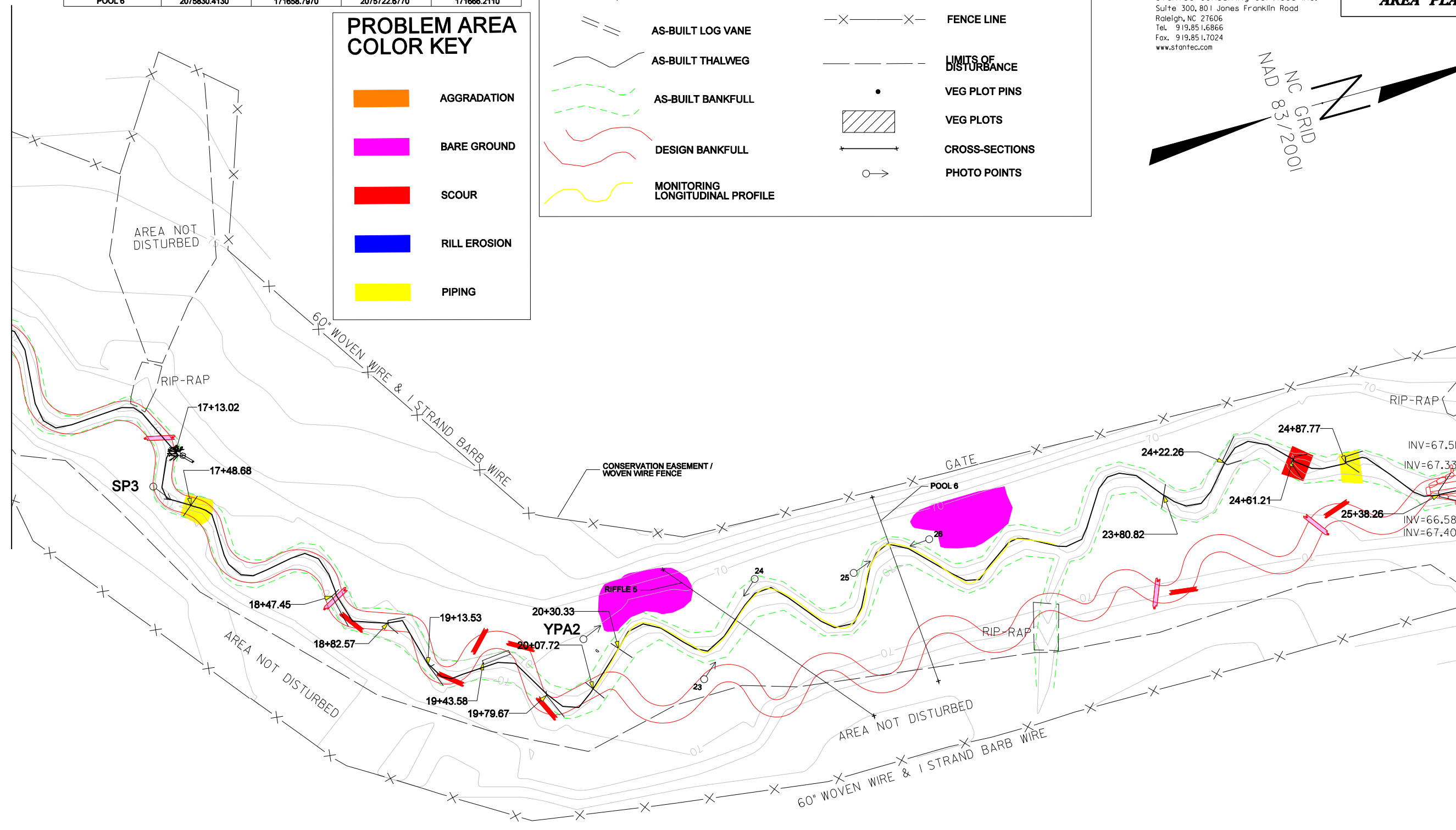
CROSS-SECTION	CROSS-SECTION COORDINATES			
	LEFT		RIGHT	
	X	Y	X	Y
RIFFLE 5	2075637.4170	171554.0230	2075730.5940	171632.4420
POOL 6	2075830.4130	171658.7970	2075722.6770	171686.2110

