Zacks Fork Creek
Stream Restoration Monitoring Report

Monitoring Year: 2008
Measurement Year: 3
As-Built Date: 2005
NCEEP Project #: AW03003A

Submitted on December 17, 2008
Revised on February 4, 2009

Delivered to: NCDENR - Ecosystem Enhancement Program
1619 Mail Service Center
Raleigh, NC 27299-1619

Prepared by: Environmental Services, Inc.
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Zacks Fork Creek
Year 3 (2008) Monitoring Report

TABLE OF CONTENTS

I. Executive Summary

The monitoring assessment of this project for Year 3 indicates that the hydrology of the restored reach is functioning within design specifications. The dimension, pattern and profile data collected post-construction remain within the designed Rosgen stream type parameters. There were a total of ten stream problem areas identified, three of which were significant structural issues (displaced or backcutting log vanes). There were four areas exhibiting mid-bar accretion or bank scour and three areas with partial occlusion of flow (tree fall, debris accumulation, or beaver dam). One of the 28 total grade-control structures which had piping through the vane arms noted previously was repaired during this year's assessment.

The Year-3 assessment of vegetation indicates continued success in the establishment of both planted and indigenous vegetation. There is evidence of beaver herbivory in the middle and lower reaches. An ancillary effort of selective spraying of wild rose was undertaken in the summer and appears to have been partially effective at suppressing this invasive species.

II. Project Background

The project site is located in Caldwell County to the north of Lenoir on Zacks Fork Road, adjacent to a municipal soccer field complex (Figure 1). The surrounding land use includes residential developments within the watershed to the north and east of the site that have likely altered the hydrologic regimen, resulting in higher peak events as evidenced by down-cutting and bank erosion The stream restoration was encompasses approximately 3,900 linear feet of a reach that had become incised and degraded. Through a combination of natural channel design, grade-control structures and excavation of a bankfull bench this project seeks to address deficiencies in the stream dimension, pattern and profile as well improve both in-stream and riparian habitat. Restoration was undertaken in 2004-5; a more complete description of the project background and design is given in "Geomorphologic Assessment & Stream Restoration Preliminary Design Report" prepared by FMSM Engineers and "Mitigation Report for Zack's Fork Creek Stream Restoration" prepared by Spaulding & Norris, as revised in February 14, 2008. The as-built plan view of the project area is given in Figure 2; more detailed maps are also available in the "Mitigation Report".

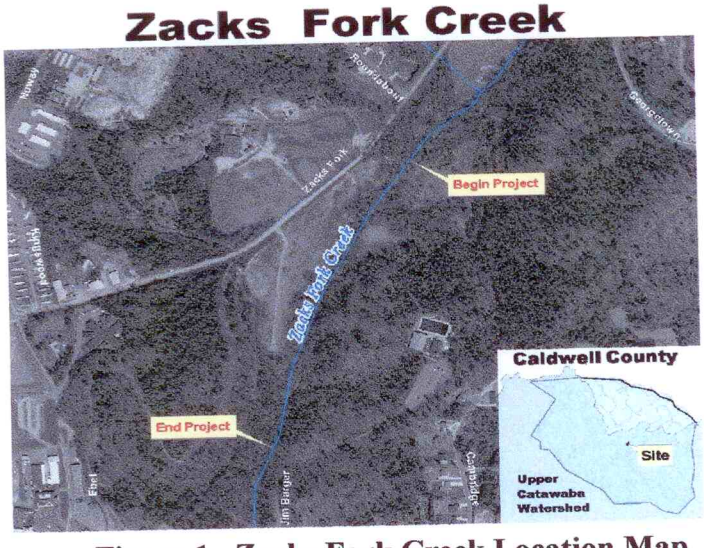

Figure 1. Zacks Fork Creek Location Map

Table 1. Project Mitigation Structure	
Project Segment or Reach ID	Linear Footage or Acreage
Reach I	3,900 lf

Table 2: Project Background	
Project County	Caldwell
Drainage Area	12.3 square miles
Rosgen Classification of As-Built	C
Dominant Soil Types	Chewacla
Reference Site ID	-
USGS HUC for Project and Reference	-
NCDWQ Sub-Basin for Project and Reference	03050101-027
NCDWQ Classification for Project and Reference	-
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	-
% of project easement fenced	0

Table 3. Project Contacts	Firm Address, Phone, Contact
Designer FMSM Engineers Attn: George Athanasakes, PE	1901 Nelson Miller Parkway Louisville, KY 40223 (502) 212-5000
Construction Contractor Environmental Services, Inc. Attn: Steve Jones	1980-A Parker Court Stone Mountain, GA 30087 Phone: 770-736-9101
Planting Contractor Coastal Plain Conservation Nursery Attn: Ellen Colodney	3067 Conners Drive Edenton, NC 27932 (252) 482-5707
Seeding Contractor Environmental Services, Inc. Attn: Steve Jones	1980-A Parker Court Stone Mountain, GA 30087 Phone: 770-736-9101
Vegetation Monitoring Environmental Services, Inc. Attn: Charles Johnston	524 S. New Hope Road Raleigh, NC 27610 (919) 212-1760
Stream Monitoring Environmental Services, Inc. Attn: Steve Jones	1980-A Parker Court Stone Mountain, GA 30087 Phone: 770-736-9101

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Structures, Cross-Sections,
Vegetative Plots, Photo Locations

Zack's Fork, Year 3 Monitoring Report

Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Nov 2008
Drwn/Chkd:	csj/csj
Figure:	3

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III. Project Condition and Monitoring Results

A. Vegetation Assessment

As specified by the guidelines in *Content, Format and Data Requirements for EEP Monitoring Reports*, upon completion of stream construction eleven vegetation sampling plots (10m x 10m) were staked at intervals in the riparian zone of the project reach. Planting was done on a per-acre scale using a combination of live stakes, containerized plants and seeding. Baseline counts for the individual sampling plots were not assessed or recorded at the time of planting. Year-1 and Year-2 vegetative assessments were performed on 12 Dec 2006 and 21 Nov 2007, respectively. The Year-3 assessment was done on 6 Nov 2008; results are given Tables 4 and 5. As Chewacla loam is the only mapped soil series within the floodplain of the project, no direct on-site soil sampling is performed as part of the yearly monitoring process. The spatial location of the vegetation sampling plots is given in Figure 3. Representative photographs of the vegetative sampling plots are contained in Appendix C.

The Year-3 assessment indicates a high level of vegetative cover in all areas of the restoration reach. Within the sampling plots the cumulative total of stems counted was 269 (up from 197 in Yr-2 and 159 in Yr-1), or a mean of 24.5 stems/plot (17.9 in Yr-2 and 14.5 in Yr-1). There was an increase in the total number of woody species recorded, some of this may be due to transplants previously missed but are now large enough to be above the grass/sedge cover, some may be due to natural recruitment via seed set or seed bank. Silky willow (*Salix sericea*) continues to dominate the vegetative count, especially in streamside plots; this species accounts for 60% of the cumulative total. Some herbivory by beavers was apparent in the lower reach of the restoration; this accounted for the only documented vegetative problem area. Vegetation plots 6 and 8 continue to have notably lower stem counts; as noted in the previous year's report. It should be noted that Plots 6 and 8 were disturbed by the City of Lenoir Parks & Recreation staff in early 2006 during their mowing operation and maintenance of the adjacent soccer fields. S&N promptly contacted the City staff to alert them to the work associated with the stream restoration, the plantings completed and the dedicated Conservation Easement. In the Spring of 2006, the City Public Works Department disturbed these areas even more when a paved pedestrian/bike trail was constructed. The City staff is fully aware of the Conservation Easement for the project, as they were the Grantor of the recorded easement, which dedicated the property to the NCEEP (formerly NCWRP). We will re-evaluate Plots 6 and 8 when the field work is underway for the Year 4 monitoring in the Fall of 2009. If supplemental plantings are necessary, we propose to address this at that time.

Of note, in June 2008 an effort was undertaken to address the proliferation of wild rose (*Rosa multiflora*) within the riparian zone of the restoration corridor by selective spot-spraying with a glycophosphate-based herbicide. The evaluation in November revealed that this was at least partially effective whereby the sprayed specimens appeared lifeless; however, it is likely that repeated applications would be necessary to effect a longer-term suppression.

Table 4. Vegetative Problem Areas			
Feature/Issue	Station#/Range	Probable Cause	Photo #
Herbivory	25+00 – 36+00	Beaver activity	21

Table 5. Stem counts by species and plot, November 2008.

Species	Plot #											
	1	2	3	4	5	6	7	8	9	10	11	Spp total
Alnus serrulata (common alder)	0	3	3	3	5	0	0	0	6	0	2	22
Betula nigra (river birch)	0	5	0	2	0	1	2	2	4	2	0	18
Cornus amomun (silky dogwood)	0	0	0	0	0	0	0	4	0	1	0	5
Ilex opaca (American holly)	0	0	0	1	0	0	0	0	1	2	0	4
Lindera benzoin (spicebush)	2	4	0	0	0	0	0	0	0	2	1	9
Liriodendron tulipifera (tulip poplar)	0	0	0	2	0	2	0	0	1	3	1	9
Platanus occidentalis (sycamore)	0	2	8	1	6	1	1	0	0	1	6	35
Salix sericea (silky willow)	23	14	28	25	15	0	20	0	12	0	25	162
Sambucus canadensis (elderberry)	0	0	0	0	0	0	0	0	2	3	0	5
Stems / Plot	25	28	39	34	26	4	23	6	26	14	35	
Spp. / Plot	2	5	3	6	3	3	3	2	6	7	5	
Est. % Cover	100	100	100	100	90	90	100	100	100	100	100	

B. Stream Assessment

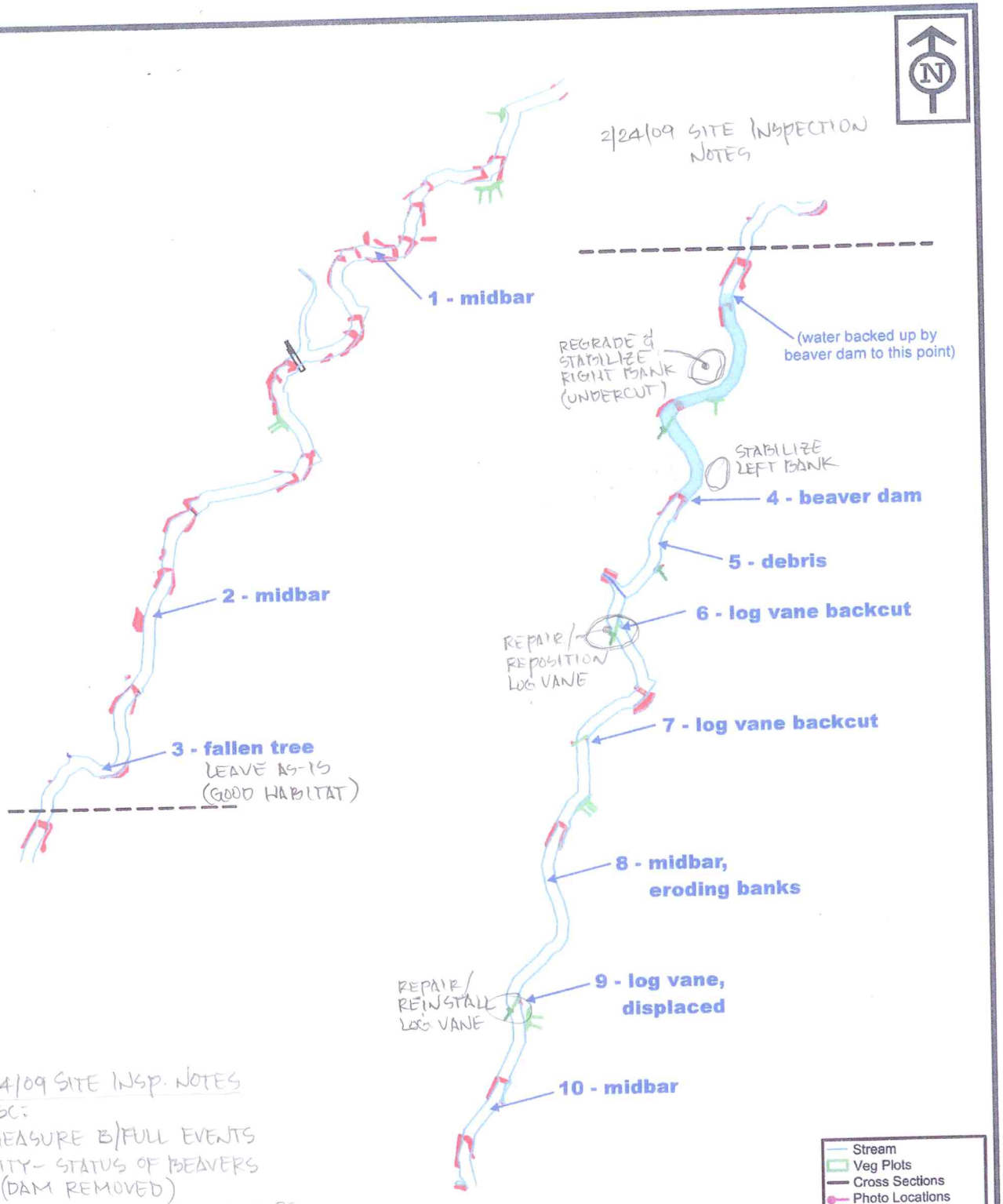
This stream restoration incorporates 28 in-stream grade controls (cross vanes, log vanes) and other natural channel design structures (J-hooks, root wads). The Year-3 monitoring assessment collected hydraulic performance parameters which include longitudinal profile, cross-sectional profiles, pebble counts, and visual stability assessment. Spatial locations of grade-control structures, cross-sections and vegetative plots are depicted in Figure 3. Longitudinal and cross-sectional profiles are given in Appendix A. Structural photographs are enclosed in Appendix B, arranged sequentially moving downstream.

