Year 3 Monitoring Report

Clear Creek Stream Restoration

February 2006
S&EC Project No. 9446.D1
EEP Project No. 00019

Designed by EcoLogic Associates

Prepared for

Ecosystem Enhancement PROGRAM

NCEEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

Table of Contents

I. Executive Summary / Project Abstract

Due to historic channel modifications such as channelization and hoof shear, Clear Creek was left in an impaired state. The restoration project, located in Henderson County, was designed by EcoLogic Associates using natural channel design methods and was restored in 2002. This report serves as the Year 3 Annual Monitoring report.

Monitoring of the vegetated buffer was performed during the growing season of 2005, by Soil & Environmental Consultants, PA. Stem counts were preformed within the established vegetation monitoring plots, resulting in a live stem density of approximately 566 stems per acre.

The physical stream channel was surveyed, and a visual stability assessment was performed for the Clear Creek Stream Restoration project. While there are several problem areas along the restored channel, the overall channel is stable and successful. In 2006, the Year 4 of 5 monitoring will commence.

II. Project Background

The background information for this report is referenced from previous monitoring reports submitted by EcoLogic Associates.

A. Location and Setting

The Clear Creek stream restoration project is located between I-26 and Clear Creek Road in Henderson County, NC. The site, a fourth order tributary to Mud Creek in the French Broad River Basin, is located in a relatively low slope mountain valley.

B. Structure and Objectives

Prior to restoration, the majority of the reach's stream banks were nearly vertical and exposed, with minimal vegetative cover. As a result, the banks were actively eroding, subsequently slumping and promoting lateral channel migration and meander creation. The degraded channel was classified as an "F" type channel under the Rosgen Stream Classification System. Some sections of channel had limited access to their historic flood plain (due to incision) during peak flood flows but not bankfull events that might typically occur as a result of the 1.5 to 2 year storm event.

The project included 1,300 linear feet of stream restoration. These figures are shown in Tables I and II.

Table I: Project Structure Table
Clear Creek Stream Restoration Site (EEP Project #00019)

Segment/Reach ID	Linear Feet or Acreage
Clear Creek	1,300 linear feet

Table II: Project Objectives Table
Clear Creek Stream Restoration Site (EEP Project #00019)

Segment/Reach ID	Objectives	Linear Feet or Acreage	Comment
Clear Creek	Restoration	1,300 lf	

C. Project History and Background

Construction of the Clear Creek Stream Restoration began in early 2002 with construction ending in Fall of 2002. The As-built survey was completed in early 2003. 2005 served as Year 3 of monitoring. Additional details regarding the timeline of the project are included in Table III.

Table III: Project Activity and Reporting History
Clear Creek Stream Restoration Site (EEP Project #00019)

Activity or Report	Calendar Year of Completion or Planned Completion	Actual Completion Date
Existing Conditions Survey		Dec-01
Restoration Design Report		Mar-02
Mitigation Plan		
Monitoring Plan		Oct-02
Construction		
Temporary S&E mix applied		
As-Built report		
Permanent seed mix applied		
Containerized and B&B plantings		
Initial-Year 1 monitoring	2003	
Year 2 monitoring	2004	
Year 3 monitoring	2005	Dec-05
Year 4 monitoring	2006	
Year 5 monitoring	2007	

The project was designed by EcoLogic Associates. The construction contractor is unknown. Monitoring activities for Year 3 were performed by S&EC. Additional information regarding contractors is shown in Table IV.

Table IV: Project Contact Table
Clear Creek Stream Restoration Site (EEP Project #00019)

Designer	EcoLogic Associates Greensboro, NC
Monitoring Performers	Soil & Environmental Consultants, PA 11010 Raven Ridge Road Raleigh, NC 27614
Stream Monitoring POC	Rebecca Wargo, S&EC
Vegetation Monitoring POC	Jessica Regan, S&EC

The project is located within Henderson County, portions of which are located within the Blue Ridge Belt of the Mountains of North Carolina. The site is located within a moderately rural area. Additional information regarding the stream is included as Table V.

Table V: Project Background Table Clear Creek Stream Restoration Site (EEP Project #00019)	
Project County	Henderson
Drainage Area	44 sq. miles
Drainage impervious cover estimate (%)	20%
Stream Order	4th order
Physiographic Region	Mountains
Ecoregion	Blue Ridge Belt
Rosgen Classification of As-Built	C4
Cowardin Classification	N/A
Dominant Soil Types	Codorus
Reference Site ID	N/A
USGS HUC for Project and Reference	06010105
NCDWQ Sub-basin for Project and Reference	
NCDWQ classification for Project	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
% of project easement fenced	0

D. Monitoring Plan View

A series of monitoring devices were previously established onsite. A total of three (3) individual cross-sections were located. Cross-sections were surveyed from left to right facing downstream. Each cross-section is also a designated photographic point that will be photographed annually. There are permanent photo points located at various points along the length of the channel.

Four (4) vegetation plots are located along the length of the channel. All plots are approximately 10m x 10m square plots located within the riparian buffer.

The locations of all monitoring devices are shown on Sheets 1 and 2 (Monitoring Plan View).

III. Project Condition and Monitoring Results

A. Vegetation Assessment

Planted zones related to the stream restoration consisted of the riparian buffer zone and the stream banks. The riparian buffer zone initiates at the top of the bank and continues out perpendicular from the stream. The planted stream bank initiates at the normal base flow elevation and extends to the top of bank or interface with the flood plain. Established success criteria require that, at the end of the 5-year monitoring period, 320 live stems per acre are present on-site.

1. Soil Data

The project site is located in the Blue Ridge Belt region of the North Carolina Mountain physiographic province. Soils present in the riparian areas adjacent to Clear Creek are characteristic of those found in recently deposited alluvial materials derived from upland soils materials weathered from mostly metamorphic and crystalline rocks. However, modifications associated with agricultural practices has likely redistributed much of the naturally occurring soils on site.

Codorus soils (*Fluvaquentic Dystrudepts*) are the prevalent map unit along the channel. Formed in recently deposited alluvial materials derived from upland soils materials weathered from mostly metamorphic and crystalline rocks, they are very deep, moderately well drained and somewhat poorly drained soils. Codorus soils are also found on floodplains with smooth, nearly level slopes.

Table VI: Preliminary Soil Data
Clear Creek Stream Restoration Site (EEP Project #00019)

Series	Max Depth (in.)	% Clay on Surface	K	T	OM %
Codorus (Co)	60	15-25	0.37	2	1.0-5.0

2. Problem Areas Plan View (vegetation)

Upon inspection on August 10, 2005, it was noted that a large population of *Kudzu* has infested the upstream end of the restoration reach.

3. Vegetative Problem Areas Plan View

The vegetative problem area is shown on Sheets 3 and 4 (Problem Area Plan View). A representative photo is included in Appendix A.

4. Stem Counts

Table VIII: Stem Counts for Each Species Arranged by Plot
Clear Creek Stream and Buffer Restoration Site (EEP Project #00019)

Species	Plots				Year 3 Totals
	1	**2**	**3**	**4**	
American Sycamore ***(Plantanus occidentalis)***	1			5	6
Willow Oak ***(Quercus phellos)***	1		1		2
Silver Maple ***(Acer saccharinum)***			2		2
Black Willow ***(Salix Nigra)***	2	3		4	9
Green Ash ***(Fraxinus pennsylvanica)***				1	1
Silky Dogwood ***(Cornus amomum)***	4	5		2	11
River Birch ***(Betula nigra)***	8	7	2	2	64
Box Elder ***(Acer negundo)***	2			1	3
Anisetree ***(Ilicium)***		2			2
Year 3 Totals	**18**	**17**	**5**	**15**	55
Average Live Stem Density/acre	**556**				

The average stems per sample plot is 14 stems. A review of the sample plots (averaging 14 stems per plot) reveals a current (2005 – Year Three) site density of approximately 556 stems per acre.

5. Vegetation Photo Plots

Photos taken during the October 10, 2005 Vegetation Sampling event are included as Appendix A.

B. Stream Assessment

1. Problem Areas Plan View (Stream)

An assessment of channel stability was preformed on August 10, 2005, by S&EC. Areas of concern that were observed and documented included localized bank scour, and stressed or failing structures. These problem areas are shown on Sheets 3 through 4 – Problem Area Plan View.