PROBLEM AREA COLOR KEY	
	AGGRADATION
	BARE GROUND
	SCOUR
	RILL EROSION
	PIPING

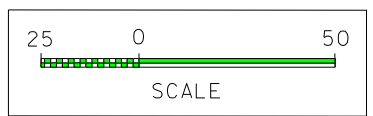
LEGEND			
	AS-BUILT ROCK CROSS VANE		DESIGN ROCK CROSS VANE
	AS-BUILT LOG VANE WITH ROCK SILL		DESIGN LOG VANE
	AS-BUILT LOG SILL		DESIGN LOG SILL
	AS-BUILT LOG VANE		INVERT
	AS-BUILT THALWEG		FENCE LINE
	AS-BUILT BANKFULL		LIMITS OF DISTURBANCE
	DESIGN BANKFULL		VEG PLOT PINS
	MONITORING LONGITUDINAL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

MATCH LINE - SEE SHEET 3

MATCH LINE - SEE SHEET 5



NOTE: ALL STATIONS REFERENCE THALWEG LOCATED FOR AS-BUILT SURVEY  
\* ALL VEG PLOTS MEET SUCCESS CRITERIA IN MONITORING YEAR 1



LOCATION: SITE LOCATED OFF HIGHWAY 701 AND LEBANON CHURCH ROAD SOUTH OF WHITEVILLE	
PROJECT NO: SCO# 02-06113-01A	COUNTY: COLUMBUS
DESIGNED BY: CGM	DRAWN BY: CGM
CHECKED BY: NEJ	DATE:

6/2/2008  
D:\102008\design\asbuilt\design\energy\millbranch\problem\_area\_sheets.dgn





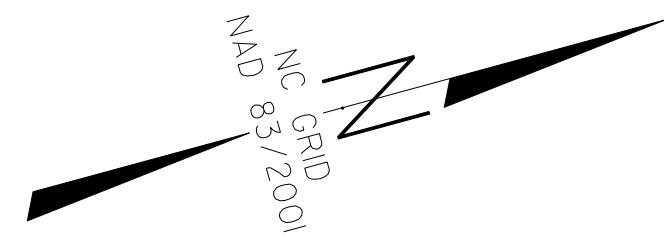
**Stantec**  
 Stantec Consulting Services Inc.  
 Suite 300, 801 Jones Franklin Road  
 Raleigh, NC 27606  
 Tel. 919.851.6866  
 Fax. 919.851.7024  
 www.stantec.com