The overall hydrology of the restoration appears to functioning within design specifications including development of scour pools and riffle runs, thalweg alignment, sediment sorting, bank re-vegetation, and stability of installed structures. The previous year's assessment cataloged one cross vane with considerable piping through and around the vane arms. This structure was repaired in November 2008 concurrently with the Year-3 monitoring assessment.

Although a total of ten stream problem areas (Table 7) were identified, the majority of these do not involved grade control structures. Three of the grade controls which utilize log vanes now exhibit evidence of episodic or increasing flow around the base where these are keyed into the outer curve of the stream bank. At one of these locations the vane, which originally consisted of two logs connected in parallel by cabling, now has the top log displaced at a significant angle. As reflected by the stability of the longitudinal profile, these structures are still adequately holding grade; however, repair or replacement may become necessary in the future if structural integrity and stability further deteriorates. A total of ten (10) stream problem areas were cataloged, locations are shown in Figure 4 and representative photographs are contained in Appendix D.

The Year-3 assessment also included Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) analysis. The BEHI evaluates variables including bank height ratio, bank angle, root depth and density, bank protection and bank materials; it generates a descriptive index of erosion risk. The NBS is similar but incorporates variables such as pool/riffle slope(s), velocity profile estimates, and near-bank maximum depth. Results of for these two evaluation indices are given in Tables 6.R and 6.L; the evaluation reaches for each bank are shown in Figures 5R and 5L. It should be noted that the Left Bank from Reach 15 to the terminus of the project at Reach 43 was not disturbed with the stream restoration.

There are vegetated bankful benches in multiple locations and pools appear to be clearing out sediment adequately. Cross-sectional morphology and sediment sorting characteristics are given in Table 8 and Table 9. Because of the issues involving the log vanes at Reaches 26 and 33 noted in Table 6.R, the visual stability assessment for vanes decreased from the previous year (Table 10); however, over the entire geomorphological range the restoration appears to be maintaining stability (Table 11). The visual assessment of the entire restored reach shows a natural progression of the riparian vegetative community, in-stream habitat development and functioning grade-control structures. Both planted and natural recruitment of vegetation in the riparian corridor continues to provide good ground cover and buffering functions. The presence of stream macroinvertebrates and finfish gives a qualitative verification of in-stream habitat and good water quality.



2/24/09 SITE INSP. NOTES

MISC:

1) MEASURE B/FULL EVENTS
2) CITY- STATUS OF BEAVERS (DAM REMOVED)
3) REPAIR RT. BANK @ REACH 26
4) PROVIDE LTR TO DESCRIBE REPAIRS
   - VERIFY DATA W/ ESI
   - AMEND YR-3 REPORT ??

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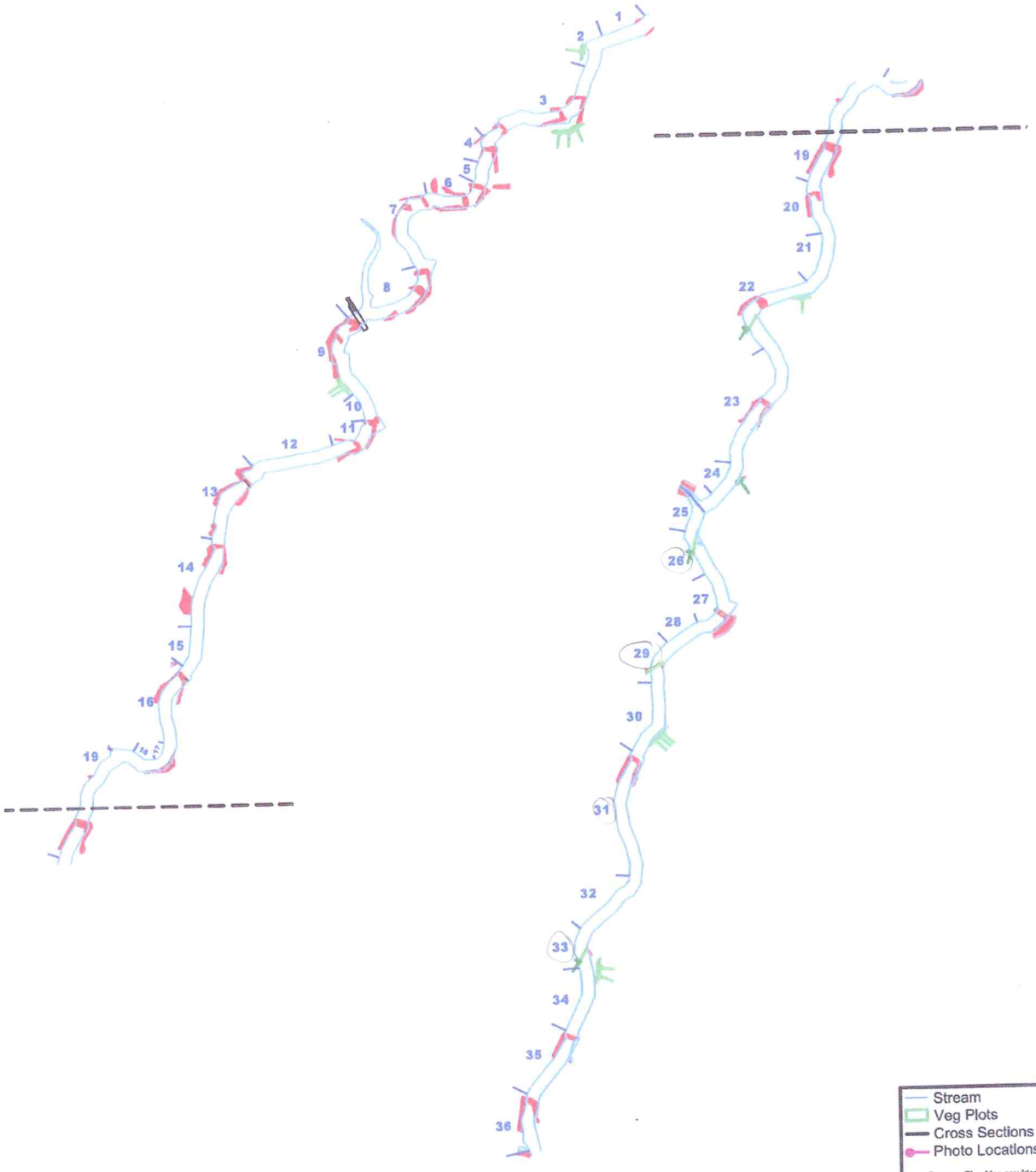
Stream Problem Areas

Zack's Fork, Year 3 Monitoring Report

Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Nov 2008
Drwn/Chkd:	csj/csj
Figure:	4



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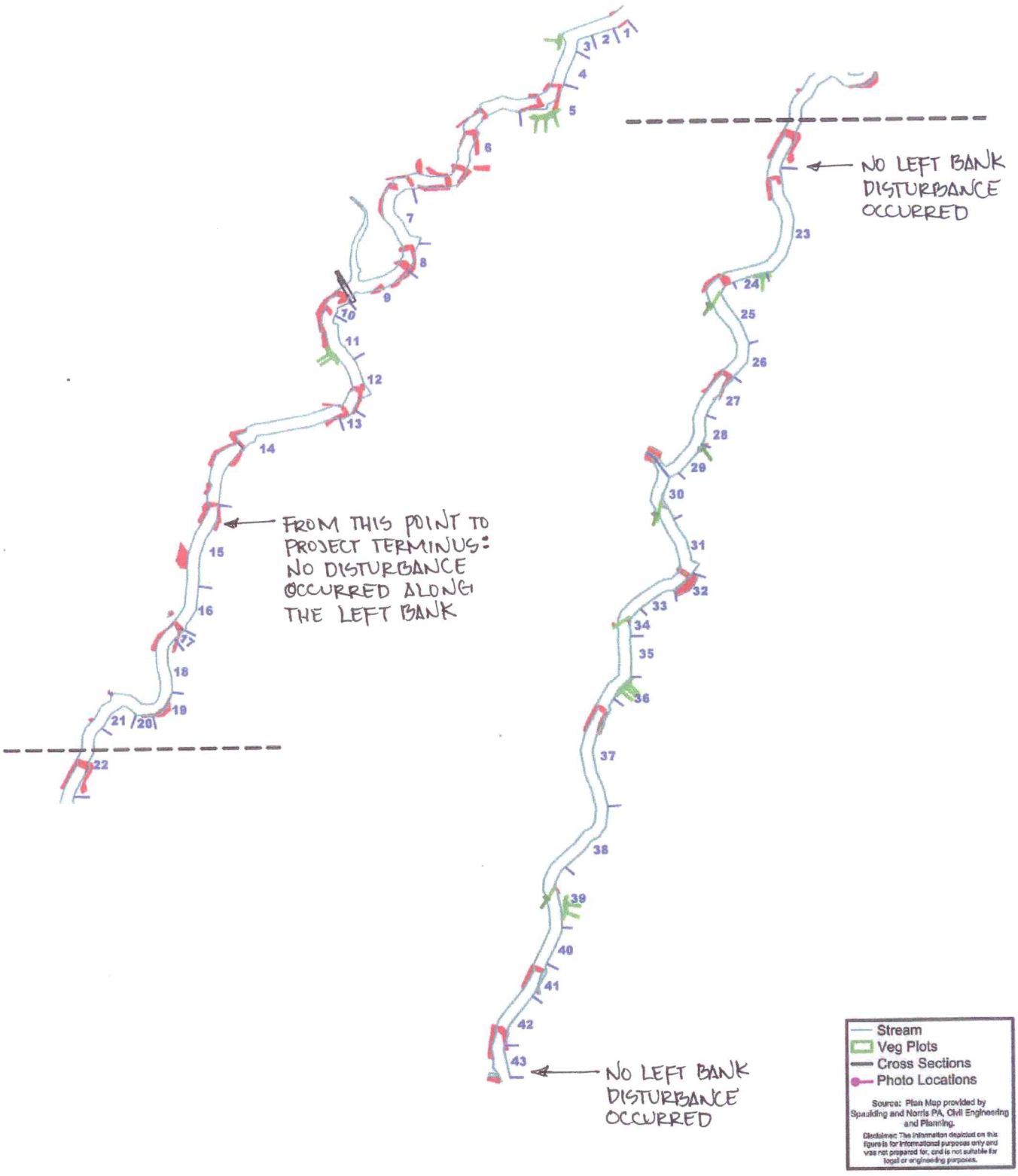
BEHI/NBS Reaches, Right Bank

Zack's Fork, Year 3 Monitoring Report

Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Nov 2008
Drwn/Chkd:	csj/csj
Figure:	5R



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BEHI/NBS Reaches, Left Bank

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Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Nov 2008
Drwn/Chkd:	csj/csj
Figure:	5L

Table 6.R. Bank Erosion Hazard Index (BEHI) and Near-Bank Stress (NBS) Assessments

Reach	BEHI Rating	NBS Rating	Bank Height	Length
Right Bank 1	Low	Low	2.5	68
Right Bank 2	Very Low	Very Low	1.5	77
Right Bank 3	Low	Very Low	2.0	220
Right Bank 4	Very Low	Very Low	2.0	35
Right Bank 5	Low	Moderate	2.0	37
Right Bank 6	Very Low	Very Low	1.5	94
Right Bank 7	Low	Moderate	2.5	153
Right Bank 8	Very Low	Very Low	1.5	128
Right Bank 9	Very Low	Very Low	2.0	171
Right Bank 10	Low	Moderate	1.5	43
Right Bank 11	Very Low	Very Low	2.0	77
Right Bank 12	Very Low	Very Low	2.5	126
Right Bank 13	Low	Moderate	3.0	153
Right Bank 14	Low	Very Low	2.5	157
Right Bank 15	Very Low	Low	2.0	65
Right Bank 16	Low	Low	3.0	139
Right Bank 17	Moderate	High	3.0	24
Right Bank 18	Very Low	Very Low	2.0	71
Right Bank 19	Very Low	Low	1.5	225
Right Bank 20	Moderate	Moderate	2.0	100
Right Bank 21	Very Low	Very Low	2.0	70
Right Bank 22	Low	Moderate	2.5	190
Right Bank 23	Very Low	Very Low	2.0	195
Right Bank 24	Very Low	Very Low	4.0	73
Right Bank 25	Very Low	Very Low	2.5	65
Right Bank 26	H	Very High	3.5	70
Right Bank 27	Very Low	Very Low	2.0	118
Right Bank 28	Low	Moderate	2.5	56
Right Bank 29	Moderate	Very High	3.5	69
Right Bank 30	Very Low	Very Low	2.5	136
Right Bank 31	Very High	Very High	3.0	197
Right Bank 32	Low	Low	3.0	105
Right Bank 33	Very High	Very High	4.0	105
Right Bank 34	Moderate	Low	2.5	88
Right Bank 35	Very Low	Moderate	3.0	107
Right Bank 36	Very Low	High	4.0	93
			total...	**3900**