2. Problem areas table summary

Table IXa: Stream Problem Areas
Clear Creek Stream Restoration Site (EEP Project #00019)

Feature Issues	Station numbers	Suspected Cause	Photo number
Bank Scour	1+21 to 1+66	Scour at arm of crossvane	Stream Problem Area Photos 1-2
	2+12 to 2+29	Scour at arm of crossvane	
	9+75 to 10+07	Root wads on outside bend, excessive scour	
	10+68 to 10+92	Root wads on outside bend (near crossvane), excessive scour	
Stressed or Failing Structures	9+75 to 10+07	Root wads on outside bend, excessive scour	Stream Problem Area Photo 2
	10+68 to 10+92	Root wads on outside bend (near crossvane), excessive scour	

3. Numbered issues photo section

Representative photos of each category of stream problem area were taken and are shown in Appendix B.

4. Fixed photo station photos

Photos from established photo stations were collected on August 10, 2005. These photos are included in Appendix B. No photos from the Year 2(2004) monitoring were provided, therefore only Year 3(2005) photos are shown.

5. Stability Assessment

A visual qualitative assessment was performed to inspect channel facets, meanders, bed, banks, and installed structures. This visual assessment was confirmed and enhanced with a quantitative assessment of the physical stream survey. The goal of this assessment is to provide a percentage of the features listed in Table X that are in a state of stability. Table X was compiled from the data in Table B1 in Appendix B of this report.

Table X: Categorical Stream Feature Visual Stability Assessment
Clear Creek Stream Restoration Site (EEP Project # 00019)

Feature	Initial 2002	MY-1 2003	MY-2 2004	MY-3 2005
A. Riffles	*	*	*	90%
B. Pools	*	*	*	100%
C. Thalweg	*	*	*	100%
D. Meanders	*	*	*	100%
E. Bed General	*	*	*	100%
F. Channel General	*	*	*	80%
G. Banks	*	*	*	98%
H. Vanes/ J Hooks, etc.	*	*	*	85%
I. Wads and Boulders	*	*	*	63%

** Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.*

6. Quantitative Morphology

The following tables (Table XI and Table XII) summarize the quantitative data collected from the cross-sectional and longitudinal stream survey. This data was analyzed and summarized, and then compared with baseline data types available for this project. The Quantitative Morphology Tables illustrate the degree of departure, if any, of the current channel from the baseline data. Tables XI and XII were compiled from the cross-section and profile raw data and plots located in Appendix B of this report.

Based on a review of available site data and observations made during 2005 site visits, no crest gauge has been installed on the site. A review of available on-line USGS gauge sites was performed to determine if a suitable surrogate gauge was present in the area. No nearby gauge was identified. The closest USGS gauge to the site was on the French Broad River (near Fletcher, NC Guage Identification Number 03447687) which is approximately 7.576 miles from the project site. Based on this large distance, significant disparity in watershed sizes, and topographic variation, it is unlikely that a conclusive determination regarding the number of bankfull events experienced on the restoration site could be made.

Table XI. Baseline Morphology and Hydraulic Summary
CLEAR CREEK STREAM RESTORATION SITE (EEP Project #00019)

Parameter	Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
BF Width (ft)	*	*	53	*	*	69	*	*	73	*	*	*
Floodprone Width (ft)	*	*	129	*	*	220	*	*	275	*	*	*
BF Cross Sectional Area (ft^2)	*	*	246	*	*	199	*	*	339	*	*	*
BF Mean Depth (ft)	*	*	4.64	*	*	2.9	*	*	4.66	*	*	*
BF Max Depth (ft)	*	*	7.7	*	*	5.2	*	*	7	*	*	*
Width/Depth Ratio	*	*	11.4	*	*	23.9	*	*	15.6	*	*	*
Entrenchment Ratio	*	*	2.4	*	*	3.2	*	*	3.8	*	*	*
Wetted Perimeter(ft)	*	*	*	*	*	*	*	*	*	*	*	*
Hydraulic radius (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Pattern												
Channel Beltwidth (ft)	*	*	67-100	*	*	*	*	*	130.8528	*	*	*
Radius of Curvature (ft)	*	*	69	*	*	*	*	*	90-150	*	*	*
Meander Wavelength (ft)	*	*	230	*	*	*	*	*	763.308	*	*	*
Meander Width ratio	*	*	1.6	*	*	*	*	*	1.8	*	*	*
Profile												
Riffle length (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Riffle slope (ft/ft)	*	*	0.008	*	*	0.022	*	*	0.003	*	*	*
Pool length (ft)	*	*	87	*	*	133-285	*	*	80	*	*	*
Pool spacing (ft)	*	*	235-393	*	*	250-631	*	*	300-420	*	*	*
Substrate												
d50 (mm)	*	*	3	*	*	45	*	*	3	*	*	*
d84 (mm)	*	*	20	*	*	425	*	*	20	*	*	*
Additional Reach Parameters												
Valley Length (ft)		*			*			*			*	
Channel Length (ft)		*			*			*			*	
Sinuosity		1.09			1.2			1.17			*	
Water Surface Slope (ft/ft)		0.002			0.004			0.002			*	
BF slope (ft/ft)		*			*			*			*	
Rosgen Classification		C4			C4/1			C4			*	
*Habitat Index		*			*			*			*	
*Macrobenthos		*			*			*			*	

* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

Table XII. Morphology and Hydraulic Monitoring Summary
CLEAR CREEK STREAM RESTORATION SITE (EEP Project #00019)

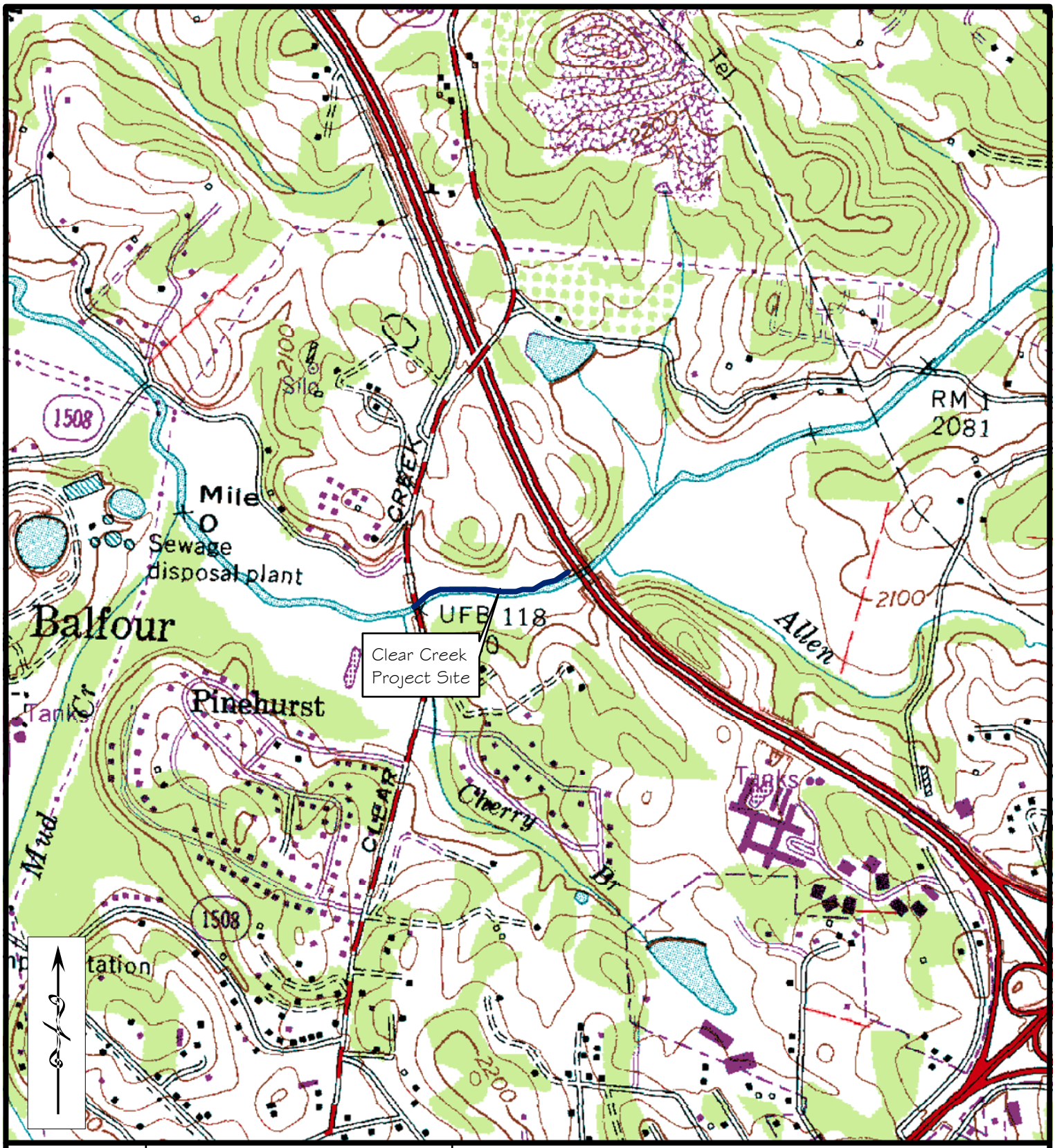
Parameter	Cross Section 1 Riffle			Cross Section 2 Pool			Cross Section 3 Riffle		
Dimension	**MY1**	**MY2**	**MY3**	**MY1**	**MY2**	**MY3**	**MY1**	**MY2**	**MY3**
	2003	**2004**	**2005**	**2003**	**2004**	**2005**	**2003**	**2004**	**2005**
BF Width (ft)	*	*	60.67	*	*	66.3	*	*	56.8
Floodprone Width (ft)	*	*	202.15	*	*	169.72	*	*	168.11
BF Cross Sectional Area (ft^2)	*	*	287.43	*	*	298.3	*	*	281.43
BF Mean Depth (ft)	*	*	4.74	*	*	4.5	*	*	4.95
BF Max Depth (ft)	*	*	5.91	*	*	7.99	*	*	7.7
Width/Depth Ratio	*	*	12.81	*	*	14.74	*	*	11.46
Entrenchment Ratio	*	*	3.33	*	*	2.56	*	*	2.96
Wetted Perimeter(ft)	*	*	65.66	*	*	71.09	*	*	61.38
Hydraulic radius (ft)	*	*	4.38	*	*	4.2	*	*	4.59
Substrate									
d50 (mm)	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*