**MILL BRANCH  
 STREAM RESTORATION  
 EEP PROJECT # 251**

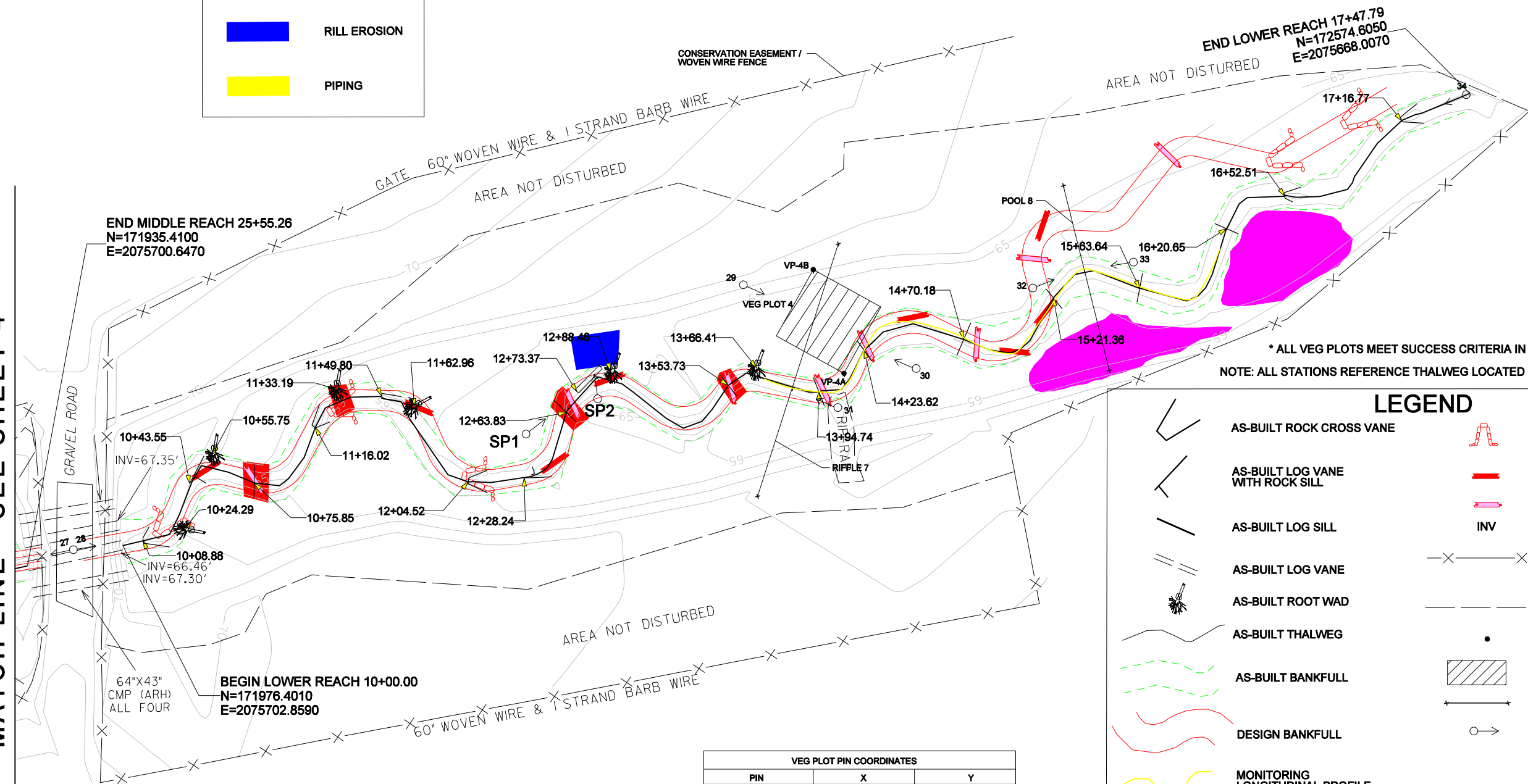
**APPENDIX D  
 INTEGRATED PROBLEM  
 AREA PLAN VIEW**

**PROBLEM AREA  
 COLOR KEY**

	AGGRADATION
	BARE GROUND
	SCOUR
	RILL EROSION
	PIPING



MATCH LINE - SEE SHEET 4



\* ALL VEG PLOTS MEET SUCCESS CRITERIA IN MONITORING YEAR 1  
 NOTE: ALL STATIONS REFERENCE THALWEG LOCATED FOR AS-BUILT SURVEY

**LEGEND**

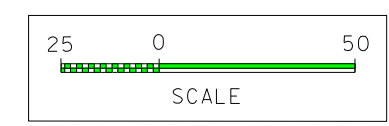
	AS-BUILT ROCK CROSS VANE		DESIGN ROCK CROSS VANE
	AS-BUILT LOG VANE WITH ROCK SILL		DESIGN LOG VANE
	AS-BUILT LOG SILL		DESIGN LOG SILL
	AS-BUILT LOG VANE		INVERT
	AS-BUILT ROOT WAD		FENCE LINE
	AS-BUILT THALWEG		LIMITS OF DISTURBANCE
	AS-BUILT BANKFULL		VEG PLOT PINS
	DESIGN BANKFULL		VEG PLOTS
	MONITORING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

**VEG PLOT PIN COORDINATES**

PIN	X	Y
VP-4A	2075668.9960	172287.9660
VP-4B	2075712.8850	172288.9580

**CROSS-SECTION COORDINATES**

CROSS-SECTION	LEFT		RIGHT	
	X	Y	X	Y
RIFFLE 7	2075659.3700	172300.9220	2075753.1770	172240.1770
POOL 8	2075680.5760	172399.0200	2075740.8880	172397.2830



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

PROJECT NO.: SCO# 02-06113-01A COUNTY: COLUMBUS  
 DESIGNED BY: CGM  
 CHECKED BY: NEJ DATE:

6/12/2008  
 01:00:00:design\asubh\design\overlays\mill\branch\problem\_area\_sheets.dgn