Table 6.L. Bank Erosion Hazard Index (BEHI) and Near-Bank Stress (NBS) Assessments

Reach	BEHI Rating	NBS Rating	Bank Height	Length
Left Bank 1	Low	Low	1.5	25
Left Bank 2	Low	Moderate	2.5	45
Left Bank 3	Low	Very Low	1.0	58
Left Bank 4	Low	Low	2.0	60
Left Bank 5	Low	Low	3.3	101
Left Bank 6	Low	Low	2.5	217
Left Bank 7	Low	Very Low	1.8	143
Left Bank 8	Low	Low	2.5	43
Left Bank 9	Low	Low	2.5	114
Left Bank 10	Low	Moderate	2.0	41
Left Bank 11	Very Low	Very Low	2.0	97
Left Bank 12	Very Low	Low	2.0	103
Left Bank 13	Moderate	Moderate	4.3	27
Left Bank 14	Very Low	Very Low	1.3	288
Left Bank 15	Very Low	Very Low	1.9	150

Table 7. Stream Problem Areas				
Feature Issue	**Station #**	**Suspected Cause**	**Location #**	**Photo #**
Aggradation/Bar Formation	15+50	Mid-stream bar	1	
	25+25	Mid-stream bar	2	
	48+50	Mid-stream bar	10	
Bank Scour	43+50	Water velocity	8	
Structure Change	38+00	Log vane backcut	6	
	41+00	Log vane backcut	7	
	46+50	Log vane displaced	9	
Flow Occlusion	28+25	Fallen tree	3	
	35+50	Beaver dam	4	
	36+50	Pipe and debris	5	

Table 8. Summary of Cross-Sectional Morphology						
	Cross-Section	**1 - pool**	**2 - riffle**	**3 -pool**	**4 -riffle**	**5 - pool**
DIMENSION	BF Width (ft)	39.3	28.0	32.6	30.3	33.8
	Floodprone Width (ft)	121.4	113.5	126.3	84.2	74.3
	BF Cross-sectional area (sq.ft)	159.6	79.1	100.6	52.1	142.5
	BF Mean Depth (ft)	4.1	2.8	3.1	1.7	4.2
	BF Max Depth (ft)	6.4	5.3	6.6	3.1	6.2
	Width/Depth Ratio	9.7	9.9	10.6	17.6	8.0
	Entrenchment Ratio	3.1	4.1	3.9	2.8	2.2
	Wetted Perimeter (ft)	43.9	32..2	37.4	31.4	37.4
	Hydraulic Radius (ft)	3.6	2.5	2.7	1.7	3.8
SUBSTRATE	D50 (mm)	-	49.0	-	40.7	-
	D84 (mm)	-	113	-	117	-
	Cross-Section	**6 - pool**	**7 - riffle**	**8 -pool**	**9 -riffle**	**10 - pool**
DIMENSION	BF Width (ft)	26.2	28.5	24.3	25.0	27.1
	Floodprone Width (ft)	101.3	71.7	77.2	99.7	157.1
	BF Cross-sectional area (sq.ft)	75.4	50.9	70.3	36.5	59.8
	BF Mean Depth (ft)	2.9	1.8	2.9	1.5	2.2
	BF Max Depth (ft)	4.7	2.8	5.15	2.06	4.4
	Width/Depth Ratio	9.1	16.0	8.4	17.09	12.3
	Entrenchment Ratio	3.9	2.5	3.2	4.0	5.8
	Wetted Perimeter (ft)	28.8	29.7	26.8	26.2	29.7
	Hydraulic Radius (ft)	2.6	2.6	2.6	1.4	2.0
SUBSTRATE	D50 (mm)	-	92.3	-	64.0	-
	D84 (mm)	-	221	-	119	-

Table 9. Summary of Reach Morphology				
		Min	Max	Med
PATTERN	Channel Beltwidth (ft)	70	150	110
	Radius of Curvature (ft)	-	-	-
	Meander Wavelength (ft)	180	300	240
	Meander Width Ratio	6.9	11.5	9.2
PROFILE	Riffle Length (ft)	71.3	133.71	89.6
	Riffle Slope (ft/ft)	.001	.009	.004
	Pool Length (ft)	53.5	264.4	103.4
	Pool Spacing (ft)	47.5	162.7	380.3

Table 10. Visual Morphological Stability Assessment						
Feature Category	**Metric**	**# Stable**	**# per As-built**	**LF of unstable state**	**% Stable**	**Feature Mean %**
A. Riffles	1. Present?	20	22	≈30	95	
	2. Armor stable?	22	22	0	100	
	3. Facet grade appears stable?	22	22	0	100	
	4. Minimal evidence of embedding/fining?	22	22	0	100	
	5. Length appropriate?	22	22	0	100	**99%**
B. Pools	1. Present?	28	28	0	100	
	2. Sufficiently deep (maxD:mean bkfl >1.6?	28	28	0	100	
	3. Length appropriate?	100	100	100	100	**100%**
C. Thalweg	1. Upstream of meander bend centering?	15	17	100	88	
	2. Downstream of meander centering?	15	17	100	88	**88%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	10	11	100	91	
	2. If eroding, # with concomitant bar formation?	4	4	75	80	
	3. Apparent Rc within specifications?	11	11	0	100	
	4. Sufficient floodplain access and relier?	11	11	0	100	**93%**
E. Bed	1. General channel bed aggradation areas?	22	22	0	100	

	2. Channel bed degradations (downcuts/headcuts)?	0	0	0	100	**100%**
F. Vanes	1. Free of back or arm scour?	25	28	0	90	
	2. Height appropriate?	26	28	0	93	
	3. Angle and geometry appear appropriate	27	28	0	96	
	4. Free of piping or other structural failures?	25	28	40	96	**94%**
G. Wads/Boulders	1. Free of scour?	6	8	60	75	
	2. Footing stable?	8	8	0	100	**88%**

Table 11. Categorical Stream Feature Visual Stability Assessment

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	NA	98%	98%	99%		
B. Pools	NA	100%	100%	100%		
C. Thalweg	NA	85%	88%	88%		
D. Meanders	NA	93%	93%	93%		
E. Bed General	NA	96%	96%	100%		
F. Structures	NA	98%	98%	94%		
G. Wads/Boulders	NA	88%	88%	88%		

VI. Methodology and References

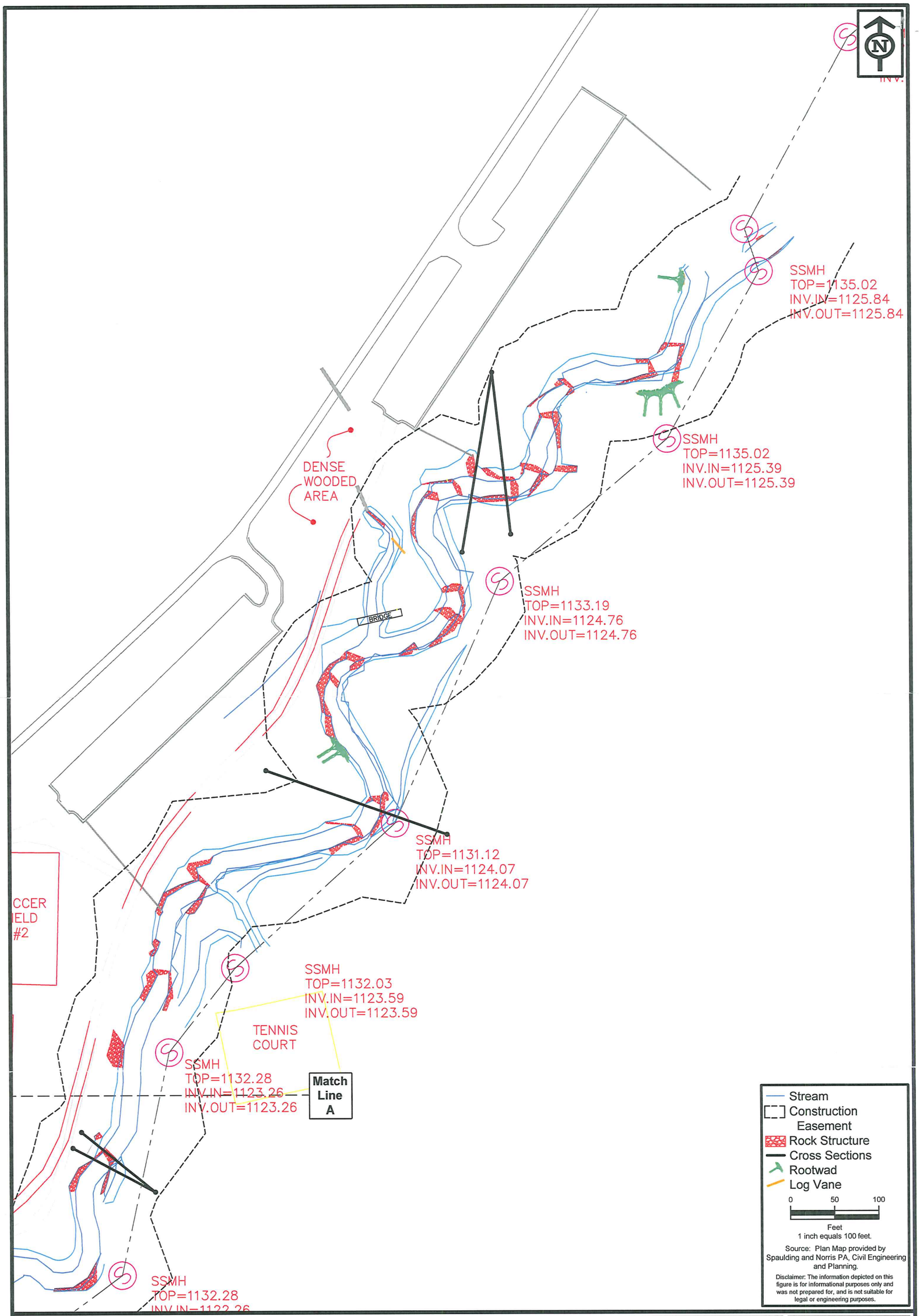
Field work was performed using usual and customary methods based on U.S. Army Corps of Engineers and N.C. Division of Water Quality guidelines. Data analysis was done using Microsoft Excel and other non-proprietary software.

References include but are not limited to:

USACOE. (2003) *Stream Mitigation Guidelines*. .