Parameter	MY-1 (2003)			MY-2 (2004)			MY-3 (2005)		
Pattern	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Channel Beltwidth (ft)	*	*	*	*	*	*	131.17	152.58	143.07
Radius of Curvature (ft)	*	*	*	*	*	*	88.66	105.4	97.05
Meander Wavelength (ft)	*	*	*	*	*	*	497.22	575.58	536.4
Meander Width ratio	*	*	*	*	*	*	2.23306	2.59755	2.43565
Profile									
Riffle length (ft	*	*	*	*	*	*	15.27	88.82	37.67
Riffle slope (ft/ft	*	*	*	*	*	*	0.00069	0.00185	0.00142
Pool length (ft)	*	*	*	*	*	*	27.76	134.61	65.22
Pool spacing (ft)	*	*	*	*	*	*	260.2	291.1	310.62
Additional Reach Parameters									
Valley Length (ft)		*			*			1115	
Channel Length (ft)		*			*			1228	
Sinuosity		*			*			1.11	
BF slope (ft/ft)		*			*			0.00146	
Rosgen Classification		*			*			C4	
Habitat Index*		*			*			*	
Macrobenthos*		*			*			*	

* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

IV. Methodology Section

No unavoidable deviations from initially prescribed methodologies were implemented as a part of monitoring Year 3 activities.



Project No. 9446.D1	Figure 1 - Vicinity Map Clear Creek NCEEP Year 3 of 5 Henderson County, NC	
Project Mgr.: JR		
Scale: 1" = 1,000'		
12/08/05	Hendersonville Quadrangle	

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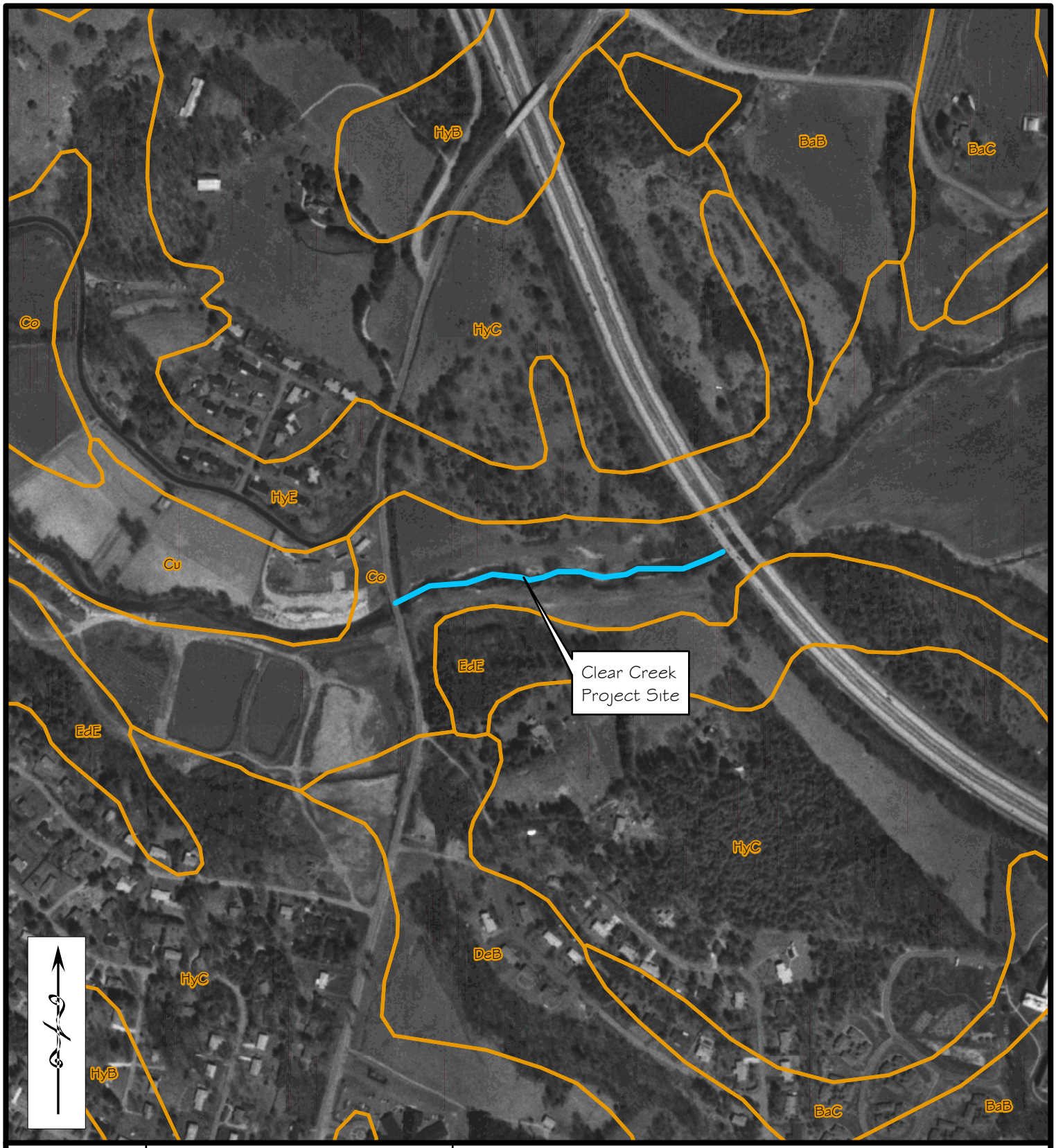
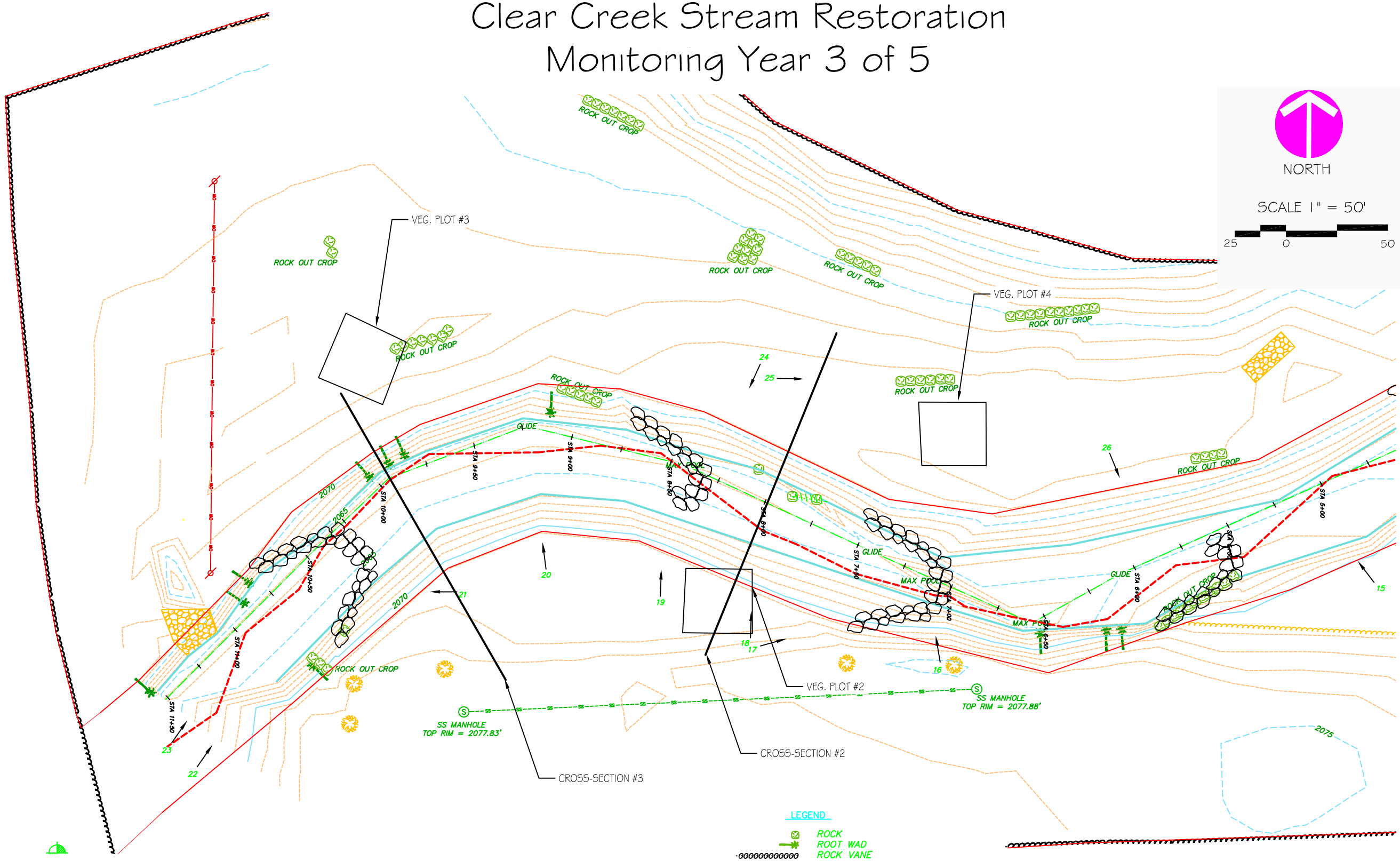


Project No. 9446.D1	Figure 2 - Soils Map Clear Creek NCEEP Year 3 of 5 Henderson County, NC	S&EC Soil & Environmental Consultants, PA 11010 Raven Ridge Rd. • Raleigh, NC 27614 (919) 846-5900 • (919) 846-9467 Web Page: www.SandEC.com
Project Mgr.: JR		
Scale: 1" = 500'		
12/08/05	Hendersonville Quadrangle	Ecosystem Enhancement Program

Clear Creek Stream Restoration
Monitoring Year 3 of 5



LEGEND

- ROCK
- ROOT WAD
- ROCK VANE
- LOG VANE
- FENCE
- THALWEG
- EDGE OF WATER
- THALWEG (AS SURVEYED BY ECOLOGIC)

BENCH MARK
NAIL IN 20" TREE
ELEV. = 2074.70'

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.

2.) All locations are approximate.

NOVEMBER 2005

MONITORING PLAN VIEW

Project No.: 9446.01 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 50'
Project: CLEAR CREEK STREAM RESTORATION | Client: NCEEP
Location: HENDERSON CO., NC | Sheet No.: 1 OF 4
Sheet Title: MONITORING PLAN VIEW-SEGMENT 1

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File: Sec\Jobs7-9k\9446.01\PAPV\9446-papv-11-14-05.dwg

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

NORTH

SCALE 1" = 50'

25 0 50

2075
2070
2065
ROCK OUT CROP
KUDZU
BANK SCOUR #3 / STRESSED STRUCTURE #1
BANK SCOUR #4 / STRESSED STRUCTURE #2
GLIDE
MAX POOL
STA 9+50
STA 8+00
STA 8+50
STA 7+50
STA 7+00
STA 6+50
STA 6+00
STA 5+50
STA 5+00
STA 10+00
STA 10+50
STA 11+00
STA 11+50
SS MANHOLE TOP RIM = 2077.83'
SS MANHOLE TOP RIM = 2077.88'

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.
2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 8/10/2005
3.) All locations are approximate.

LEGEND

- ROCK
- ROOT WAD
- ROCK VANE
- LOG VANE
- FENCE
- THALWEG
- EDGE OF WATER
- THALWEG (AS SURVEYED BY ECOLOGIC)

PROBLEM AREA PLAN VIEW

NOVEMBER 2005

File: S:\cvJobs\7-9k\9446.01\PAPV\9446-papv-11-14-05.dwg

Project No.: 9446.01 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 50'
Project: CLEAR CREEK STREAM RESTORATION
Location: HENDERSON CO., NC | Client: NCEEP
Sheet Title: PAPV - SEGMENT 1 | Sheet No.: 3 OF 4

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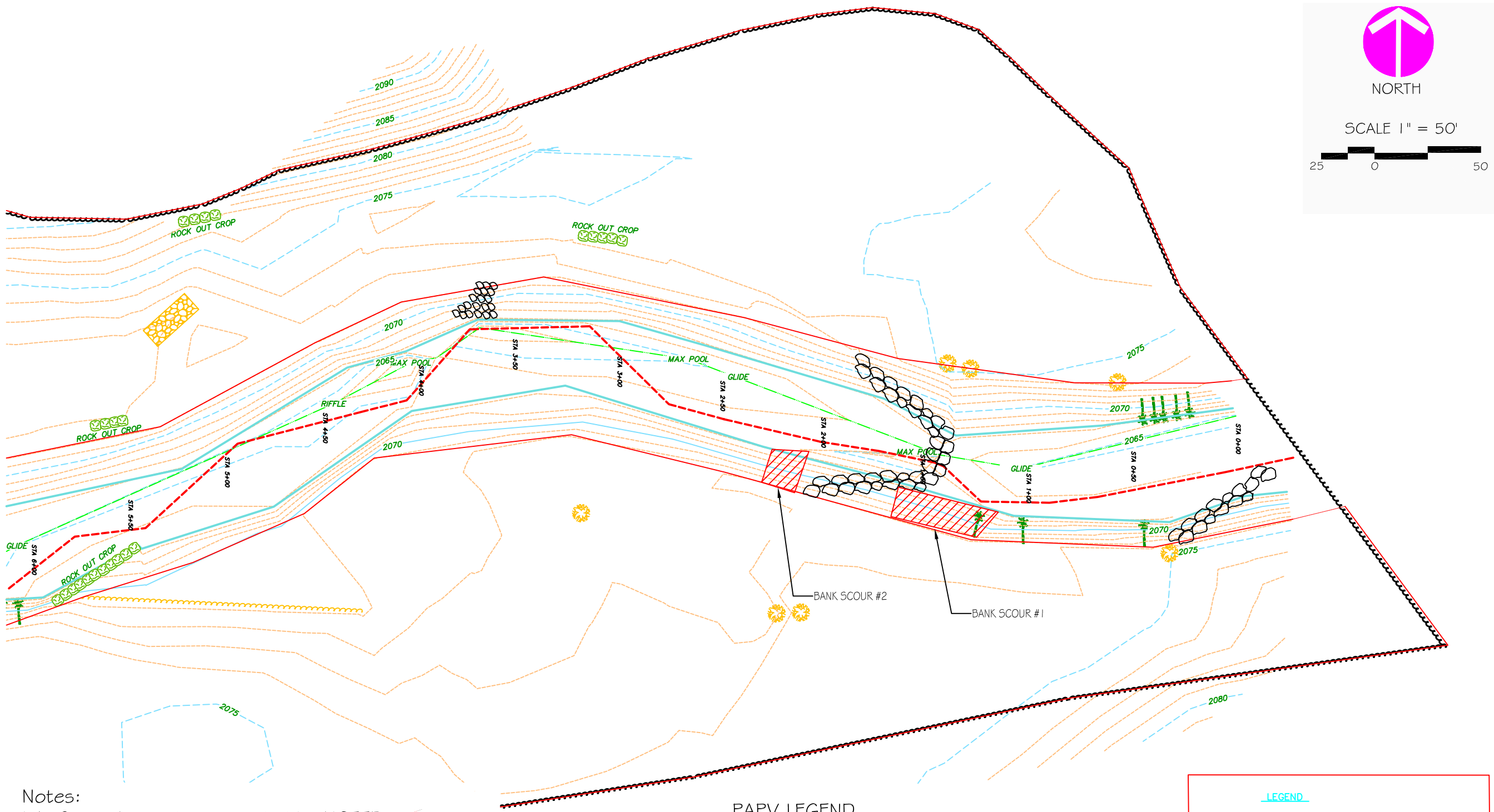

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.