NCDWQ (2005) *Content, Format and Date Requirements for EEP Monitoring Reports*

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



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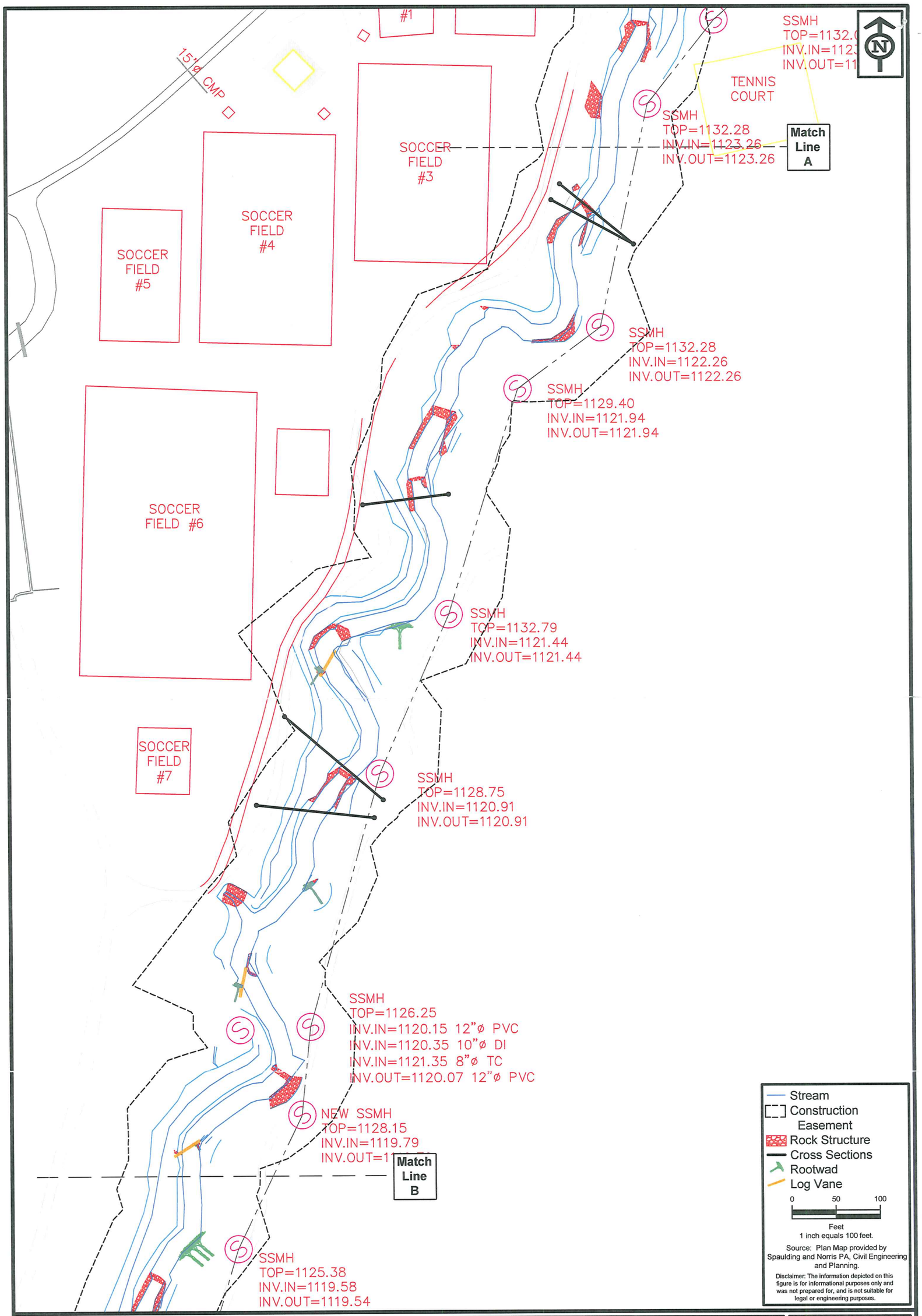
Preconstruction Plan View

Zacks Fork Monitoring Report

Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Dec 2006
Drwn/Chkd:	KT/CSJ
Figure:	2.1



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Preconstruction Plan View

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Project:	BUR06127
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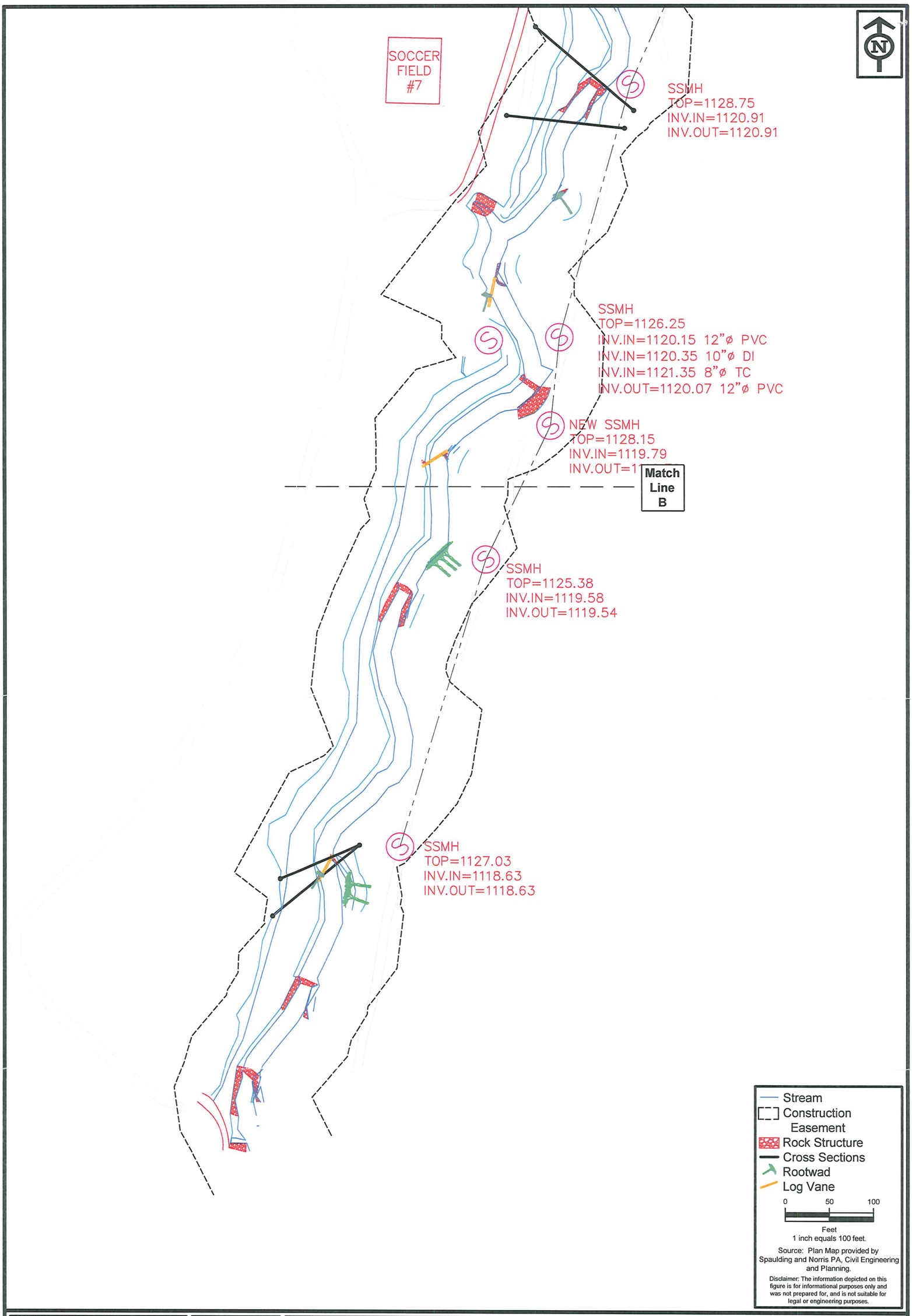
Figure:	2.2



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Preconstruction Plan View

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Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Dec 2006
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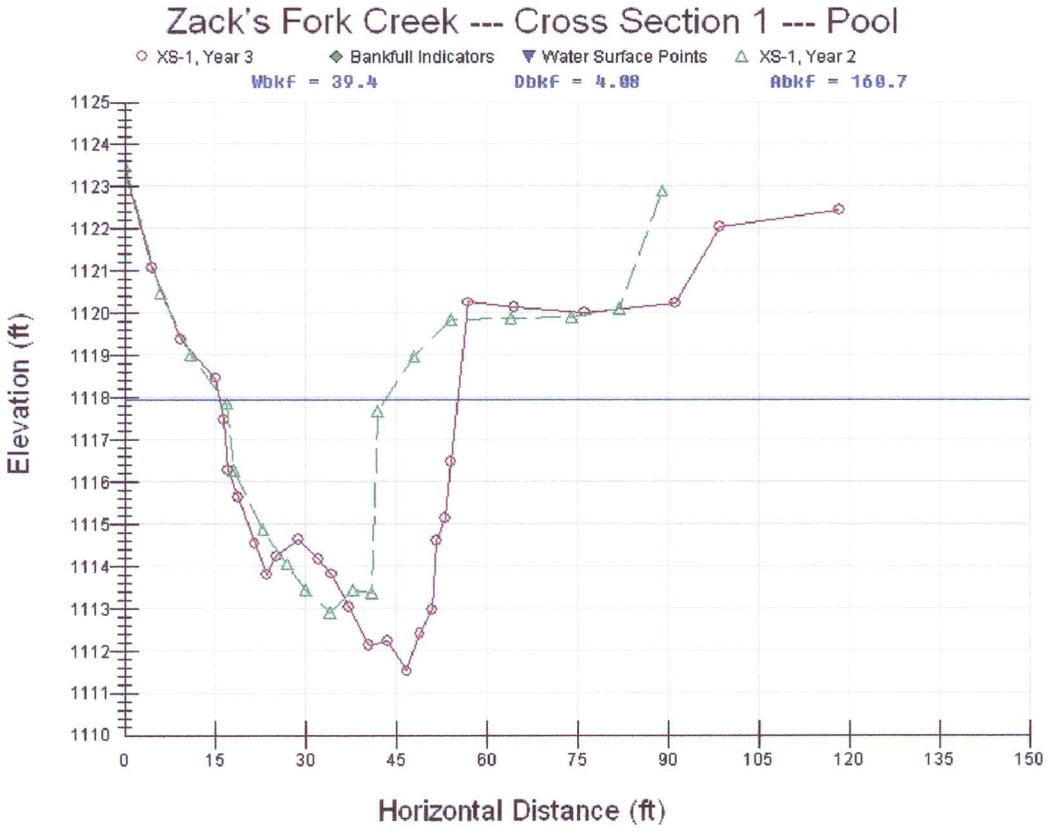
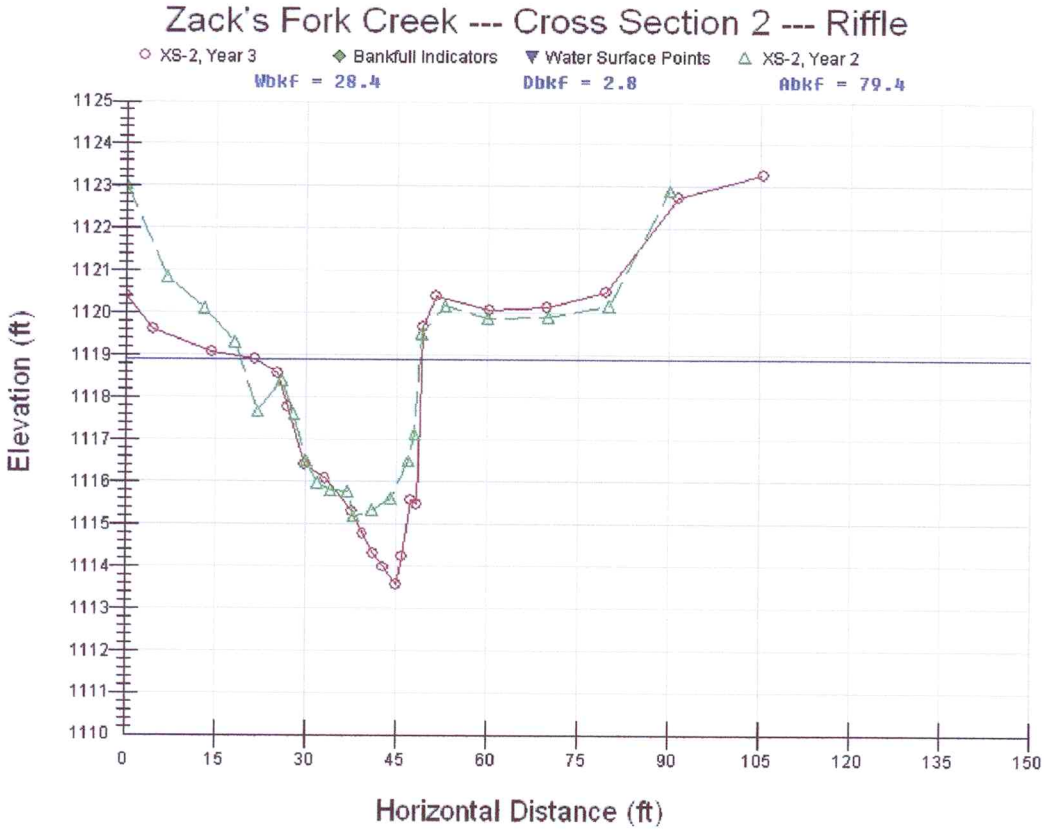
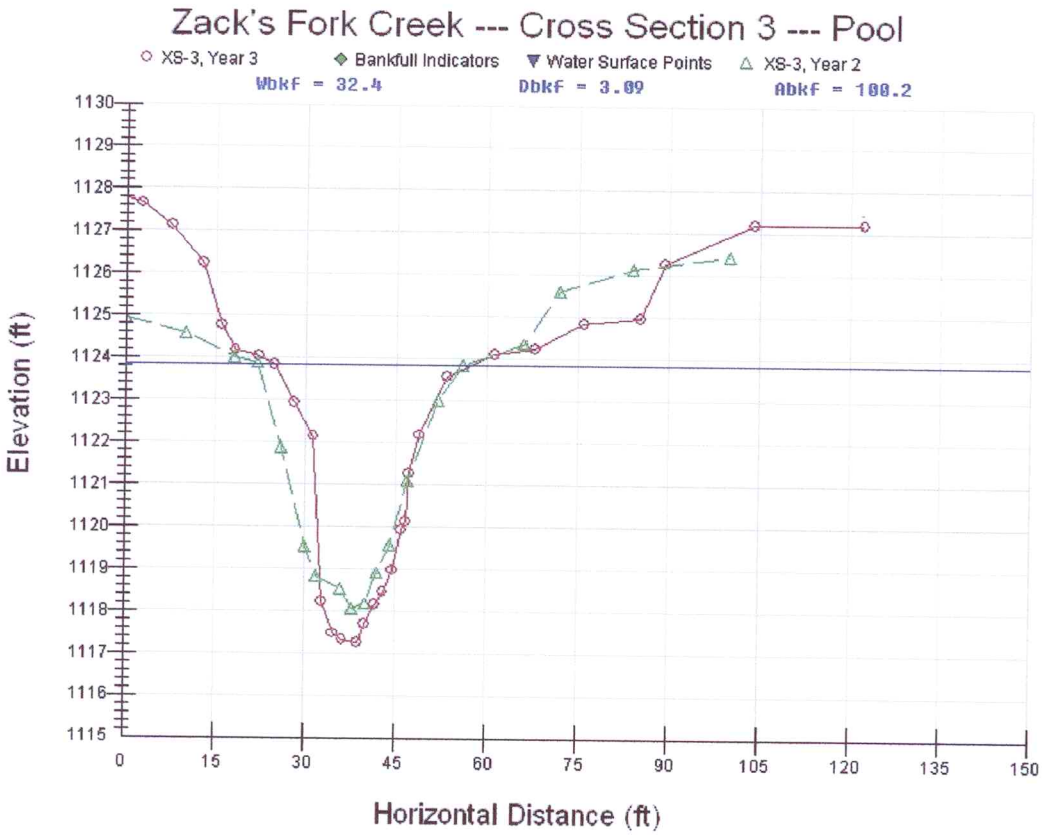
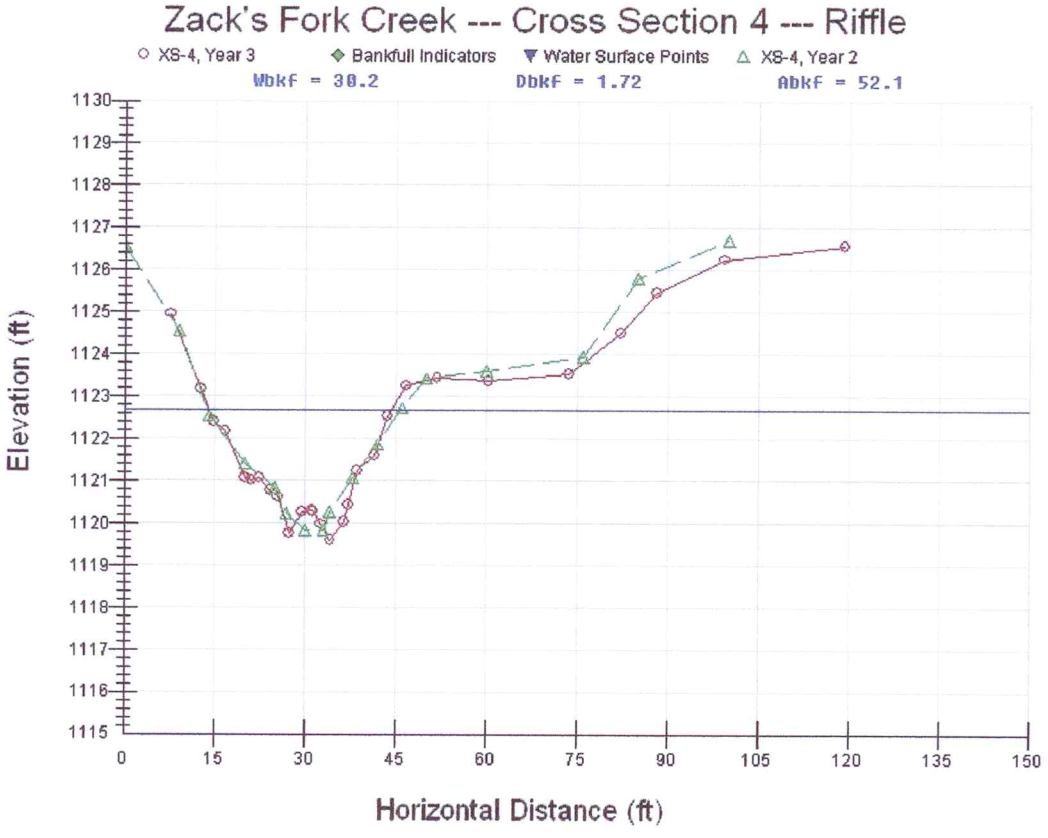
Figure:	2.3