2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 8/10/2005

3.) All locations are approximate.

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

LEGEND

- ROCK
- ROOT WAD
- ROCK VANE
- LOG VANE
- FENCE
- THALWEG
- EDGE OF WATER
- THALWEG (AS SURVEYED BY ECOLOGIC)

PROBLEM AREA PLAN VIEW

NOVEMBER 2005

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Project No.: 9446.D1 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 50'
Project: CLEAR CREEK STREAM RESTORATION
Location: HENDERSON CO., NC | Client: NCEEP
Sheet Title: PAPV - SEGMENT 2 | Sheet No.: 4 OF 4

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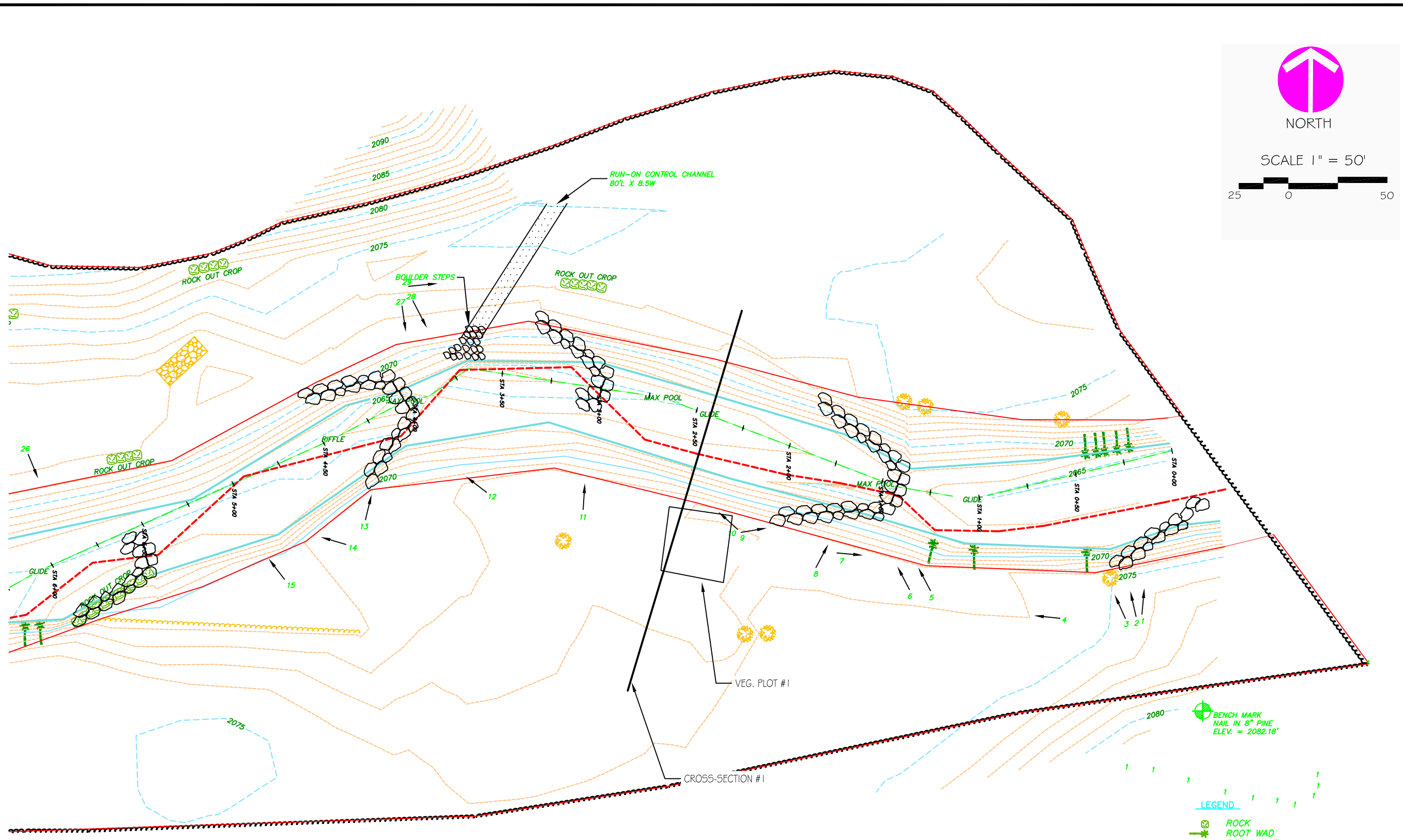

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.

2.) All locations are approximate.

MONITORING PLAN VIEW

NOVEMBER 2005

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Project No.: 9446.01 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 50'
Project: CLEAR CREEK STREAM RESTORATION
Location: HENDERSON CO., NC | Client: NCEEP
Sheet Title: MONITORING PLAN VIEW-SEGMENT 2 | Sheet No.: 2 OF 4

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APPENDIX A

APPENDIX A –

Vegetation Survey Data Tables

Table VIII: Stem Counts for Each Species Arranged by Plot
Clear Creek Stream and Buffer Restoration Site (EEP Project #00019)

Species	Plots				Year 3 Totals
	1	**2**	**3**	**4**	
American Sycamore ***(Plantanus occidentalis)***	1			5	6
Willow Oak ***(Quercus phellos)***	1		1		2
Silver Maple ***(Acer saccharinum)***			2		2
Black Willow ***(Salix Nigra)***	2	3		4	9
Green Ash ***(Fraxinus pennsylvanica)***				1	1
Silky Dogwood ***(Cornus amomum)***	4	5		2	11
River Birch ***(Betula nigra)***	8	7	2	2	64
Box Elder ***(Acer negundo)***	2			1	3
Anisetree ***(Ilicium)***		2			2
Year 3 Totals	**18**	**17**	**5**	**15**	55
Average Live Stem Density/acre	**556**				

EEP Stem Count Data Sheet

EEP Project #:	**00019**	**Date:**	October 10,2005
Project Name:	**Clear Creek**	**Staff Name:**	D. Gainey
Monitoring Contractor:	**S&EC**	**Staff Name:**	J. Regan
County:	**Henderson**		
8 Digit Catalog Unit	**06010105**		
Stream/Wetland Name:	**Clear Creek**		

Plot Location

Plot ID	Species	2004	Stem #
1	Birch		8
1	Box Elder		2
1	Silky		4
1	Black Willow		2
1	Sycamore		1
1	Willow Oak		1

Plot Location

Plot ID	Species	2004	Stem #
2	Birch		7
2	Dogwood		5
2	Illicium		2
2	Black Willow		3

Plot Location

Plot ID	Species	2004	Stem #
3	Silver Maple		2
3	Willow Oak		1
3	Birch		2
3			
3			
3			

Plot Location

Plot ID	Species	2004	Stem #
4	Ash		1
4	Dogwood		2
4	Elder		1
4	Sycamore		5
4	Black Willow		4
4	Birch		2
4			

APPENDIX A –

Vegetation Problem Area Photos

Photo 1—*Kudzu* population

APPENDIX A –

Vegetation Monitoring Plot Photos

Vegetation Plot #1—Year 3 (2005)

Vegetation Plot #2—Year 3 (2005)

Vegetation Plot #3—Year 3 (2005)

Vegetation Plot #4—Year 3 (2005)

APPENDIX B

APPENDIX B –

Representative Stream Problem Area Photos

Photo 1—Representative Bank Scour

Photo 2—Representative Bank Scour/Stressed or Failing Structure

APPENDIX B –

Stream Photo Point Photos

Permanent Photo Point #1—Year 3 (2005)

Permanent Photo Point #2—Year 3 (2005)

Permanent Photo Point #3—Year 3 (2005)

Permanent Photo Point #4—Year 3 (2005)

Permanent Photo Point #5—Year 3 (2005)

Permanent Photo Point #6—Year 3 (2005)

Permanent Photo Point #7—Year 3 (2005)

Permanent Photo Point #8—Year 3 (2005)

Permanent Photo Point #9—Year 3 (2005)

Permanent Photo Point #10—Year 3 (2005)

Permanent Photo Point #11—Year 3 (2005)

Permanent Photo Point #12—Year 3 (2005)

Permanent Photo Point #13—Year 3 (2005)

Permanent Photo Point #14—Year 3 (2005)

Permanent Photo Point #15—Year 3 (2005)

Permanent Photo Point #16—Year 3 (2005)

Permanent Photo Point #17—Year 3 (2005)

Permanent Photo Point #18—Year 3 (2005)

Permanent Photo Point #19—Year 3 (2005)

Permanent Photo Point #20—Year 3 (2005)