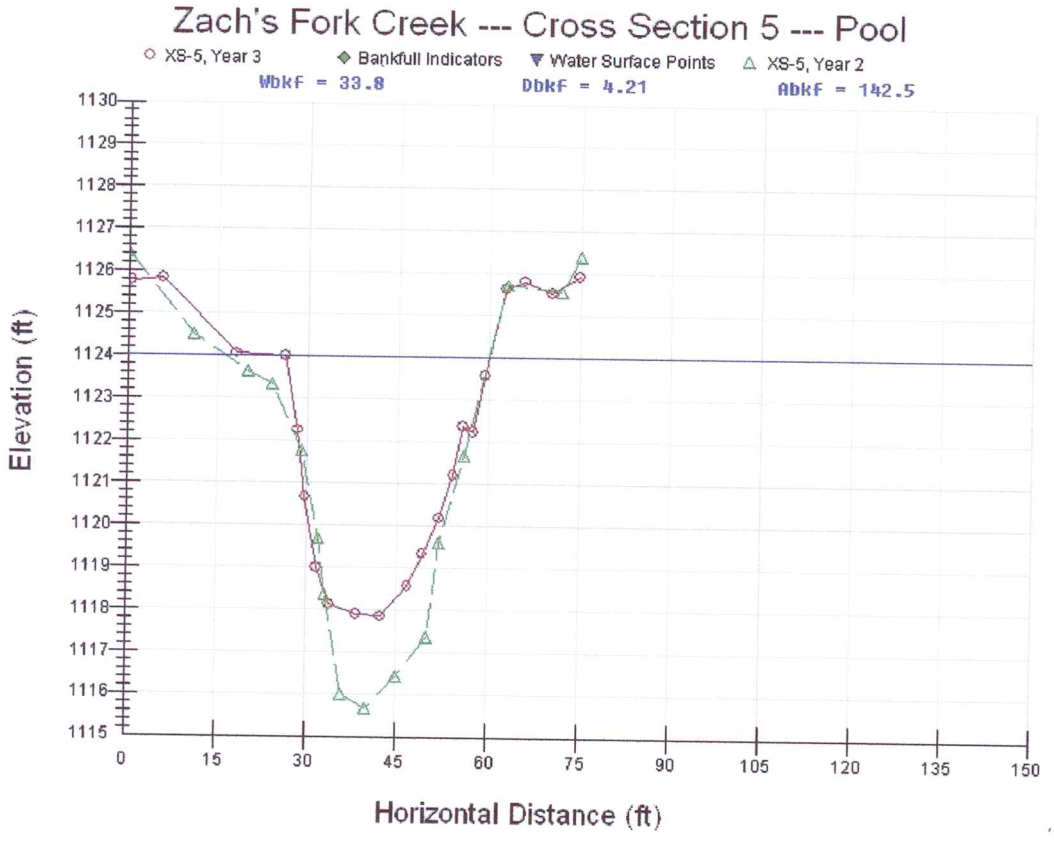
APPENDIX A – Longitudinal and Cross-sectional Profiles and Data

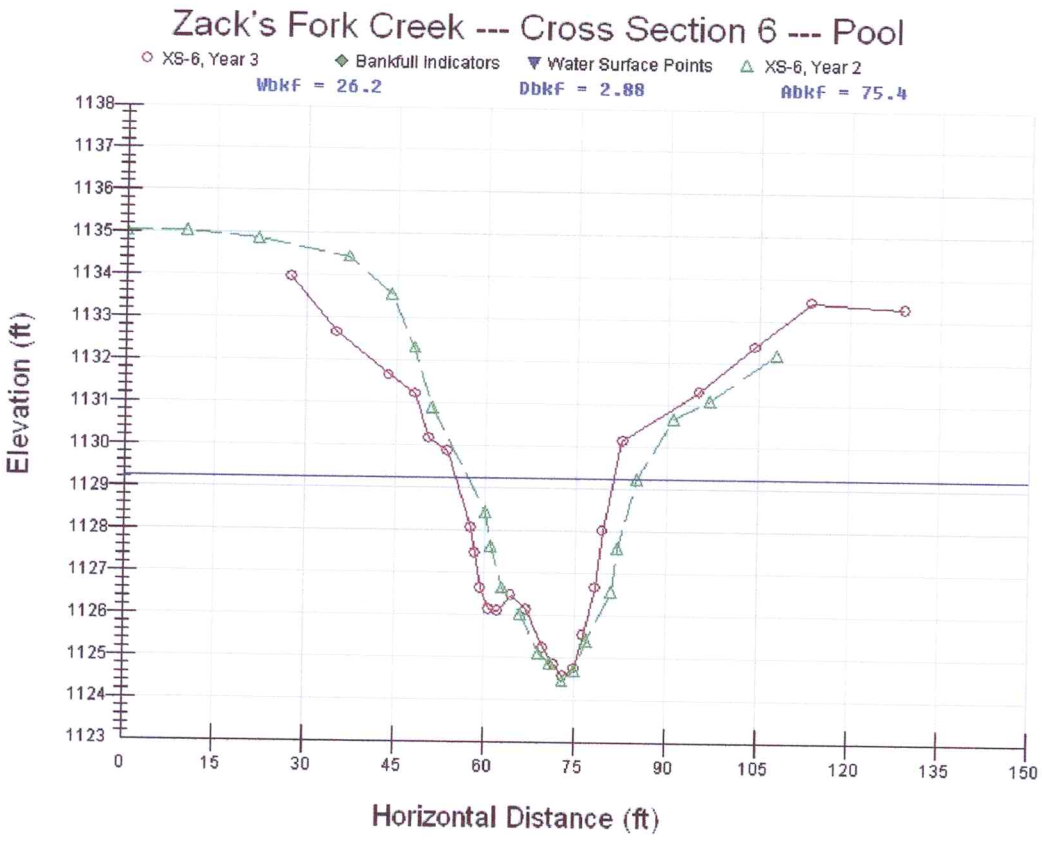

Zack's Fork Creek --- Cross Section 1 --- Pool
XS-1, Year 3
Bankfull Indicators
Water Surface Points
XS-1, Year 2
Wbkf = 39.4
Dbkf = 4.08
Abkf = 160.7
Elevation (ft)
1125
1124
1123
1122
1121
1120
1119
1118
1117
1116
1115
1114
1113
1112
1111
1110
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)

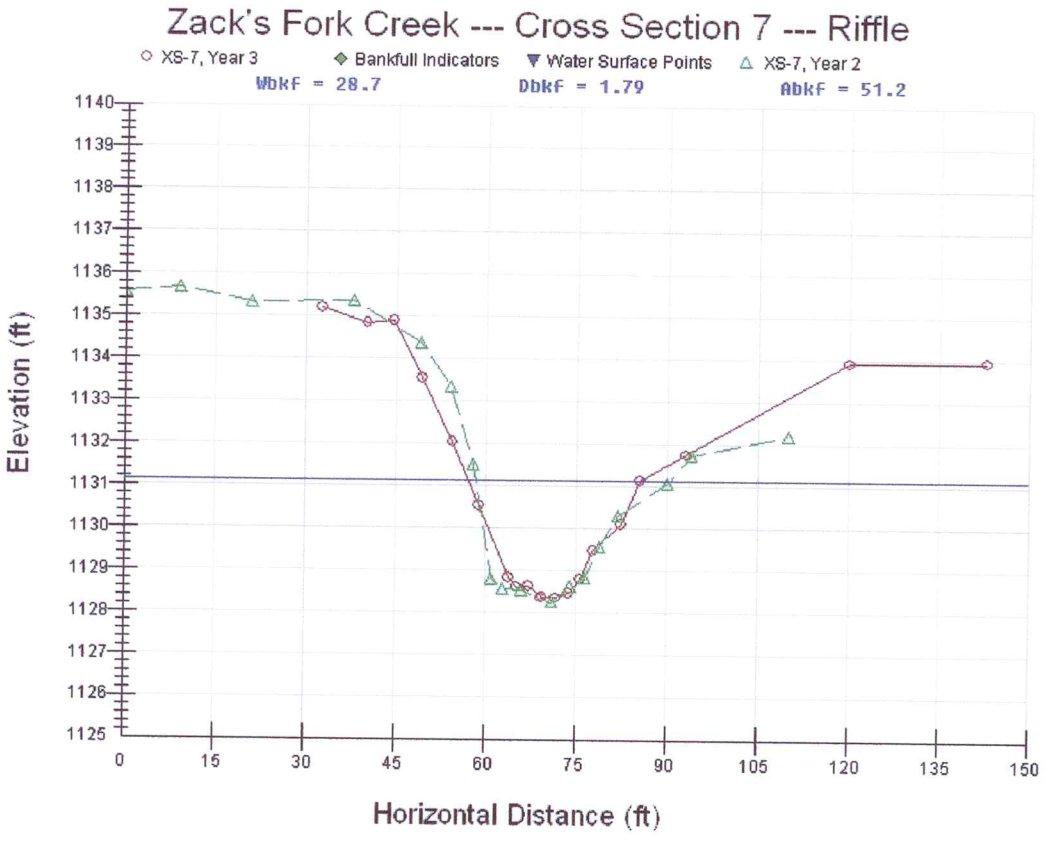

Zack's Fork Creek --- Cross Section 2 --- Riffle
XS-2, Year 3
Bankfull Indicators
Water Surface Points
XS-2, Year 2
WbkF = 28.4
DbkF = 2.8
AbkF = 79.4
Elevation (ft)
1125
1124
1123
1122
1121
1120
1119
1118
1117
1116
1115
1114
1113
1112
1111
1110
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)