Permanent Photo Point # 21—Year 3 (2005)

Permanent Photo Point # 22—Year 3 (2005)

Permanent Photo Point #23—Year 3 (2005)

Permanent Photo Point #24—Year 3 (2005)

Permanent Photo Point #25—Year 3 (2005)

Permanent Photo Point #26—Year 3 (2005)

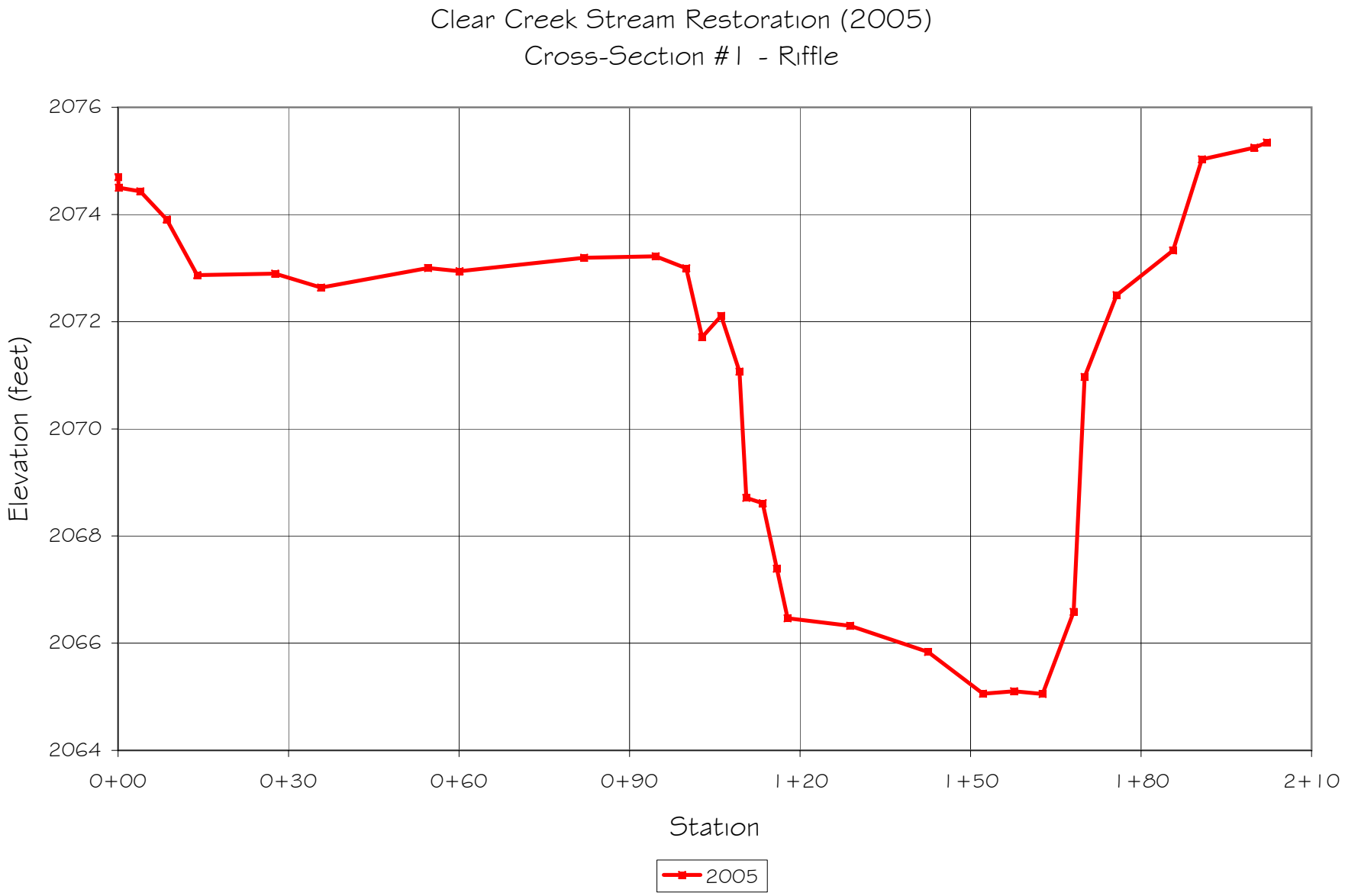
Permanent Photo Point #27—Year 3 (2005)

Permanent Photo Point #28—Year 3 (2005)

Permanent Photo Point #29—Year 3 (2005)

APPENDIX B –

Cross-section Data


Clear Creek Stream Restoration (2005)
Cross-Section #1 - Riffle
2076
2074
2072
2070
2068
2066
2064
Elevation (feet)
0+00
0+30
0+60
0+90
1+20
1+50
1+80
2+10
Station
2005

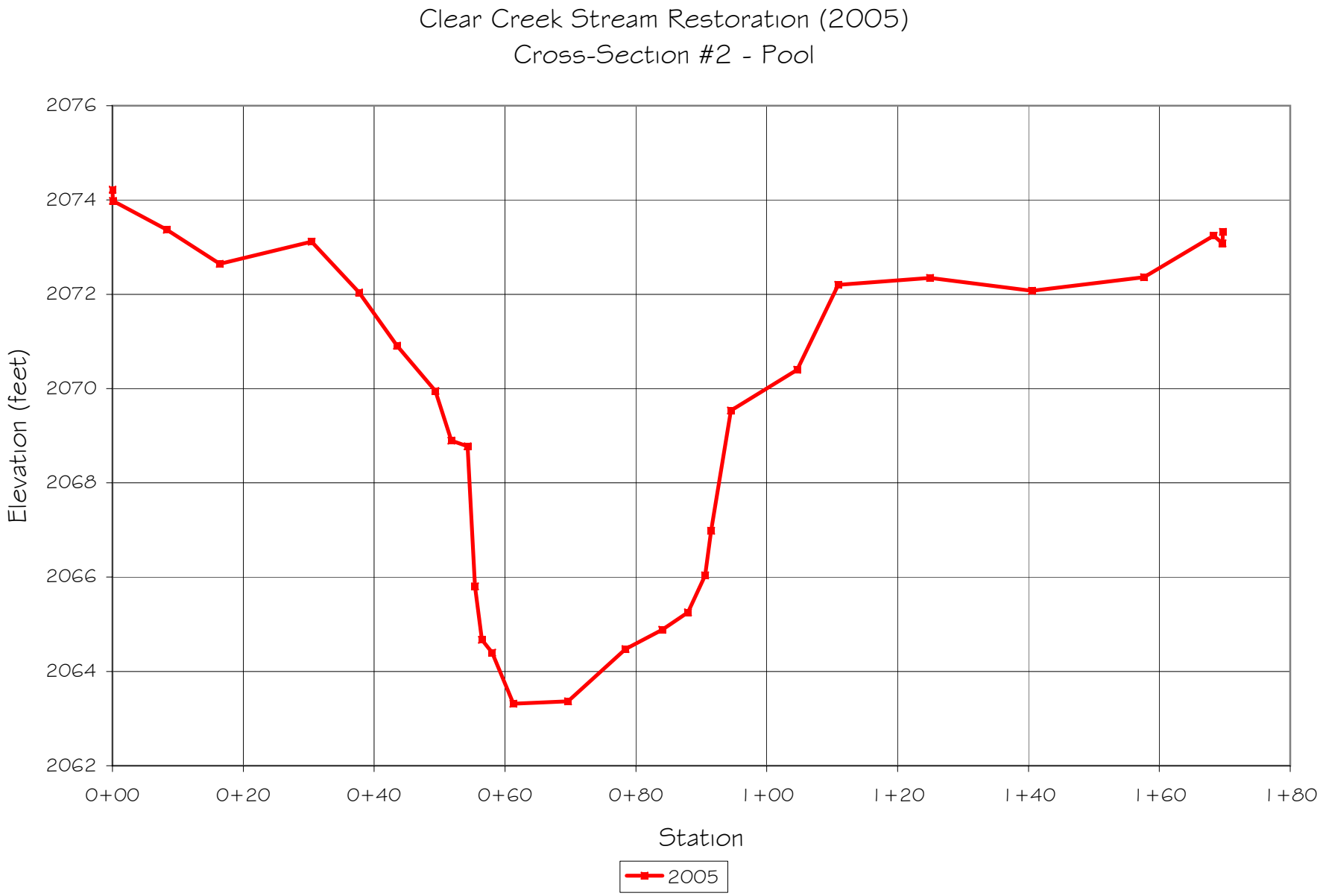
RIVERMOI CROSS SECTION SUMMARY

River Name: Clear Creek
Reach Name: 2005
Cross Section Name: XS1
Survey Date: ########