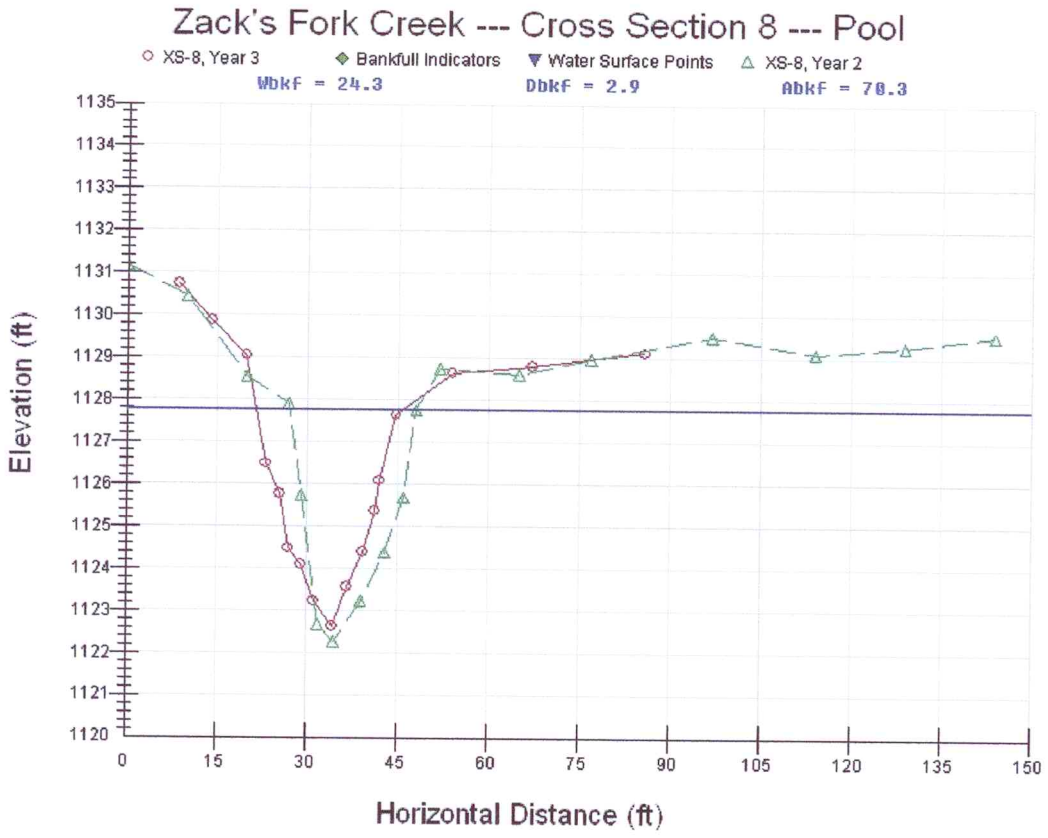

Zack's Fork Creek --- Cross Section 3 --- Pool
XS-3, Year 3
Bankfull Indicators
Water Surface Points
XS-3, Year 2
WbkF = 32.4
DbkF = 3.09
AbkF = 100.2
Elevation (ft)
1130
1129
1128
1127
1126
1125
1124
1123
1122
1121
1120
1119
1118
1117
1116
1115
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)

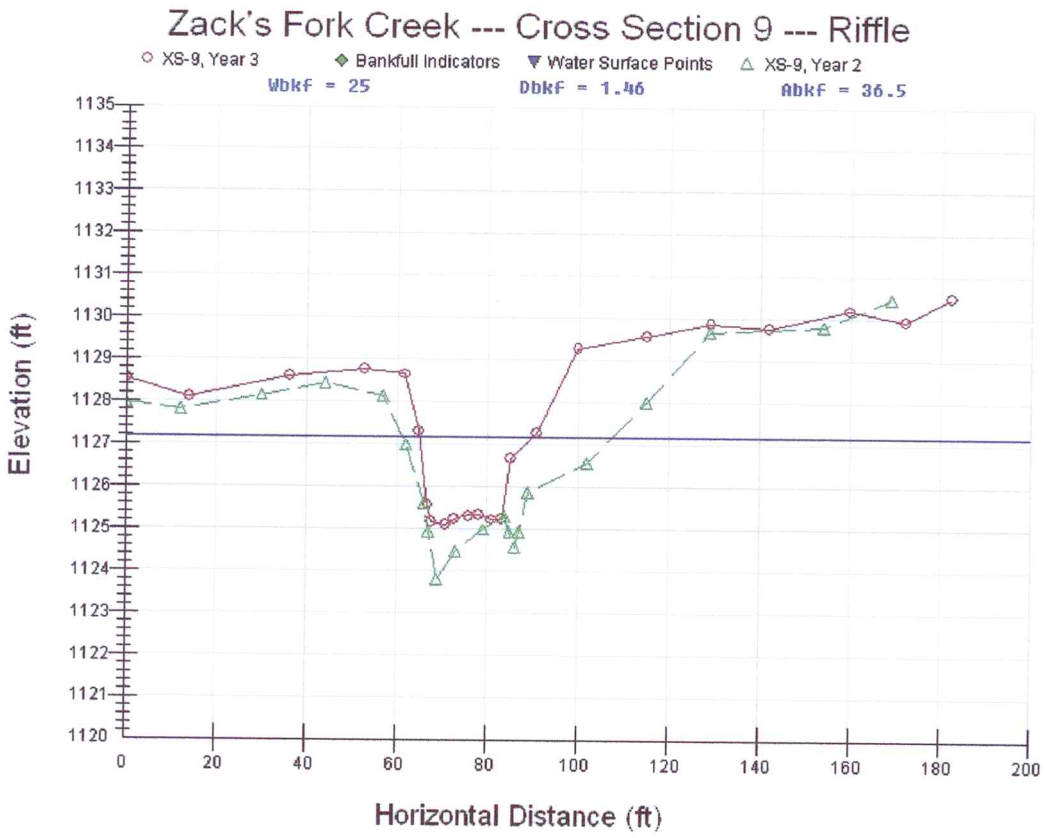

Zack's Fork Creek --- Cross Section 4 --- Riffle
XS-4, Year 3
Bankfull Indicators
Water Surface Points
XS-4, Year 2
WbkF = 30.2
DbkF = 1.72
AbkF = 52.1
Elevation (ft)
1130
1129
1128
1127
1126
1125
1124
1123
1122
1121
1120
1119
1118
1117
1116
1115
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)

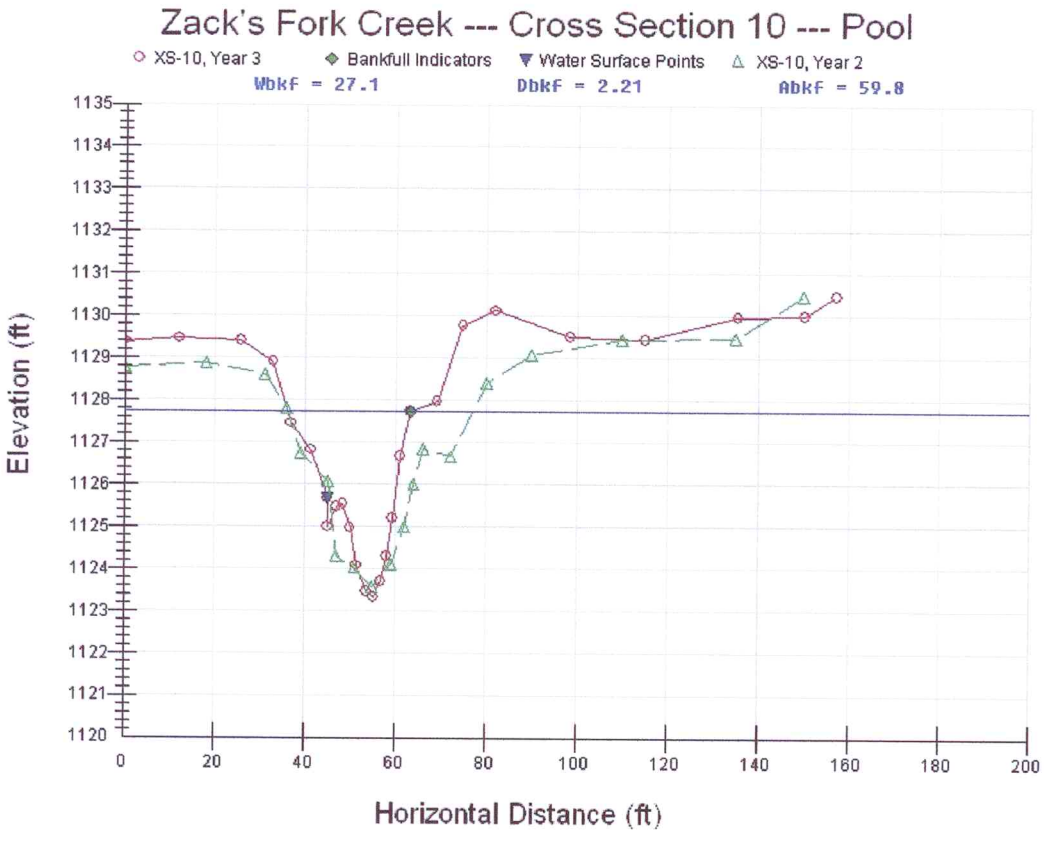

Zach's Fork Creek --- Cross Section 5 --- Pool
XS-5, Year 3
Bankfull Indicators
Water Surface Points
XS-5, Year 2
WbkF = 33.8
DbkF = 4.21
AbkF = 142.5
Elevation (ft)
1130
1129
1128
1127
1126
1125
1124
1123
1122
1121
1120
1119
1118
1117
1116
1115
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)


Zack's Fork Creek --- Cross Section 6 --- Pool
XS-6, Year 3
Bankfull Indicators
Water Surface Points
XS-6, Year 2
WbkF = 26.2
DbkF = 2.88
AbkF = 75.4
Elevation (ft)
1138
1137
1136
1135
1134
1133
1132
1131
1130
1129
1128
1127
1126
1125
1124
1123
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)


Zack's Fork Creek --- Cross Section 7 --- Riffle
XS-7, Year 3
Bankfull Indicators
Water Surface Points
XS-7, Year 2
WbkF = 28.7
DbkF = 1.79
AbkF = 51.2
Elevation (ft)
1140
1139
1138
1137
1136
1135
1134
1133
1132
1131
1130
1129
1128
1127
1126
1125
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)


Zack's Fork Creek --- Cross Section 8 --- Pool
XS-8, Year 3
Bankfull Indicators
Water Surface Points
XS-8, Year 2
WbkF = 24.3
DbkF = 2.9
AbkF = 70.3
Elevation (ft)
1135
1134
1133
1132
1131
1130
1129
1128
1127
1126
1125
1124
1123
1122
1121
1120
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)


Zack's Fork Creek --- Cross Section 9 --- Riffle
XS-9, Year 3
Bankfull Indicators
Water Surface Points
XS-9, Year 2
Wbkf = 25
Dbkf = 1.46
Abkf = 36.5
Elevation (ft)
1135
1134
1133
1132
1131
1130
1129
1128
1127
1126
1125
1124
1123
1122
1121
1120
0
20
40
60
80
100
120
140
160
180
200
Horizontal Distance (ft)


Zack's Fork Creek --- Cross Section 10 --- Pool
XS-10, Year 3
Bankfull Indicators
Water Surface Points
XS-10, Year 2
Wbkf = 27.1
Dbkf = 2.21
Abkf = 59.8
Elevation (ft)
1135
1134
1133
1132
1131
1130
1129
1128
1127
1126
1125
1124
1123
1122
1121
1120
0
20
40
60
80
100
120
140
160
180
200
Horizontal Distance (ft)

APPENDIX B – Structures, Representative Photographs

Photo Station 1

Photo Station 2

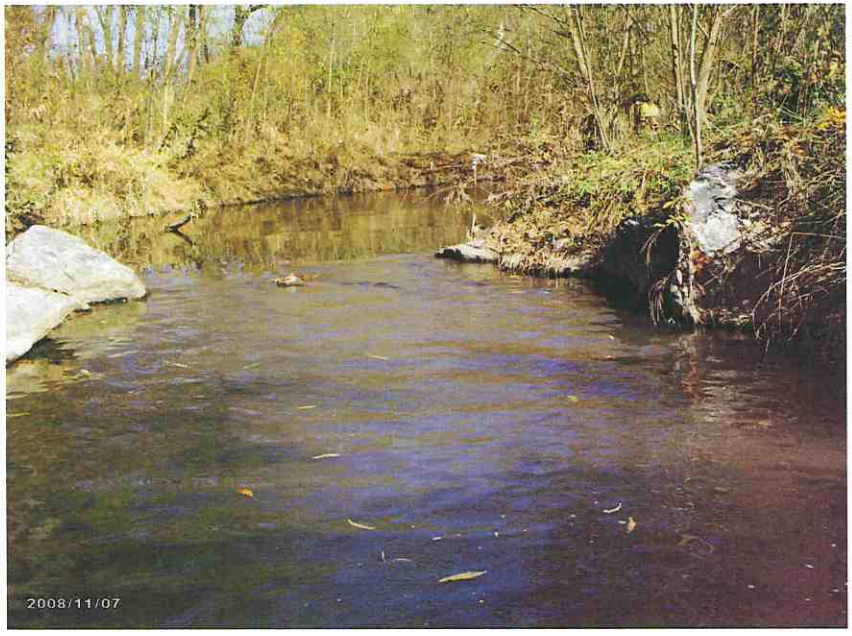


Photo Station 3

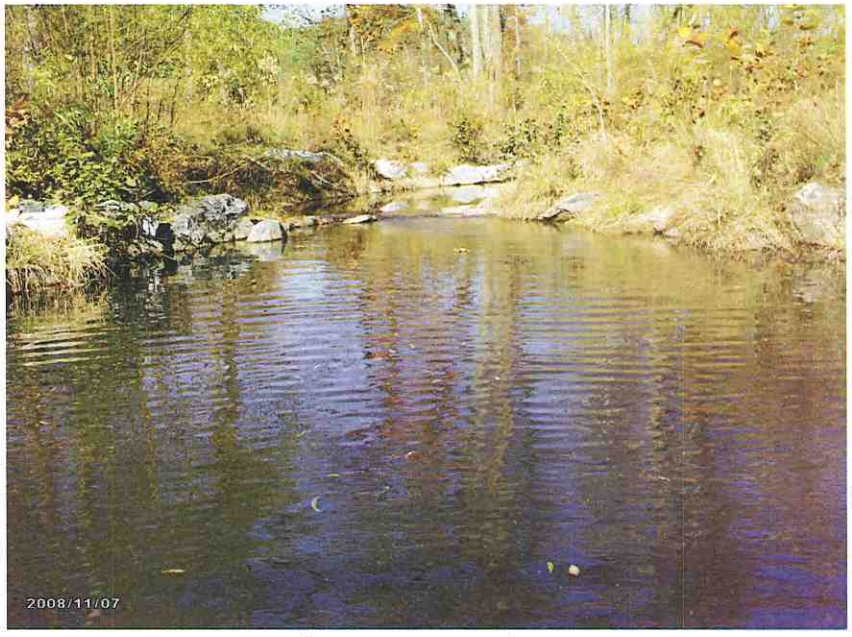


Photo Station 4

Photo Station 5

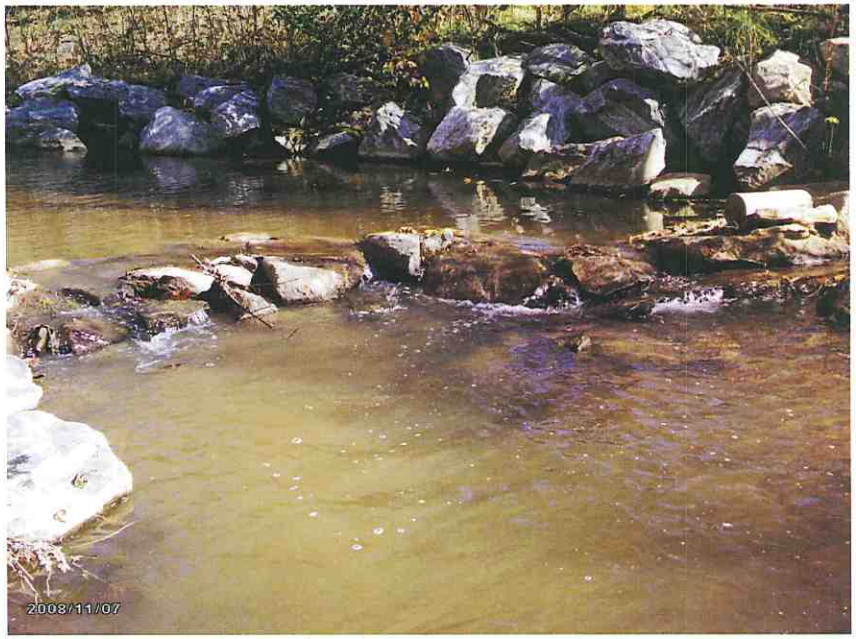


Photo Station 6

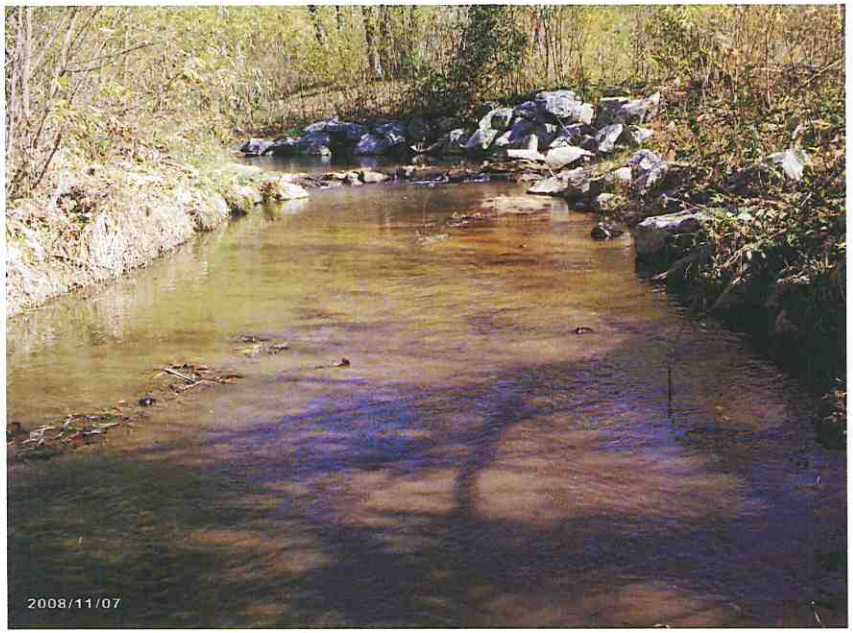


Photo Station 7

Photo Station 8

Photo Station 9

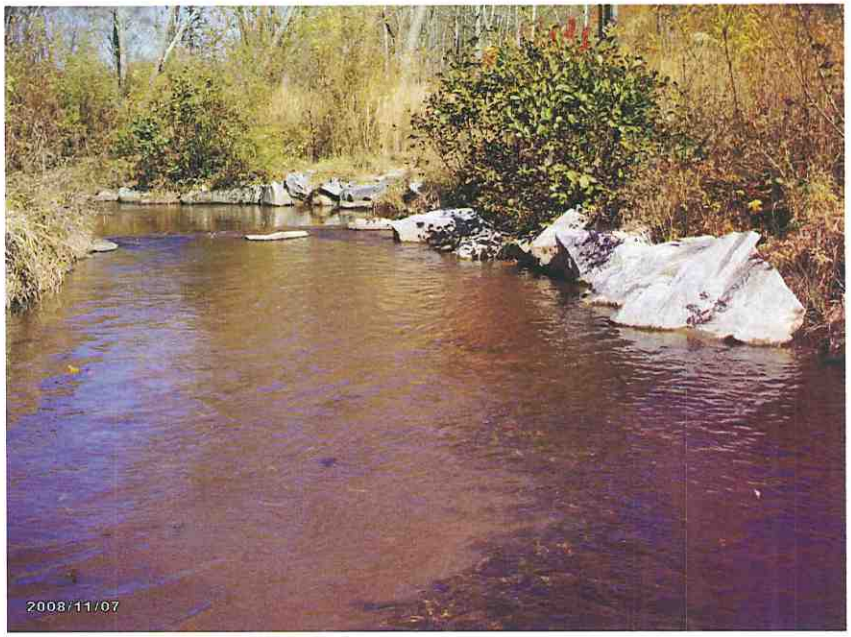


Photo Station 10

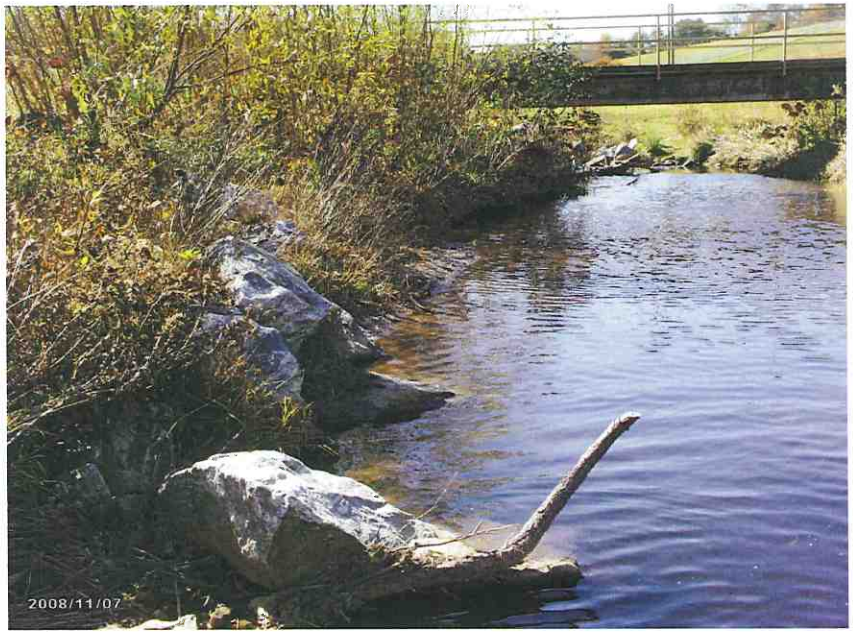


Photo Station 11

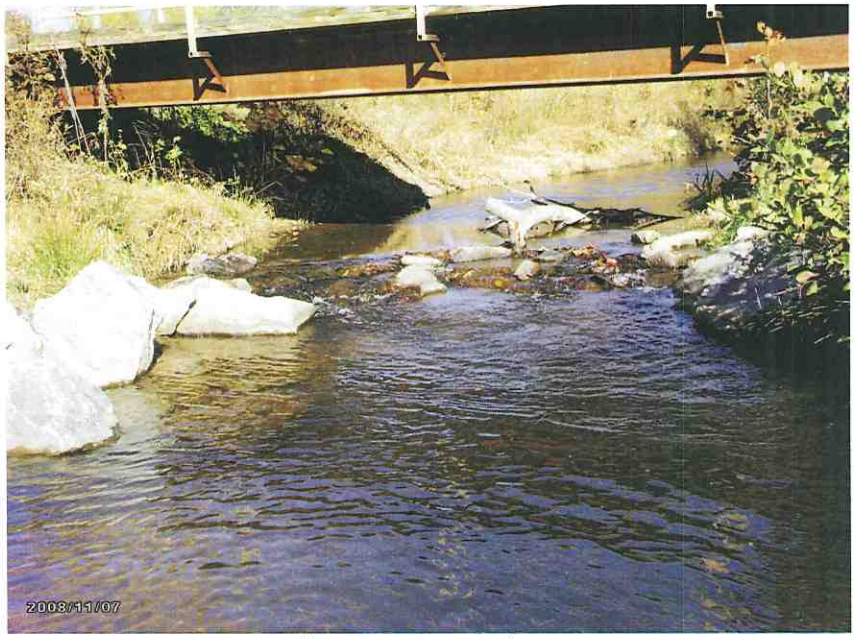


Photo Station 12

Photo Station 13

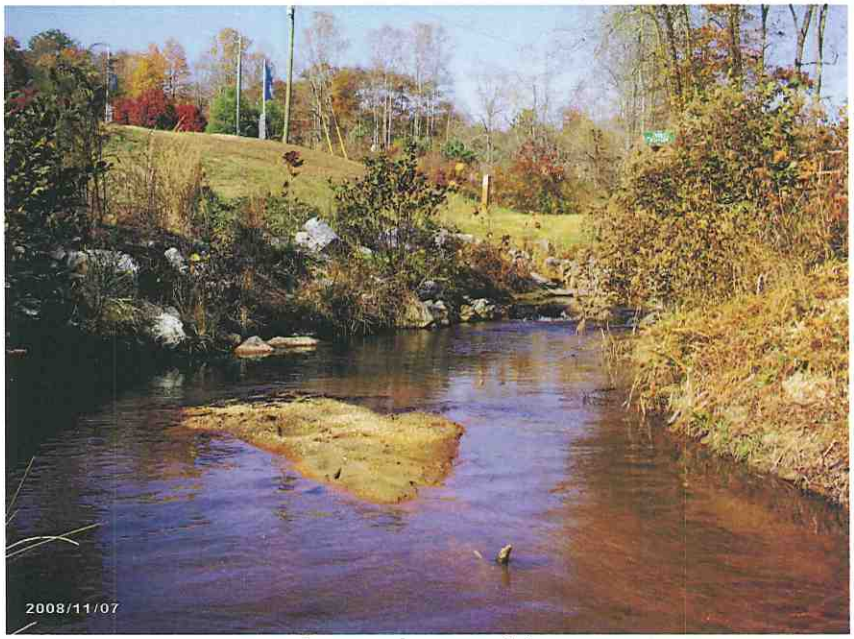


Photo Station 14

Photo Station 15

Photo Station 16

Photo Station 17

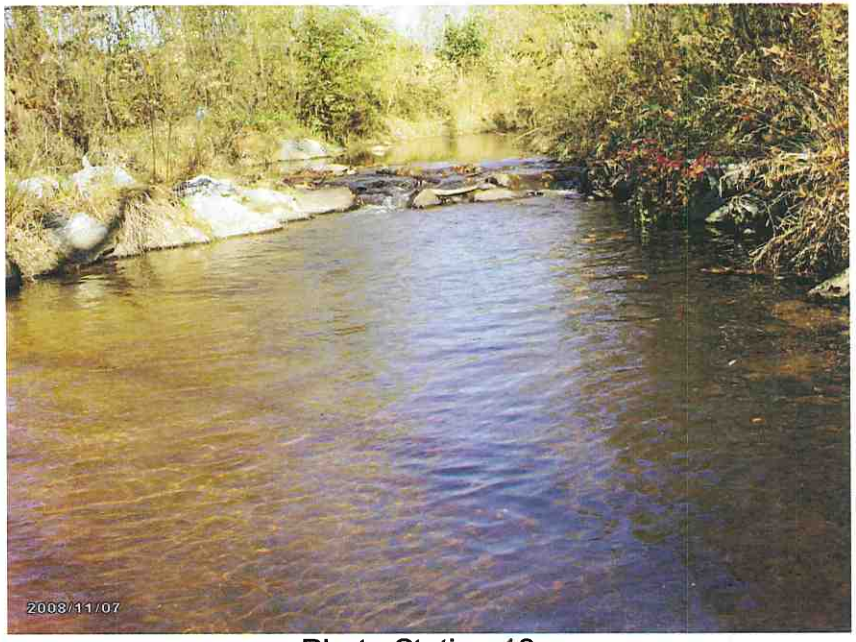


Photo Station 18

Photo Station 19

Photo Station 20

Photo Station 21

Photo Station 22

Photo Station 23

Photo Station 24

Photo Station 25

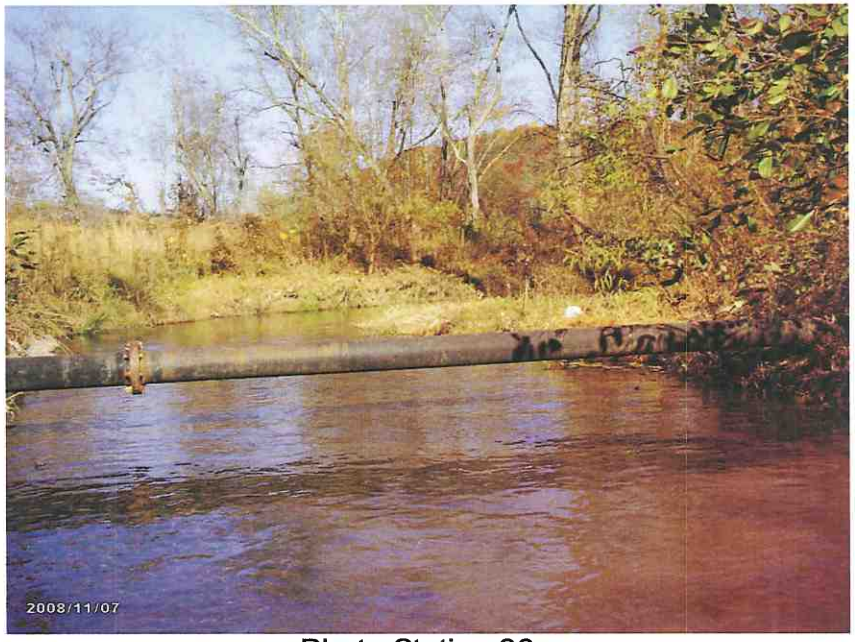


Photo Station 26

Photo Station 27

Photo Station 28

Photo Station 29

Photo Station 30

Photo Station 31

Photo Station 32

Photo Station 33

Photo Station 34

Photo Station 35

Photo Station 36