0	2074.695
0.12	2074.501
3.9	2074.433
8.55	2073.909
13.91	2072.869
27.65	2072.895
35.73	2072.636
54.55	2073
60.11	2072.94
81.99	2073.191
94.62	2073.219
99.99	2072.995
102.78	2071.714
106.1	2072.107
109.35	2071.069
110.55	2068.711
113.44	2068.612
115.9	2067.39
117.79	2066.468
128.8	2066.322
142.51	2065.835
152.18	2065.057
157.65	2065.104
162.7	2065.054
168.15	2066.583
170.08	2070.968
175.69	2072.496
185.63	2073.329
190.7	2075.03
199.94	2075.249
202.15	2075.344

Cross Sectional Geometry

Floodprone	Elevation	(ft)		2076.87
Bankfull	Elevation	(ft)		2070.96
Floodprone	Width	(ft)		202.15
Bankfull	Width	(ft)		60.67
Entrenchm	Ratio		3.33	-----
Mean	Depth	(ft)		4.74
Maximum	Depth	(ft)		5.91
Width/Dept	Ratio		12.81	
Bankfull	Area	(sq FT)		287.43
Wetted	Perimeter	(ft)		65.66
Hydraulic	Radius	(ft)		4.38
Begin	BKF	Station		109.41
End	BKF	Station		170.08


Clear Creek Stream Restoration (2005)
Cross-Section #2 - Pool
Elevation (feet)
2076
2074
2072
2070
2068
2066
2064
2062
0+00
0+20
0+40
0+60
0+80
1+00
1+20
1+40
1+60
1+80
Station
2005

RIVERMOI CROSS SECTION SUMMARY

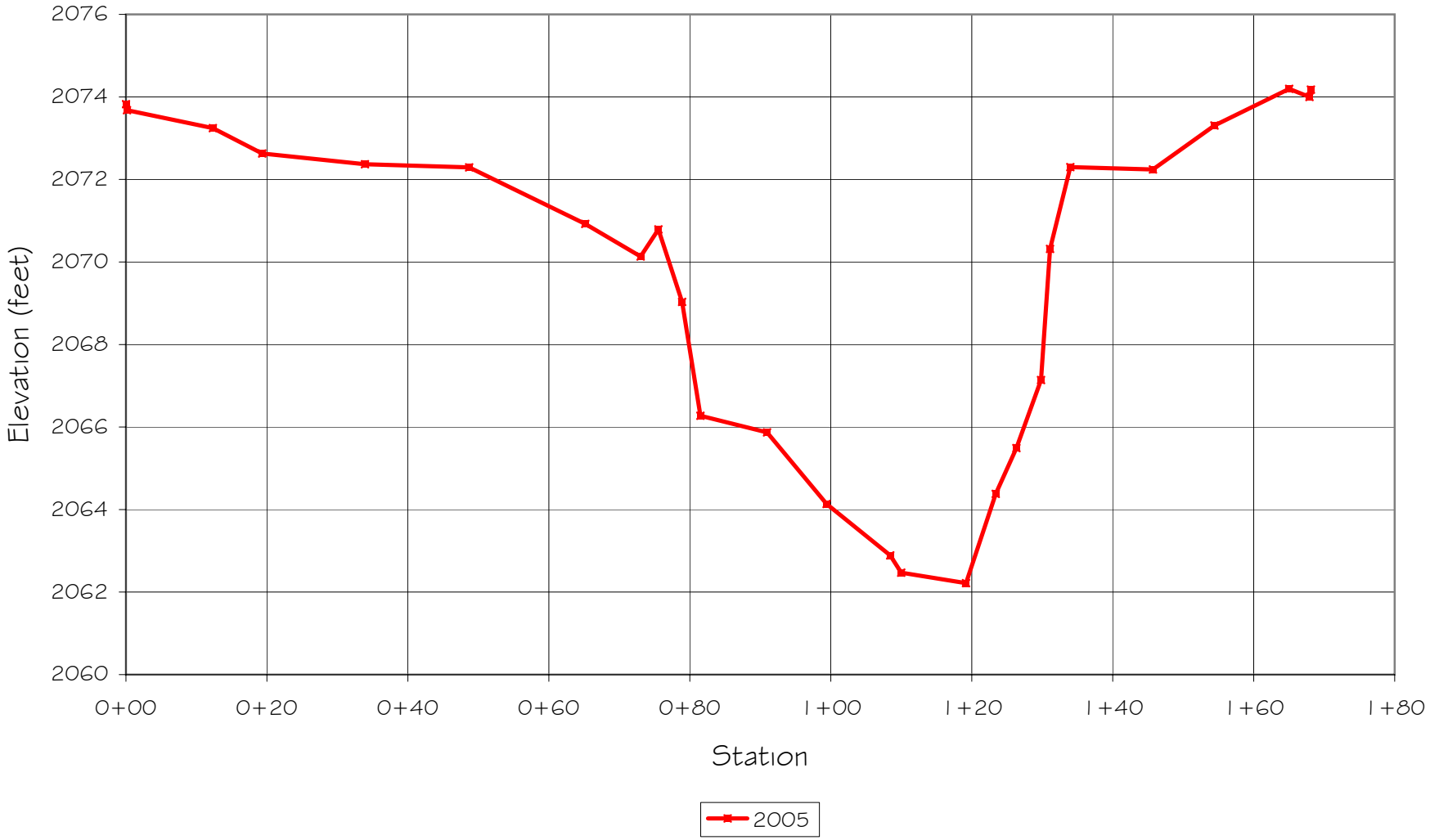
River Name: Clear Creek
Reach Name: 2005
Cross Section Name: XS2
Survey Date: ########

0	0	2074.221
0.08	0	2073.983
8.32	0	2073.37
16.41	0	2072.644
30.45	0	2073.118
37.69	0	2072.04
43.48	0	2070.909
49.34	0	2069.947
51.79	0	2068.897
54.26	0	2068.777
55.39	0	2065.803
56.46	0	2064.673
58.02	0	2064.399
61.29	0	2063.313
69.62	0	2063.367
78.41	0	2064.476
84.03	0	2064.883
87.95	0	2065.252
90.59	0	2066.037
91.5	0	2066.982
94.51	0	2069.532
104.64	0	2070.397
110.91	0	2072.199
124.96	0	2072.348
140.51	0	2072.072
157.66	0	2072.363
168.29	0	2073.242
169.65	0	2073.082
169.72	0	2073.323

Cross Sectional Geometry

Floodprone	Elevation	(ft)		2079.29
Bankfull	Elevation	(ft)		2071.3
Floodprone	Width	(ft)		169.72
Bankfull	Width	(ft)		66.3
Entrenchm	Ratio		2.56	-----
Mean	Depth	(ft)		4.5
Maximum	Depth	(ft)		7.99
Width/Dept	Ratio		14.74	
Bankfull	Area	(sq ft)		298.3
Wetted	Perimeter	(ft)		71.09
Hydraulic	Radius	(ft)		4.2
Begin	BKF	Station		41.48
End	BKF	Station		107.78

Clear Creek Stream Restoration (2005)
Cross-Section #3 - Riffle



RIVERMOI CROSS SECTION SUMMARY

River Name: Clear Creek
Reach Name: 2005
Cross Section Name: XS3
Survey Date: ########

0	0	2073.825
0.15	0	2073.679
12.33	0	2073.243
19.33	0	2072.63
33.92	0	2072.369
48.69	0	2072.292
65.15	0	2070.924
73.02	0	2070.132
78.91	0	2069.031
81.5	0	2066.274
90.96	0	2065.872
99.4	0	2064.135
108.43	0	2062.889
110	0	2062.47
119.19	0	2062.215
123.4	0	2064.38
126.34	0	2065.49
129.83	0	2067.139
131.11	0	2070.316
133.98	0	2072.299
145.7	0	2072.243
154.42	0	2073.307
165.04	0	2074.195
167.91	0	2073.998
168.11	0	2074.176

Cross Sectional Geometry

Floodprone	Elevation	(ft)		2077.62
Bankfull	Elevation	(ft)		2069.92
Floodprone	Width	(ft)		168.11
Bankfull	Width	(ft)		56.8
Entrenchm	Ratio		2.96	-----
Mean	Depth	(ft)		4.95
Maximum	Depth	(ft)		7.7
Width/Dept	Ratio		11.46	
Bankfull	Area	(sq ft)		281.43
Wetted	Perimeter	(ft)		61.38
Hydraulic	Radius	(ft)		4.59
Begin	BKF	Station		74.15
End	BKF	Station		130.95

Cross-section 1—Year 3 (2005)