Photo Station 37

Photo Station 38

Photo Station 39

Photo Station 40

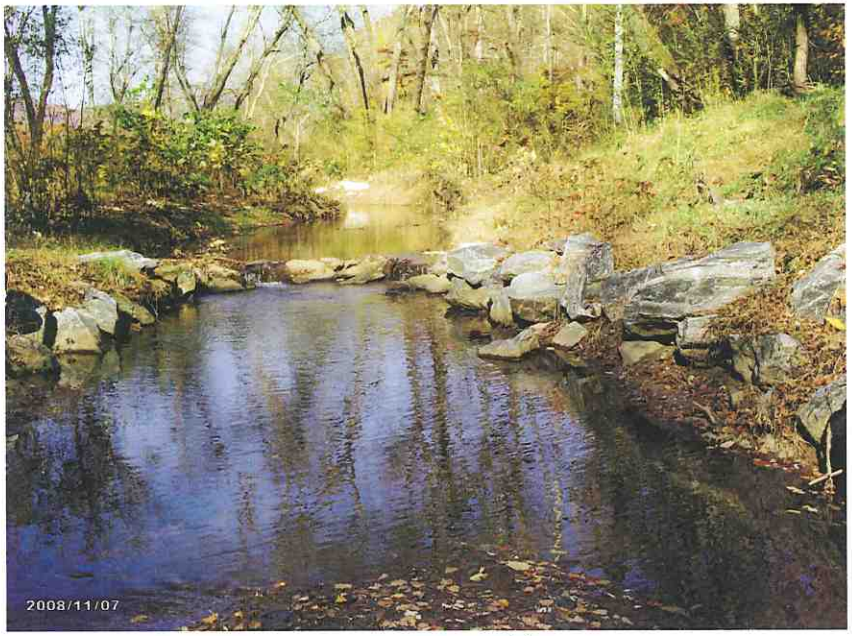


Photo Station 41

Photo Station 42

Photo Station 43

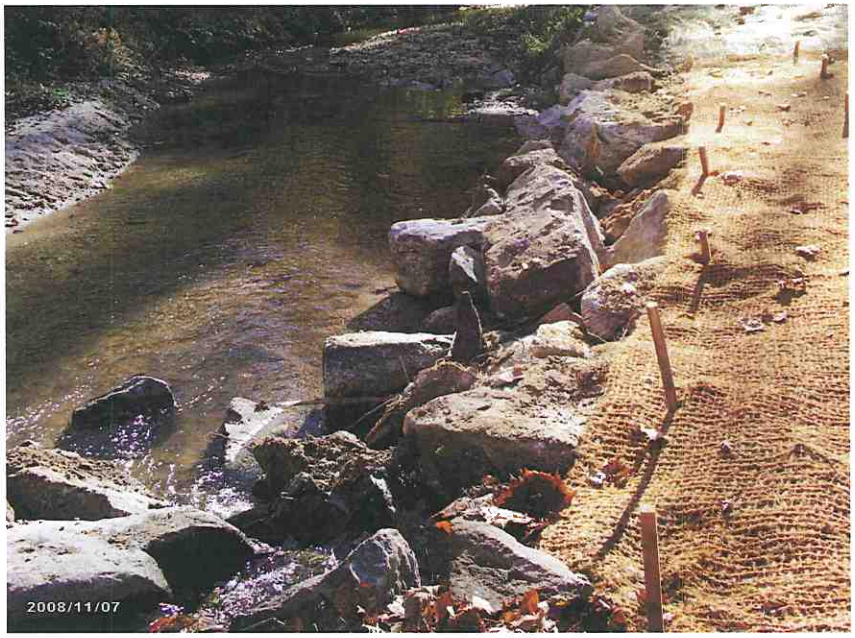


Photo Station 44

Photo Station 45

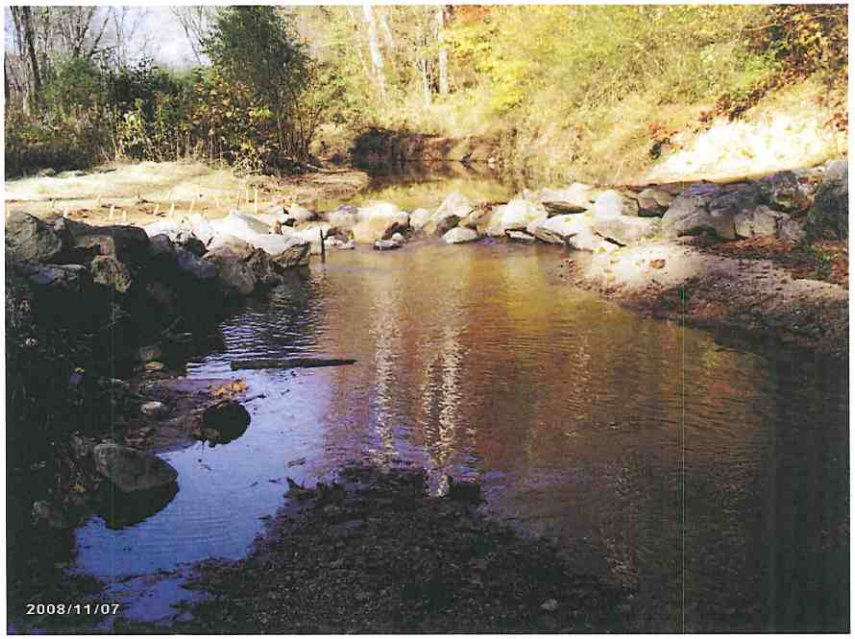


Photo Station 46

Photo Station 47

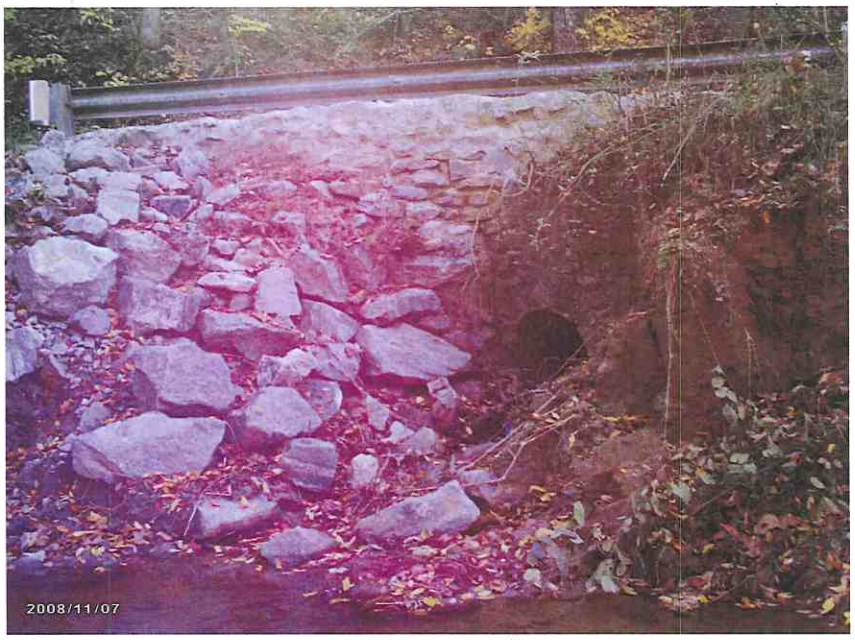


Photo Station 48

APPENDIX C –Vegetative Plots, Representative Photographs

Vegetative Plot 1

Vegetative Plot 2

Vegetative Plot 3

Vegetative Plot 4

Vegetative Plot 5

Vegetative Plot 6

Vegetative Plot 7

Vegetative Plot 8

Vegetative Plot 9

Vegetative Plot 10

Vegetative Plot 11

APPENDIX D – Stream Problem Areas, Representative Photographs

Problem Area 1 - vegetated mid-bar

Problem Area 2 - vegetated mid-bar

Problem Area 3 - fallen tree across channel

Problem Area 4 - beaver dam

Problem Area 5 - pipe and debris, partial occlusion

Problem Area 6 - log vane beginning to backcut

Problem Area 7 - log vane backcut

Problem Area 8 - mid-bar and active bank erosion

Problem Area 9 - log vane displaced

Problem Area 10 - mid-bar accreting