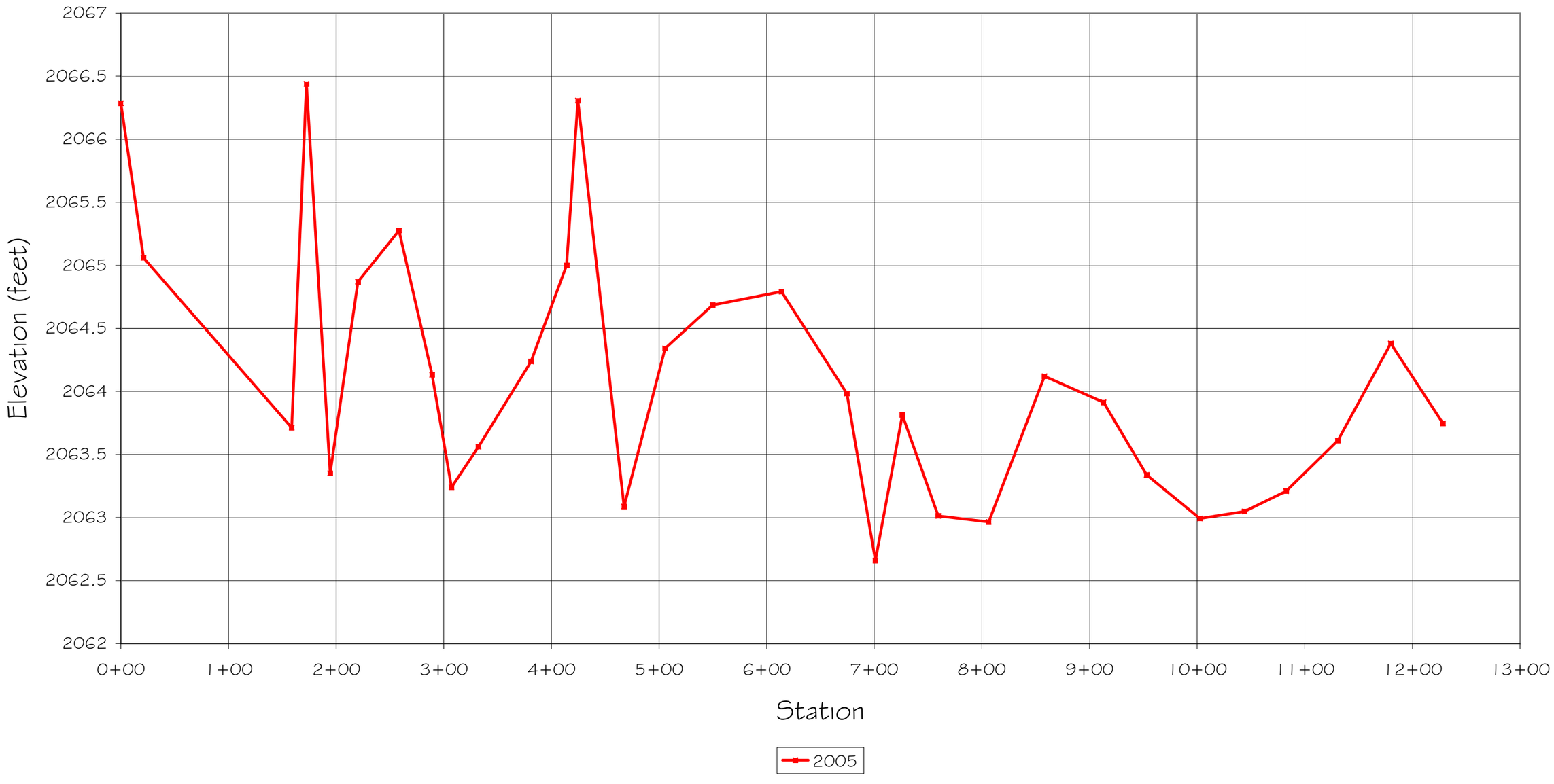
Cross-section 2—Year 3 (2005)

Cross-section 3—Year 3 (2005)

APPENDIX B –

Longitudinal Profile

Clear Creek Stream Restoration (2005)
Longitudinal Profile



RIVERMOI PROFILE SUMMARY

River Name: Clear Creek
Reach Name: 2005
Profile Name: 2005 ETW
Survey Date: ########

Survey Data

DIST	CH	BKF	P1	P2
0	2066.285			
21.097	2065.06			
158.766	2063.712			
172.396	2066.44			
194.465	2063.35			
220.352	2064.87			
258.448	2065.275			
277	2065.057	2070.96		
289.221	2064.131			
307.233	2063.24			
332.292	2063.562			
381.066	2064.238			
414.074	2064.999			
424.653	2066.308			
467.49	2063.087			
505.595	2064.34			
549.839	2064.685			
613.813	2064.791			
674.609	2063.982			
700.966	2062.658			
726.037	2063.813			
759.441	2063.012			
806.245	2062.965			
831.31	2063.313	2071.3		
858.198	2064.121			
913.087	2063.914			
953.105	2063.338			
1002.494	2062.992			
1021.75	2062.215	2069.92		
1044.038	2063.047			
1082.631	2063.208			
1130.734	2063.611			
1179.864	2064.38			
1228.367	2063.747			

Cross Section Locations

Cross	Section	Name	Type	Profile	Station
XS1	Riffle	277			
XS2	Pool	831.31			
XS3	Riffle	1021.75			

Measurem from Graph

Bankfull Slope: 0.00146

Variable	Min	Avg	Max
S riffle	0.00069	0.00142	0.00185
S pool	0	0.00136	0.00237
P-P	48.57	163.29	277.55
P length	27.76	65.22	134.61
R length	15.27	37.67	88.82

Length and depth measurem in feet, slopes in ft/ft.

Valley Length 1115 ft

Variable			Min	Avg	Max
Sinuosity	1.11				
Meander	Wavelengtl	(ft)	497.22	536.4	575.58
Radius	Curvature	(ft)	88.66	97.05	105.4
Belt	Width	(ft)	131.17	143.07	152.58
Wblt/	Wbkf	(MWR)	2.23306	2.43565	2.59755

C4
-

Table B1. Qualitative Visual Stability Assessment

Date: August 10, 2005 Project # 9446.D1

Evaluators: J. Regan, R. Wargo Segment/Reach: Clear Creek

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	% perfor. in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	5	5	NA	100%	
	2. Armor stable (e.g. no displacement)?	4	5	NA	80%	
	3. Facet grade appears stable?	5	5	NA	100%	
	4. Stable interval grade?	4	5	NA	80%	
	5. Feature spacing appropriate?	5	5	NA	100%	
	6. Mnimal evidence of embedding/fining?	5	5	NA	100%	
	7. Depth appears appropriate for current discharge?	5	5	NA	100%	
	8. Length appropriate?	3	5	NA	60%	**90%**
B. Pools	1. Present? (e.g. not subject to severe aggradation?)	5	5	NA	100%	
	2. Suffieciently deep (Max Pool D:Mean Bkf>1.6)	5	5	NA	100%	
	3. Thalweg located outer bend?	5	5	NA	100%	
	4. Spacing appropriate?	5	5	NA	100%	
	5. Non-aggrading (not filling)?	5	5	NA	100%	
	6. Length appropriate?	5	5	NA	100%	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	3	3	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	3	3	NA	100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	0	3	NA	100%	
	2. Of those eroding, # w/ concomitant point bar formation?	0	3	NA	100%	
	3. Apparent Rc within spec?	3	3	NA	100%	
	4. Sufficient floodplain access and relief?	3	3	NA	100%	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	NA	NA	0	100%	**100%**
F. Channel Capac./Dimen	1. Channel width: depth appears out of design/type spec?	NA	NA	240	80%	**80%**
G. Banks	1. Apparent scour points from channel processes	NA	NA	40	97%	
	2. Apparent cut points from overland flow	NA	NA	20	98%	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	NA	NA	40	97%	
	4. Tension cracks	NA	NA	0	100%	
	5. Bank gradient in excess of 40%?	NA	NA	80	93%	
	6. Collapse/slumping	NA	NA	0	100%	
	7. Ratio of bank height: bankfull height elevated	NA	NA	0	100%	**98%**
H. Vanes	1. Free of back or arm scour?	4	8	NA	50%	
	2. Height appropriate?	8	8	NA	100%	
	3. Angle and geometry appear appropriate?	8	8	NA	100%	
	4. Free of piping or other structural failures?	7	8	NA	88%	**85%**
I. Wads/Boulders	1. Free of scour?	12	19	NA	63%	
	2. Footing stable?	12	19	NA	63%	**63%**

Notes: