Year 4 Monitoring Report

Lyle Creek Stream Restoration

February 2006

S&EC Project No. 9442.D1
EEP Project No. 00102

Designed By
Ecoscience Corporation

Prepared for

Ecosystem Enhancement PROGRAM

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

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I. Executive Summary / Project Abstract

Due to historic channel modifications such as channelization, periodic dredging, vegetation clearing, and livestock trampling, Lyle Creek was in a degraded state. The project, located in Catawba County, was designed by Ecoscience, Inc., using natural channel design methods. The restoration completed in 2002. This report serves as the Year 4 (2005) 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 404 stems per acre.

The physical stream channel was surveyed and a visual stability assessment was performed for the Lyle Creek Stream Restoration project. While there are several stable areas along the restored channel, the severity of some of the problem areas on this project warrant immediate repair. These problem areas are shown on the Problem Area Plan View. In 2006, the fifth and final year of required monitoring will commence.

II. Project Background

The background information for this report is referenced from previous monitoring reports submitted to the North Carolina Ecosystem Enhancement Program (NCEEP) by the Biological and Agricultural Engineering Department at North Carolina State University.

A. Location and Setting

The Lyle Creek stream restoration site is located within a 12.4 acre tract approximately 3 miles west of the Catawba River in Catawba County, NC (USGS Subbasin 03050101). The site, shown in Figure 1, is situated between US Interstate Route 40 and US Route 70. Traveling on Interstate 40, take Exit #138. Turn left onto Wyke Road (SR 1718). Turn right onto Stagecoach Road for ½ mile. The restored reach is south of Stagecoach Road.

B. Structure and Objectives

This site was originally utilized for agricultural hay production and livestock grazing. Due to past vegetation clearing, dredging, straightening activities, and livestock hoof shear, the stream had been impaired. Dredging and straightening appears to have been conducted to facilitate agricultural production and to expedite drainage from the site. These activities resulted in an unstable, incised stream channel with poor aquatic habitat.

The mitigation plan proposed to restore 2,400 linear feet of stream channel (1,345 linear feet on new alignment and 1,055 linear feet restored in place), enhance/preserve 800 linear feet of an unnamed tributary to Lyle Creek, and establish a riparian buffer along Lyle Creek. These lengths are shown in Tables I and II.

Table I: Project Structure Table
Lyle Creek Stream Restoration Site (EEP Project #00102)

Segment/Reach ID	Linear Feet or Acreage
Restoration Reach 1-Lyle Creek	1,345 lf
Restoration Reach 2-Lyle Creek	1,055 lf
Preservation Reach-Unnamed Tributary to Lyle Creek	800 lf

Table II: Project Objectives Table
Lyle Creek Stream Restoration Site (EEP Project #00102)

Segment/Reach ID	Objectives	Linear Feet or Acreage	Comment
Restoration Reach 1	Relocation	1,345 lf	Relocation/Restoration
Restoration Reach 2	Restoration in place	1,055 lf	
Preservation Reach	Preservation / Enhancement	800 lf	Exclusion of Cattle/Bare root planting

C. Project History and Background

Construction of the Lyle Creek Stream Restoration commenced in 2002 with construction ending in July 2002. The as-built survey was submitted in August 2002. Year 1 monitoring was completed in February 2003, Year 2 monitoring was completed in November 2003, and Year 3 monitoring was completed in March 2004. 2005 served as Year 4 of monitoring. Additional details regarding the timeline of the project are included in Table III.

Table III: Project Activity and Reporting History
Lyle Creek Stream Restoration Site (EEP Project #00102)

Activity or Report	Calendar Year of Completion or Planned Completion	Actual Completion Date
Restoration Plan		
Mitigation Plan		
Construction	2002	Jul-02
Temporary S&E mix applied to entire project area		2002
As-Built report		2002
Permanent seed mix applied	Fall 2002	
Initial-Year 1 monitoring	2002	Feb-03
Year 2 monitoring	2003	Nov-03
Year 3 monitoring	2004	Mar-04
Year 4 monitoring	2005	Dec-05
Year 5 monitoring	2006	

The project was designed by Ecoscience Corporation. Construction was performed by North State Environmental, Inc. Additional information regarding contractors are shown in Table IV.

Table IV: Project Contact Table
Lyle Creek Stream Restoration Site (EEP Project #00102)

Designer	Ecoscience Corporation 1101 Haynes Street, Suite 101 Raleigh, NC 27604
Construction Contractor	North State Environmental, Inc. 2889 Lowery Street, Suite B Winston-Salem, NC 27101
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 Catawba County of the Piedmont of North Carolina. The site is located within a rural, agricultural area. Additional information regarding the restoration reach is included as Table V.

Table V: Project Background Table
Lyle Creek Stream Restoration Site (EEP Project #00102)

Project County	Catawba
Drainage Area	0.5 sq. mi.
Drainage impervious cover estimate (%)	10%
Stream Order	3rd order
Physiographic Region	Piedmont
Ecoregion	Piedmont
Rosgen Classification of As-Built	E
Dominant Soil Types	Cecil, Chewacla
USGS HUC for Project and Reference	3050101
NCDWQ Sub-basin for Project and Reference	03-08-32
NCDWQ classification for Project	WS-IV;CA
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 seven (7) 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 twelve (12) permanent photo points located at various points along the length of the channel. S&EC encountered vertical and horizontal errors in the northings, eastings, and elevations provided for the benchmarks in the as-built. While this has not prevented the comparison of cross-sections and profiles between monitoring years, it should be addressed for future site surveys.

Three (3) 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 floodplain.

Three vegetation plots were established onsite by Ecoscience in 2002. These plots are shown on the Monitoring Plan View (Sheets 1 and 2). Success criteria, as outlined in the 2002 as-built report, require 290 live stems per acre in Year 4 (2005), and 260 live stems per acre in Year 5 (2006). Planted species must represent a minimum of 30% of the required density, which is equivalent to 87 stems per acre for 2005.

1. Soil Data

The project site is located in the Inner Piedmont Belt of the North Carolina Piedmont physiographic province. Soils present in the riparian areas adjacent to Lyle Creek are characteristic of those found in alluvial landforms in the Inner Piedmont Belt. However, extensive grading and filling has likely redistributed much of the naturally occurring soils on site.

Chewacla soils (*Aquic Fluventic Dystrochrepts*) are the prevalent map unit along the channel. Formed in fine loamy alluvial material, they are somewhat poorly drained with low natural fertility. Cecil soils (*Typic Kanhapludults*) are present along the channel to a lesser extent. These soils are also formed in fine loamy alluvial material, and are poorly drained with low fertility. Other soils in the project's vicinity include Hiwassee (*Rhodic Kanhapludults*), which are often mapped on high stream terraces.

Table VI: Preliminary Soil Data
Lyle Creek Stream Restoration Site (EEP Project #00102)

Series	Max Depth (in.)	% Clay on Surface	K	T	OM %
Chewacla (Cw)	60	10-35	0.28	5	1.0-4.0
Cecil (CmB2,CmC2,CmD2)	75	5-20	0.28	5	0.5-1.0
Hiwassee, moderately eroded (HsD2)	80	10-35	0.28	5	0.5-2.0
Hiwassee (HsE)	60	10-35	0.28	5	0.5-2.0

2. Problem Areas Plan View (Vegetation)

During a field inspection on September 12, 2005, it was noted that several areas along the banks of Lyle Creek and its floodplain have suffered localized loss of vegetation. It is suspected that large overbank flows occurred before the newly planted vegetation had sufficient time to establish a root system capable of withstanding flood flows. There is an area with exposed soil as indicated on the Problem Area Plan View as "Bare Bank."

Table VII: Vegetative Problem Areas
Lyle Creek Stream Restoration Site (EEP Project #00102)

Feature Issues	Station numbers	Suspected Cause	Photo number
Bare Bank	5+00 to 5+25	Overbank Flow	N/A

3. Vegetative Problem Areas Plan View

Vegetative problem areas are shown on Sheets 3 and 4 – Problem Area Plan View.

4. Stem Counts

On September 12, 2005, S&EC conducted vegetation counts within each of the three established plots. The results of this survey are shown below in Table VIII.

The following tree species were planted in the riparian buffer area: Tulip poplar (L*iriodendron tulipifera*), River birch (*Betula nigra*), Oak (*Quercus* sp.), Ash (*Fraxinus* sp.), Tag alder (*Alnus serrulata*), Eastern redcedar (*Juniperus virginiana*), Black willow (*Salix nigra*), American sycamore (*Platanus occidentalis*), and Silky dogwood (*Cornus amomum*).

Table VIII: Stem Counts for Each Species Arranged by Plot
Lyle Creek Stream Restoration Site (EEP Project #00102)

Species	Plots			Year 4 Totals
	1	**2**	**3**	
Fraxinus sp. **(Ash)**	1			**1**
Platanus occidentalis **(American sycamore)**			2	**2**
Liriodendron tulipifera **(Tulip poplar)**	6		2	**8**
Betula nigra **(River birch)**	3	5	1	**9**
Alnus serrulata **(Tag alder)**	3			**3**
Juniperus virginiana **(Eastern red cedar)**		1	2	**3**
Salix nigra **(Black willow)**	1		3	**4**
Year 4 Totals	**14**	**6**	**10**	**30**
Year 3 Totals	29	6	10	**45**
Average Live Stem Density/acre	**404**			
Survival % From Year 3-Year 4	48%	100%	100%	**83%**

The average stems per sample plot is 10 stems. A review of the sample plots (averaging 10 stems per plot) reveals a current (2005 – Year Four) site density of approximately 404 stems per acre.

As shown in Table VIII, the average survival rate is greater than 80%. In addition, while not shown in the above table, every plot has shown a large number of volunteers in addition to the original planted stems. If these new plants are taken into consideration, survival rate would be much greater than 80%.

5. Vegetation Photo Plots

Photos taken during the September 12, 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 September 12, 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 and 4 – Problem Area Plan View.

2. Problem Areas Table Summary

Table IXa: Stream Problem Areas
Lyle Creek Stream Restoration Site (EEP Project #00102)

Feature Issues	Station numbers	Suspected Cause	Photo number
Bank Scour	10+50 to 10+75	Excessive shear stress on banks	Photos 1-3
	11+05 to 11+40	Excessive shear stress on banks	
	12+50 to 12+75	Excessive shear stress on banks	
	14+05 to 14+50	Excessive shear stress on banks	
	16+00 to 16+25	Excessive shear stress on banks	
	16+50 to 17+25	Excessive shear stress on banks	
	18+00 to 18+25	Excessive shear stress on banks	
	18+70 to 19+00	Excessive shear stress on banks	
	19+20 to 19+40	Excessive shear stress on banks	
Stressed or Failing Structures	16+65	Excessive shear stress on banks	Photo 4
	19+25	Excessive shear stress on banks	

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 July 2, 2005 during the stream survey. These photos are included in Appendix B along with the photos taken during the Year 3 monitoring activities.

5. Stability Assessment

While most structures on this restoration are functional and stable, the two (2) most downstream rock cross vanes are currently failing. A comparison of the surveyed thalwegs for 2004 and 2005 shows some lateral migration of meanders, as well as some downvalley migration. The profile shows that a headcut may have already moved though a portion of the reach, and another headcut may be caused in the near future by the complete failure of either of the stressed rock cross vanes. For these reasons, it is recommended that a repair plan be prepared immediately for the Lyle Creek restoration project.

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
Lyle Creek Stream Restoration Site (EEP Project # 00102)

Feature	AS-BUILT 2002	MY-2 2003	MY-3 2004	MY-4 2005
A. Riffles	*	*	*	36%
B. Pools	*	*	*	92%
C. Thalweg	*	*	*	92%
D. Meanders	*	*	*	67%
E. Bed General	*	*	*	86%
F. Channel General	*	*	*	N/A
G. Banks	*	*	*	89%
H. Vanes/ J Hooks, etc.	*	*	*	89%
I. Wads and Boulders	*	*	*	N/A

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 Norwood Creek (Gauge Identification Number 0214253830) which is approximately 10.227 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
LYLE 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)	*	*	*	*	*	*	*	*	*	*	*	*
Floodprone Width (ft)	*	*	*	*	*	*	*	*	*	*	*	*
BF Cross Sectional Area (ft^2)	*	*	*	*	*	*	*	*	*	*	*	*
BF Mean Depth (ft)	*	*	*	*	*	*	*	*	*	*	*	*
BF Max Depth (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Width/Depth Ratio	*	*	*	*	*	*	*	*	*	*	*	*
Entrenchment Ratio	*	*	*	*	*	*	*	*	*	*	*	*
Wetted Perimeter(ft)	*	*	*	*	*	*	*	*	*	*	*	*
Hydraulic radius (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Pattern												
Channel Beltwidth (ft)	*	*	*	*	*	*	*	*	*	33	141	88
Radius of Curvature (ft)	*	*	*	*	*	*	*	*	*	14.9	32.5	22.4
Meander Wavelength (ft)	*	*	*	*	*	*	*	*	*	33	114	63
Meander Width ratio	*	*	*	*	*	*	*	*	*	1	0.81	0.72
Profile												
Riffle length (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Riffle slope (ft/ft)	*	*	*	*	*	*	*	*	*	0.00%	3.64%	1.41%
Pool length (ft)	*	*	*	*	*	*	*	*	*	14	64	27
Pool spacing (ft)	*	*	*	*	*	*	*	*	*	22	161	54
Substrate												
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*
Additional Reach Parameters												
Valley Length (ft)		*			*			*			*	
Channel Length (ft)		*			*			*			*	
Sinuosity		*			*			*			*	
Water Surface Slope (ft/ft)		*			*			*			*	
BF slope (ft/ft)		*			*			*			*	
Rosgen Classification		*			*			*			*	
*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.

Exhibit Table XII. Morphology and Hydraulic Monitoring Summary
LYLE CREEK STREAM RESTORATION SITE

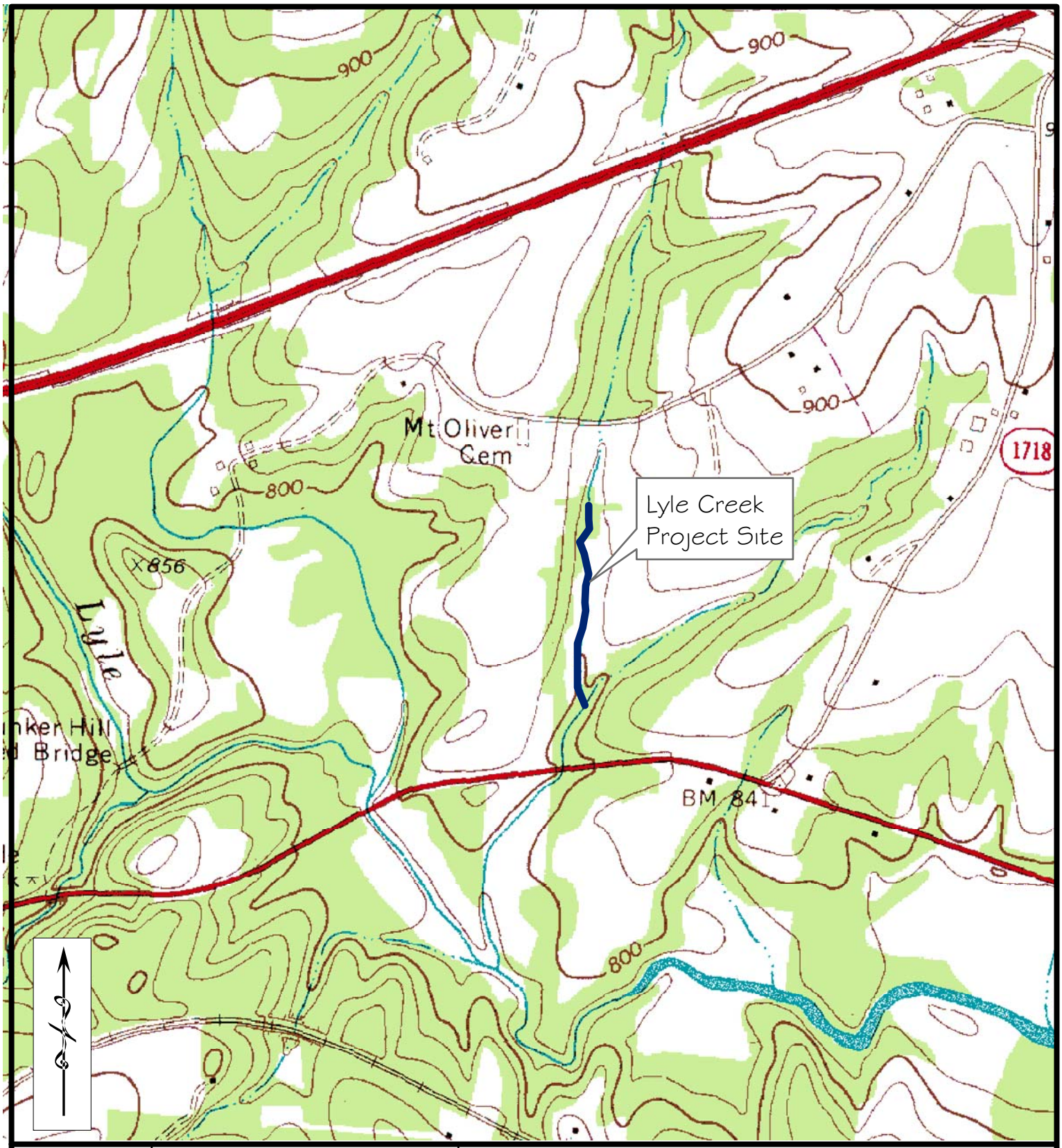
Parameter	Cross Section 1 Pool				Cross Section 2 Riffle				Cross Section 3 Riffle				Cross Section 4 Riffle				Cross Section 5 Riffle				Cross Section 6 Pool				Cross Section 7 Riffle			
Dimension	AS-BUILT	MY2	MY3	MY4	AS-BUILT	MY2	MY3	MY4	AS-BUILT	MY2	MY3	MY4	AS-BUILT	MY2	MY3	MY4	AS-BUILT	MY2	MY3	MY4	AS-BUILT	MY2	MY3	MY4	AS-BUILT	MY2	MY3	MY4
BF Width (ft)	22.2	19.5	19.5	18.16	11	17	19.8	12.79	12	14.6	16	14.28	10.6	10.6	11.2	9.67	9	12.4	15.7	11.95	12	15.3	15.7	14.65	9	10.4	10.8	11.02
Floodprone Width (ft)	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50	*	*	*	50
BF Cross Sectional Area (ft^2)	31.1	20.1	18.4	21.09	17.8	30.1	31.5	13.44	17.1	26	26.9	13.65	16.9	17.6	19	13.51	15.2	20.4	24.6	13.77	19.9	26.9	27	21.65	14.5	15.9	18.2	13.66
BF Mean Depth (ft)	1.4	1	0.9	1.16	1.6	1.8	1.6	1.05	1.4	1.8	1.7	0.96	1.6	1.7	1.7	1.4	1.7	1.6	1.6	1.15	1.7	1.8	1.7	1.48	1.6	1.5	1.7	1.24
BF Max Depth (ft)	3.6	2.2	1.9	1.97	2.4	2.5	2.7	1.45	2.3	2.1	2.1	1.63	2.8	2.7	2.9	2.31	2.5	2.6	2.4	1.81	2.7	2.6	2.8	2.34	2.1	1.9	2.3	1.93
Width/Depth Ratio	15.8	19	20.5	15.64	6.8	9.6	12.4	12.16	8.5	8.2	9.5	14.94	6.6	6.3	6.6	6.92	5.3	7.5	10	10.37	7.3	8.7	9.2	9.91	5.6	6.8	6.4	8.89
Entrenchment Ratio	*	*	*	2.75	*	*	*	3.91	*	*	*	3.5	*	*	*	5.17	*	*	*	4.18	*	*	*	3.41	*	*	*	4.54
Wetted Perimeter(ft)	*	*	*	19.02	*	*	*	13.48	*	*	*	14.96	*	*	*	11.01	*	*	*	12.84	*	*	*	15.7	*	*	*	12.82
Hydraulic radius (ft)	*	*	*	1.11	*	*	*	1	*	*	*	0.91	*	*	*	1.23	*	*	*	1.07	*	*	*	1.38	*	*	*	1.07
Substrate																												
d50 (mm)	0.09	0.29	0.33	*	0.19	0.29	0	*	0.19	0.45	0.08	*	0.19	0.11	0.033	*	0.19	0.33	1.05	*	0.11	0.71	0.26	*	0.19	0.34	0.41	*
d84 (mm)	0.52	0.76	0.66	*	15.91	13.33	0.31	*	15.91	1.01	0.4	*	15.91	3.11	79.4	*	15.91	17.52	8.64	*	0.65	31.78	19.78	*	15.91	3	0.71	*

Parameter	AS-BUILT (2002)			MY-2 (2003)			MY-3 (2004)			MY-4 (2005)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	33	141	88	22	56	33	32	84	42	26.33	102.68	47.58
Radius of Curvature (ft)	14.9	32.5	22.4	16.7	38.5	20.9	15.9	47	22.8	18.81	51.17	28.46
Meander Wavelength (ft)	33	114	63	49	150	71	53	165	82	47.59	210.84	115.46
Meander Width ratio	1.00	0.81	0.72	2.23	2.68	2.15	1.66	1.96	1.95	1.81	2.05	2.43
Profile												
Riffle length (ft)	*	*	*	7	39	17	7	28	15	*	*	*
Riffle slope (ft/ft)	0.00%	3.64%	1.41%	0.56%	4.94%	1.71%	0.65%	4.80%	2.10%	0.00%	10.00%	3.00%
Pool length (ft)	14	64	27	9	41	23	9	41	23	12.31	78.77	32.43
Pool spacing (ft)	22	161	54	27	176	46	31	92	43	12.31	152.61	69.52
Additional Reach Parameters												
Valley Length (ft)		*			*			*			1337	
Channel Length (ft)		*			*			*			1940	
Sinuosity		*			*			*			1.45	
Water Surface Slope (ft/ft)		*			*			*			*	
BF slope (ft/ft)		*			*			*			0.01	
Rosgen Classification		*			*			*			C4	
Habitat Index*		*			*			*			*	
Macrobenthos*		*			*			*			*	

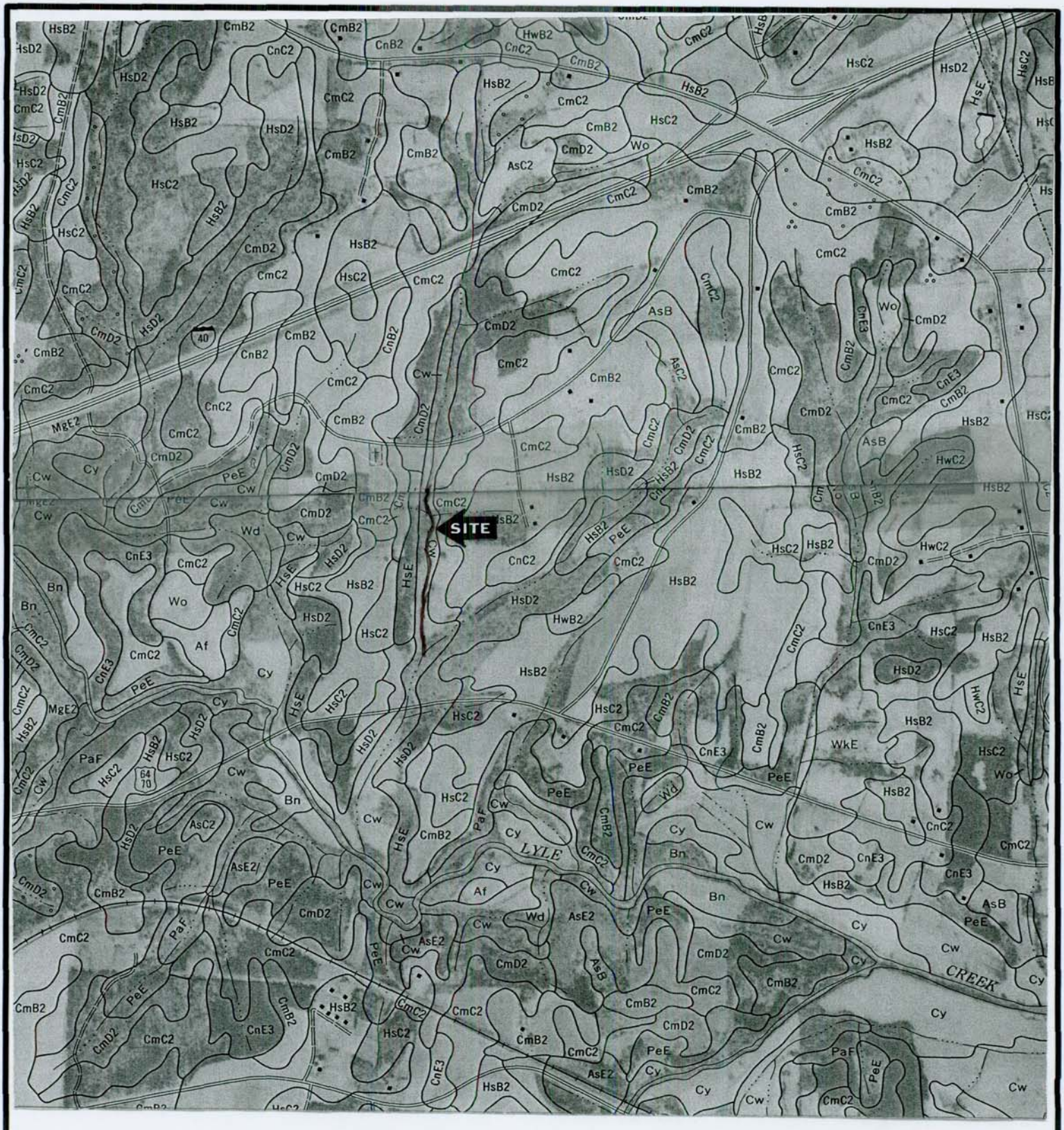
* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

IV. Methodology Section

No unavoidable deviations from initially prescribed methodologies were implemented as a part of monitoring Year 4 activities.



Project No. 9442.D1	Figure 1 - Vicinity Map Lyle Creek Project Site NCEEP Year 4 of 5 Catawba 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		Ecosystem Enhancement Program
Scale: 1" = 1,000'		
12/08/05	Catawba Quadrangle	



Project No. 9442.D1	Figure 2 - NRCS Soil Survey Map Lyle Creek NCEEP Year 4 of 5 Catawba County, NC	S&EC Soil & Environmental Consultants, PA 11010 Raven Ridge Rd.• Raleigh, NC 27614 (919) 846-5900 • (919) 846-9457 Web Page: www.SandEC.com
Project Mgr.: JR		
Scale: 1" = 1,320'		Ecosystem Enhancement PROGRAM
12/08/05	Catawba County Soil Survey	

File: SecJobs7-9k\9442.D1\PAF\papv 2005 11-14.dwg

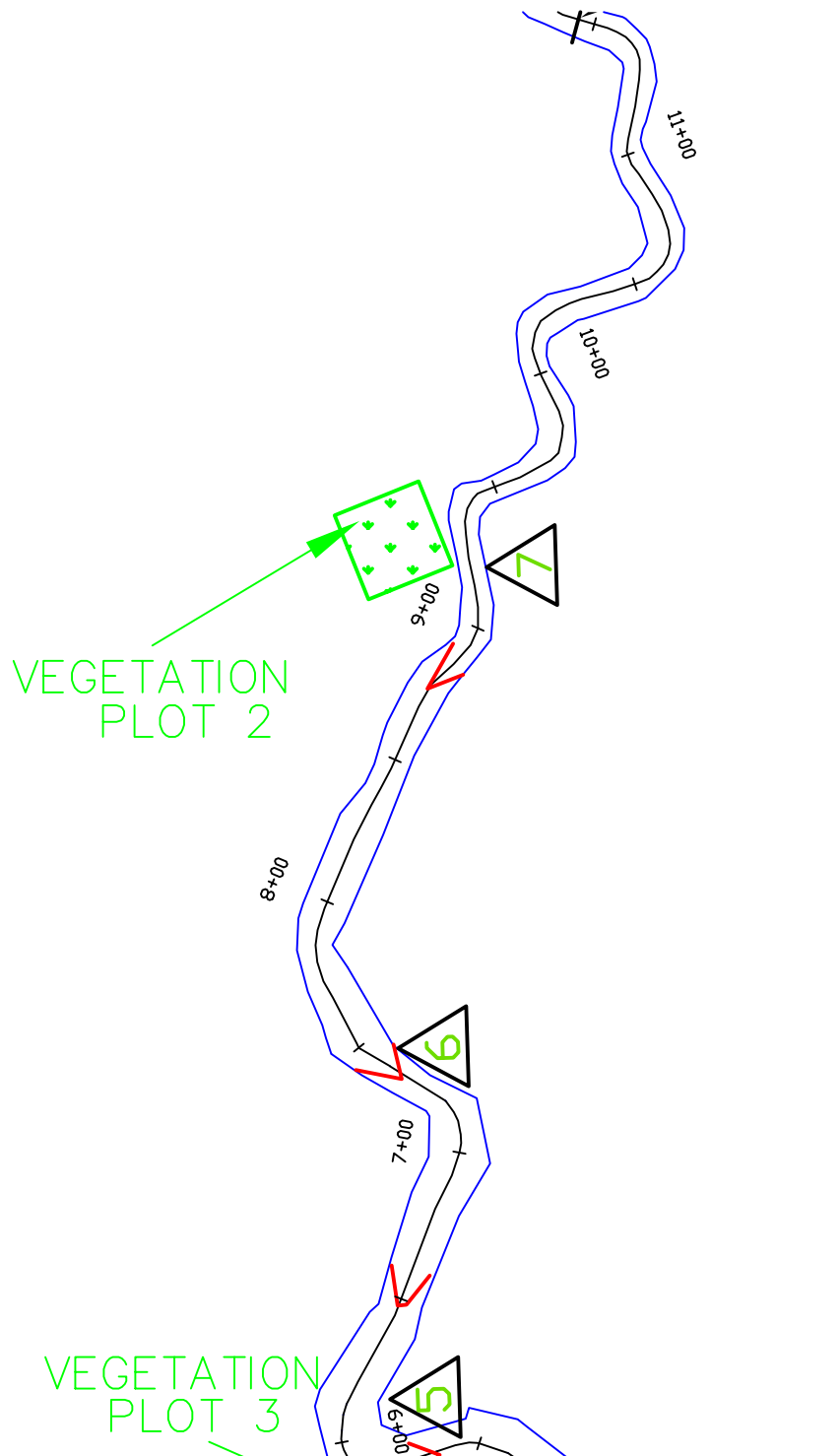
Lyle Creek Stream Restoration
Monitoring Year 4 of 5

MONITORING PLAN VIEW

APPROXIMATE NORTH

SCALE 1" = 60'

30 0 60



Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoScience, Inc.

2.) All locations are approximate.

NOVEMBER 2005

Ecosystem Enhancement Program

S&EC Soil & Environmental Consultants, PA

11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467

www.SandEC.com

Project: LYLE CREEK STREAM RESTORATION			Project No.: 9442.D1
		Proj. Mgr.: PKS	Drawn: JER
Location: CATAWBA CO., NC	Client: NCEEP		Scale: 1" = 60'
Sheet Title: MONITORING PLAN VIEW - SEGMENT 1			Sheet No.: 1 OF 4

File: SecJobs7-9k\9442.D1\PAFV\papv 2005 11-14.dwg

APPROXIMATE NORTH

SCALE 1" = 60'

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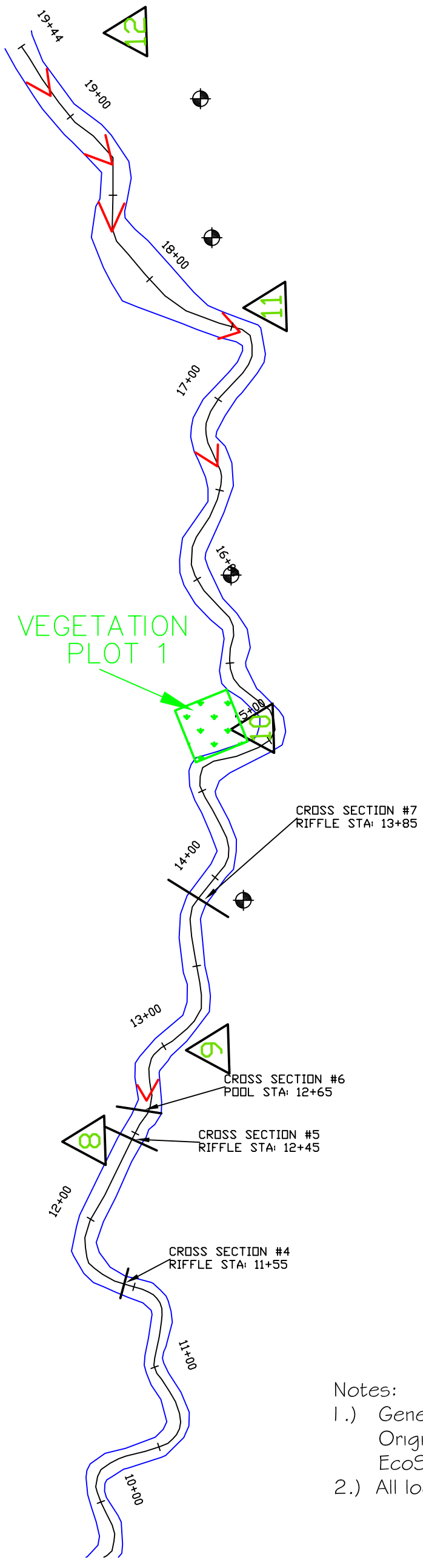


LEGEND

- PERMANENT PHOTO POINT
- SURVEY BM
- VEGETATION PLOT
- ROCK CROSS VANE
- THALWEG
- CHANNEL BANKS
- PERMANENT CROSS-SECTION

MONITORING PLAN VIEW

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoScience, Inc.

2.) All locations are approximate.

NOVEMBER 2005

Ecosystem Enhancement Program

S&EC Soil & Environmental Consultants, PA

11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467

www.SandEC.com

Project: LYLE CREEK STREAM RESTORATION		Project No.: 9442.D1	
		Proj. Mgr.: PKS	Drawn: JER
Location: CATAWBA CO., NC	Client: NCEEP	Scale: 1" = 60'	
Sheet Title: MONITORING PLAN VIEW - SEGMENT 2		Sheet No.: 2 OF 4	

File: Sec\Jobs7-9k\9442.D1\PAPV\papv 2005 11-14.dwg

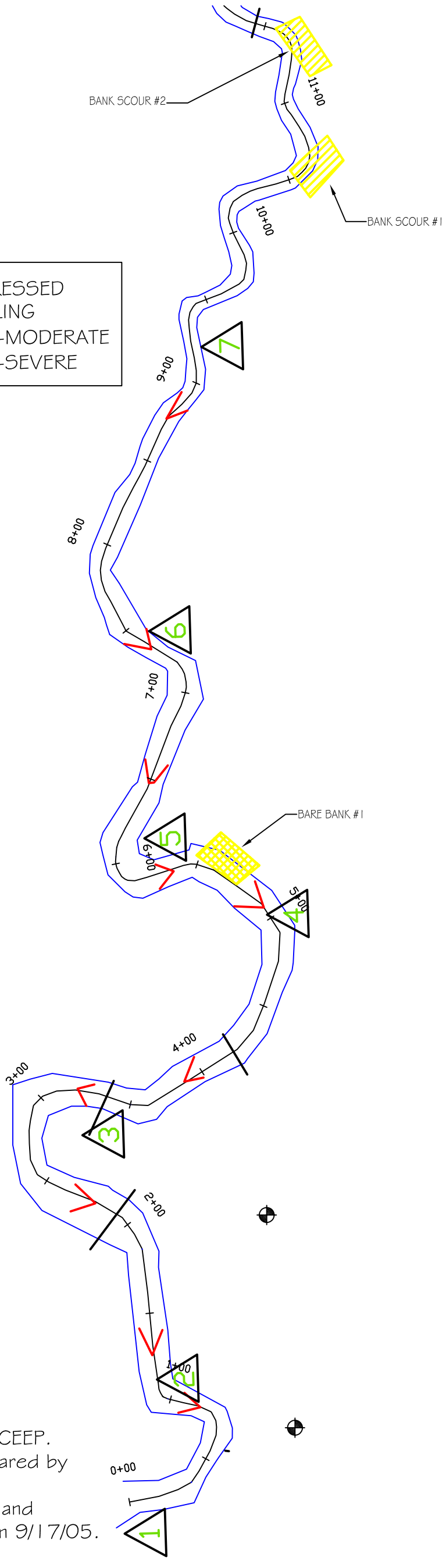
APPROXIMATE NORTH

SCALE 1" = 60'

30 0 60

PAPV LEGEND

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



LEGEND

- PERMANENT PHOTO POINT
- SURVEY BM
- VEGETATION PLOT
- ROCK CROSS VANE
- THALWEG
- CHANNEL BANKS
- PERMANENT CROSS-SECTION

PROBLEM AREA PLAN VIEW

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoScience, Inc.

2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 9/17/05.

3.) All locations are approximate.

NOVEMBER 2005

Ecosystem Enhancement Program

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Project: LYLE CREEK STREAM RESTORATION			Project No.: 9442.D1
		Proj. Mgr.: PKS	Drawn: JER
Location: CATAWBA CO., NC	Client: NCEEP		Scale: 1" = 60'
Sheet Title: PAPV - SEGMENT 1			Sheet No.: 3 OF 4

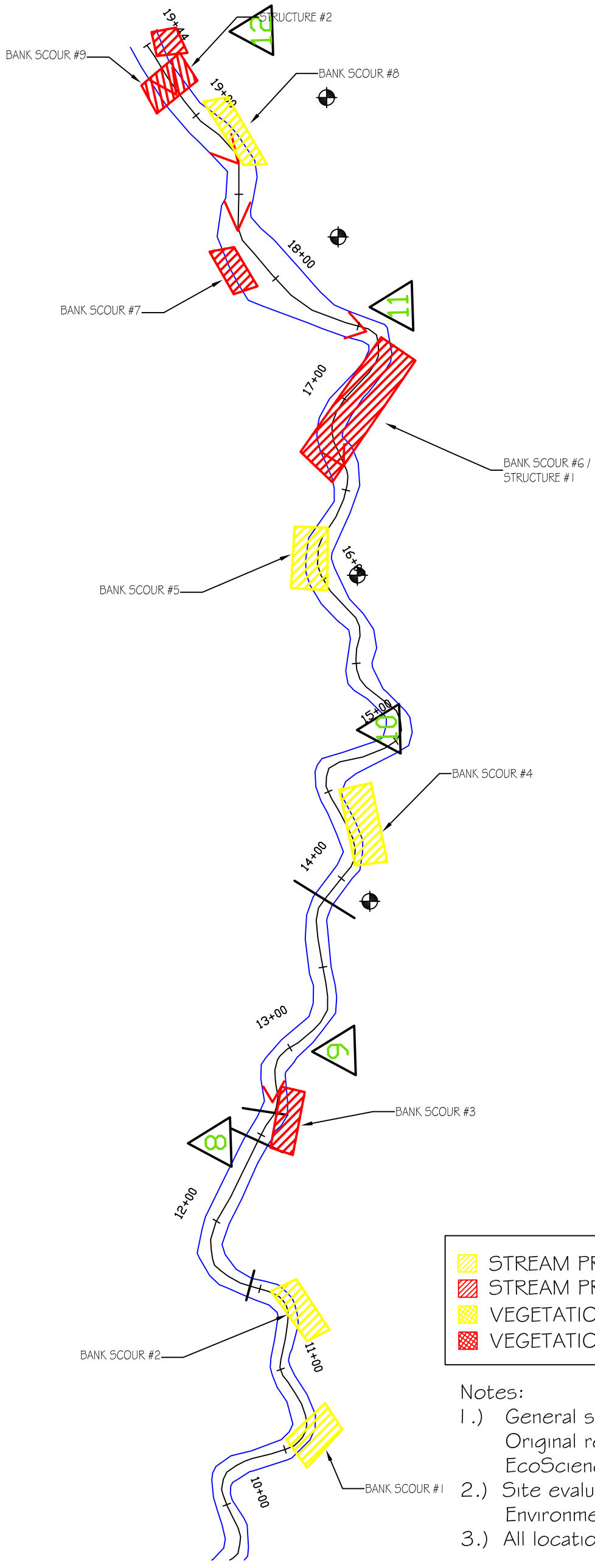
File: Sec\Jobs7-9k\9442.D1\PAPV\papv 2005 11-14.dwg

APPROXIMATE NORTH

SCALE 1" = 60'

30 0 60

PROBLEM AREA PLAN VIEW



LEGEND

- PERMANENT PHOTO POINT
- SURVEY BM
- VEGETATION PLOT
- ROCK CROSS VANE
- THALWEG
- CHANNEL BANKS
- PERMANENT CROSS-SECTION

PAPV LEGEND

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

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoScience, Inc.

2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 9/17/05.

3.) All locations are approximate.

NOVEMBER 2005

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S&EC

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www.SandEC.com

Project: LYLE CREEK STREAM RESTORATION		Project No.: 9442.D1
		Proj. Mgr.: PKS / Drawn: JER
Location: CATAWBA CO., NC	Client: NCEEP	Scale: 1" = 60'
Sheet Title: PAPV - SEGMENT 2		Sheet No.: 4 OF 4

APPENDIX A

APPENDIX A

APPENDIX A –

Vegetation Survey Data Tables

Table VIII: Stem Counts for Each Species Arranged by Plot
Lyle Creek Stream Mitigation Site (EEP Project #00102)

Species	Plots			Year 4 Totals
	1	**2**	**3**	
Fraxinus sp. (Ash)	1			**1**
Platanus occidentalis (American sycamore)			2	**2**
Liriodendron tulipifera (tulip poplar)	6		2	**8**
Betula nigra (River birch)	3	5	1	**9**
Alnus serrulata (Tag alder)	3			**3**
Juniperus virginiana (Eastern red cedar)		1	2	**3**
Salix nigra (Black willow)	1		3	**4**
Year 4 Totals	**14**	**6**	**10**	**30**
Year 3 Totals	29	6	10	**45**
Average Live Stem Density/Acre	404			
Survival % From Year 3-Year 4	48%	100%	100%	**83%**

EEP Stem Count Data Sheet

EEP Project #:	**00102**	**Date:**
Project Name:	**Lyle Creek**	**Staff Name:**
Monitoring Contractor:	**S&EC**	**Staff Name:**
County:	**Catawba**	
8 Digit Catalog Unit	**03050101**	
Stream/Wetland Name:	**Lyle Creek**	

Plot Location

Plot ID	Species	Stem #
1	Tulip Poplar	4
1	River Birch	3
1	Oak sp.	
1	Ash sp.	1
1	Black Willow	1
1	Tag Alder	3
1	Red Maple	2

Plot Location

Plot ID	Species	Stem #
2	Eastern Red Cedar	1
2	River Birch	5

Plot Location

Plot ID	Species	Stem #
3	Tulip Poplar	2
3	River Birch	1
3	Black Willow	3
3	American Sycamore	2
3	Red Cedar	2

APPENDIX A –

Vegetation Monitoring Plot Photos

Vegetation Plot 1—Year 4 (2005)

Vegetation Plot 2—Year 4 (2005)

Vegetation Plot 3—Year 4 (2005)

APPENDIX B

APPENDIX B

APPENDIX B –

Representative Stream Problem Area Photos

Figure 1— Typical Bank Scour

Figure 2—Typical Bank Scour

Figure 3—Typical Bank Scour

Figure 4—Typical Failing Structure

APPENDIX B –

Stream Photo Point Photos

Figure 1— Photo Point 1 Downstream 2004

Figure 2—Photo Point 1 Downstream 2005

Figure 3—Photo Point 2 Downstream 2004

Figure 4—Photo Point 2 Downstream 2005

Figure 5—Photo Point 2 Upstream 2004

Figure 6—Photo Point 2 Upstream 2005

Figure 7—Photo Point 3 Downstream 2004

Figure 8—Photo Point 3 Downstream 2005

Figure 9—Photo Point 3 Upstream 2004

Figure 10—Photo Point 3 Upstream 2005

Figure 11—Photo Point 4 Downstream 2004

Figure 12—Photo Point 4 Downstream 2005

Figure 13—Photo Point 4 Upstream 2004

Figure 14—Photo Point 4 Upstream 2005

Figure 15—Photo Point 5 Downstream 2004

Figure 16—Photo Point 5 Downstream 2005

Figure 17— Photo Point 5 Upstream 2004

Figure 18—Photo Point 5 Upstream 2005

Figure 19—Photo Point 6 Downstream 2004

Figure 20—Photo Point 6 Downstream 2005

Figure 21—Photo Point 6 Upstream 2004

Figure 22—Photo Point 6 Upstream 2005

Figure 23— Photo Point 7 Downstream 2004

Figure 24—Photo Point 7 Downstream 2005

Figure 25— Photo Point 7 Upstream 2004

Figure 26—Photo Point 7 Upstream 2005

Figure 27—Photo Point 8 Downstream 2004

Figure 28—Photo Point 8 Downstream 2005

Figure 29— Photo Point 8 Upstream 2004

Figure 30—Photo Point 8 Upstream 2005

Figure 31— Photo Point 9 Downstream 2004

Figure 32—Photo Point 9 Downstream 2005

Figure 33— Photo Point 9 Upstream 2004

Figure 34—Photo Point 9 Upstream 2005

Figure 35—Photo Point 10 Downstream 2004

Figure 36—Photo Point 10 Downstream 2005

Figure 37—Photo Point 11 Downstream 2004

Figure 38—Photo Point 11 Downstream 2005

Figure 39—Photo Point 11 Upstream 2004

Figure 40—Photo Point 11 Upstream 2005

Figure 41— Photo Point 12 Downstream 2004

Figure 42—Photo Point 12 Downstream 2005

Figure 43—Photo Point 12 Upstream 2004

Figure 44—Photo Point 12 Upstream 2005

APPENDIX B –

Cross-section Data

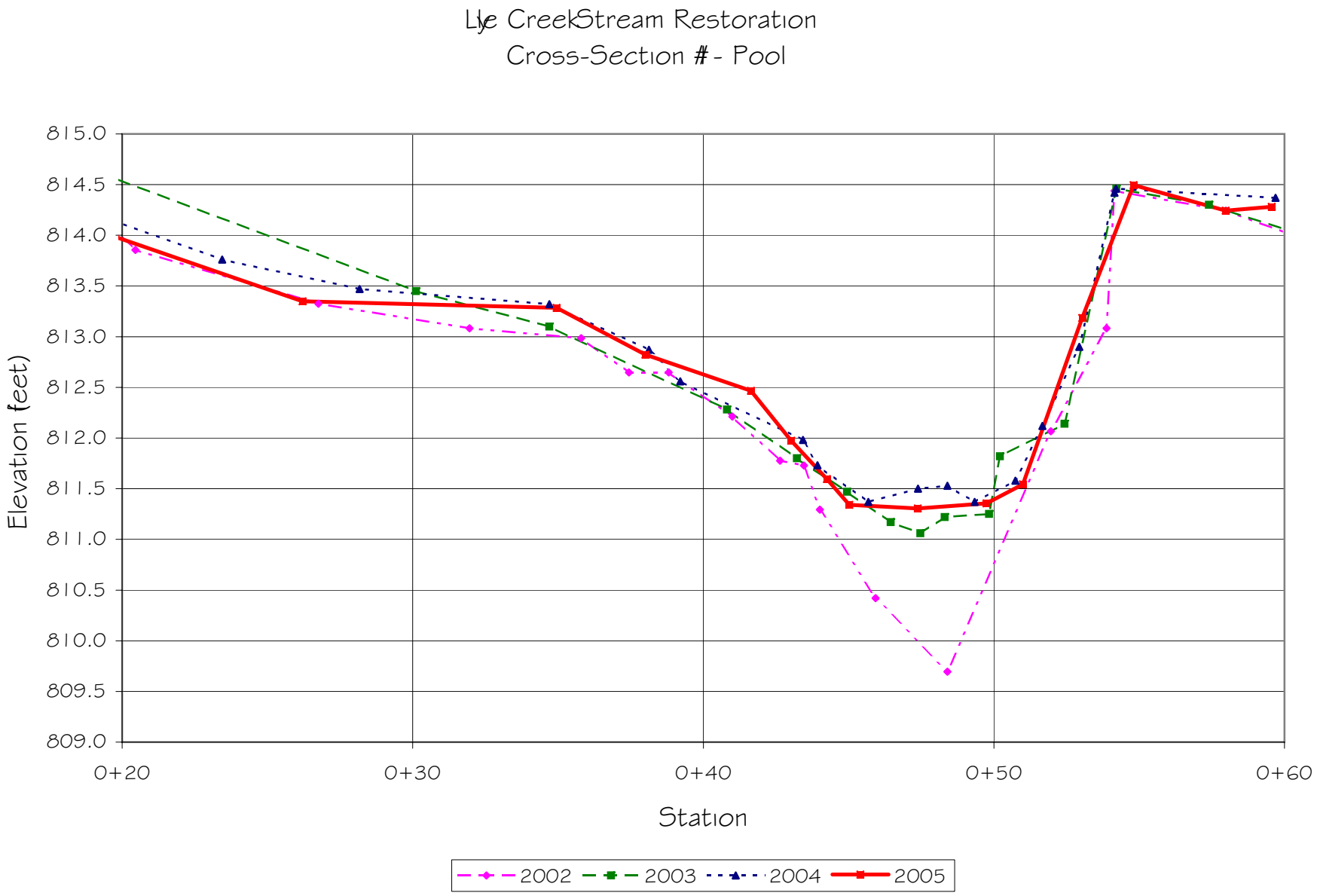

Lye CreekStream Restoration
Cross-Section # - Pool
815.0
814.5
814.0
813.5
813.0
812.5
812.0
811.5
811.0
810.5
810.0
809.5
809.0
Elevation (feet)
0+20
0+30
0+40
0+50
0+60
Station
2002
2003
2004
2005

Figure 1—Cross Section # 1 (2005)

Figure 2—Cross Section # 1 (2004)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Lyle Creek
Reach Name: 2005 (YR4)
Cross Section Name: XS1
Survey Date: 38688

Cross Section Data Entry

TAPE	FS	ELEV	NOTE
19.60	0.00	814.15	
19.85	0.00	813.98	
26.20	0.00	813.35	
34.95	0.00	813.29	
38.00	0.00	812.82	
41.64	0.00	812.47	
43.02	0.00	811.97	
44.25	0.00	811.60	
45.02	0.00	811.34	
47.38	0.00	811.31	
49.74	0.00	811.36	
51.00	0.00	811.54	
53.04	0.00	813.18	
54.81	0.00	814.50	
57.98	0.00	814.24	
59.56	0.00	814.28	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	815.25
Bankfull	Elevation	(ft)	813.28
Floodprone	Width	(ft)	50.00
Bankfull	Width	(ft)	18.16
Entrenchment	Ratio		2.75
Mean	Depth	(ft)	1.16
Maximum	Depth	(ft)	1.97
Width/Depth	Ratio		15.64
Bankfull	Area	(sq ft)	21.09
Wetted	Perimeter	(ft)	19.02
Hydraulic	Radius	(ft)	1.11
Begin	BKF	Station	35.01
End	BKF	Station	53.17

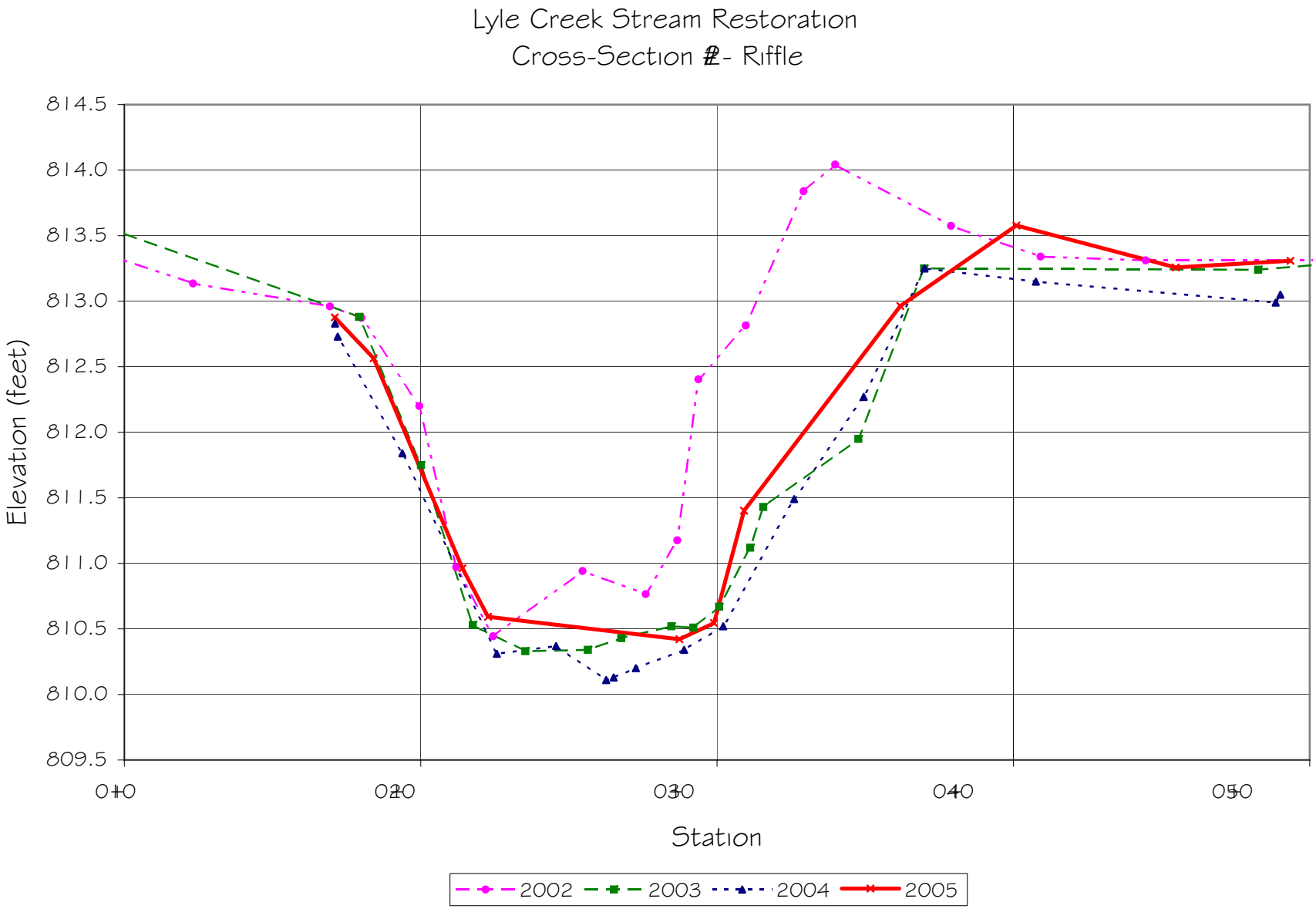

Lyle Creek Stream Restoration
Cross-Section #- Riffle
814.5
814.0
813.5
813.0
812.5
812.0
811.5
811.0
810.5
810.0
809.5
Elevation (feet)
010
020
030
040
050
Station
2002
2003
2004
2005

Figure 3—Cross Section # 2 (2005)

Figure 4—Cross Section # 2 (2004)

RIVERMORPH CROSS SECTION SUMMARY

River	Name:	Lyle	Creek
Reach	Name:	2005	(YR4)
Cross	Section	Name:	XS2
Survey	Date:	38688	

Cross	Section	Data	Entry
TAPE	FS	ELEV	NOTE
17.10	0.00	812.88	
18.41	0.00	812.57	
21.41	0.00	810.96	
22.27	0.00	810.59	
28.73	0.00	810.42	
29.90	0.00	810.54	
30.91	0.00	811.40	
36.19	0.00	812.96	
40.10	0.00	813.58	
45.47	0.00	813.26	
49.35	0.00	813.31	

Cross	Sectional	Geometry	
			Channel
Floodprone	Elevation	(ft)	813.32
Bankfull	Elevation	(ft)	811.87
Floodprone	Width	(ft)	50.00
Bankfull	Width	(ft)	12.79
Entrenchment	Ratio		3.91
Mean	Depth	(ft)	1.05
Maximum	Depth	(ft)	1.45
Width/Depth	Ratio		12.16
Bankfull	Area	(sq ft)	13.44
Wetted	Perimeter	(ft)	13.48
Hydraulic	Radius	(ft)	1.00
Begin	BKF	Station	19.71
End	BKF	Station	32.50

Lyle Creek Stream Restoration
Cross-Section #8 - Riffle

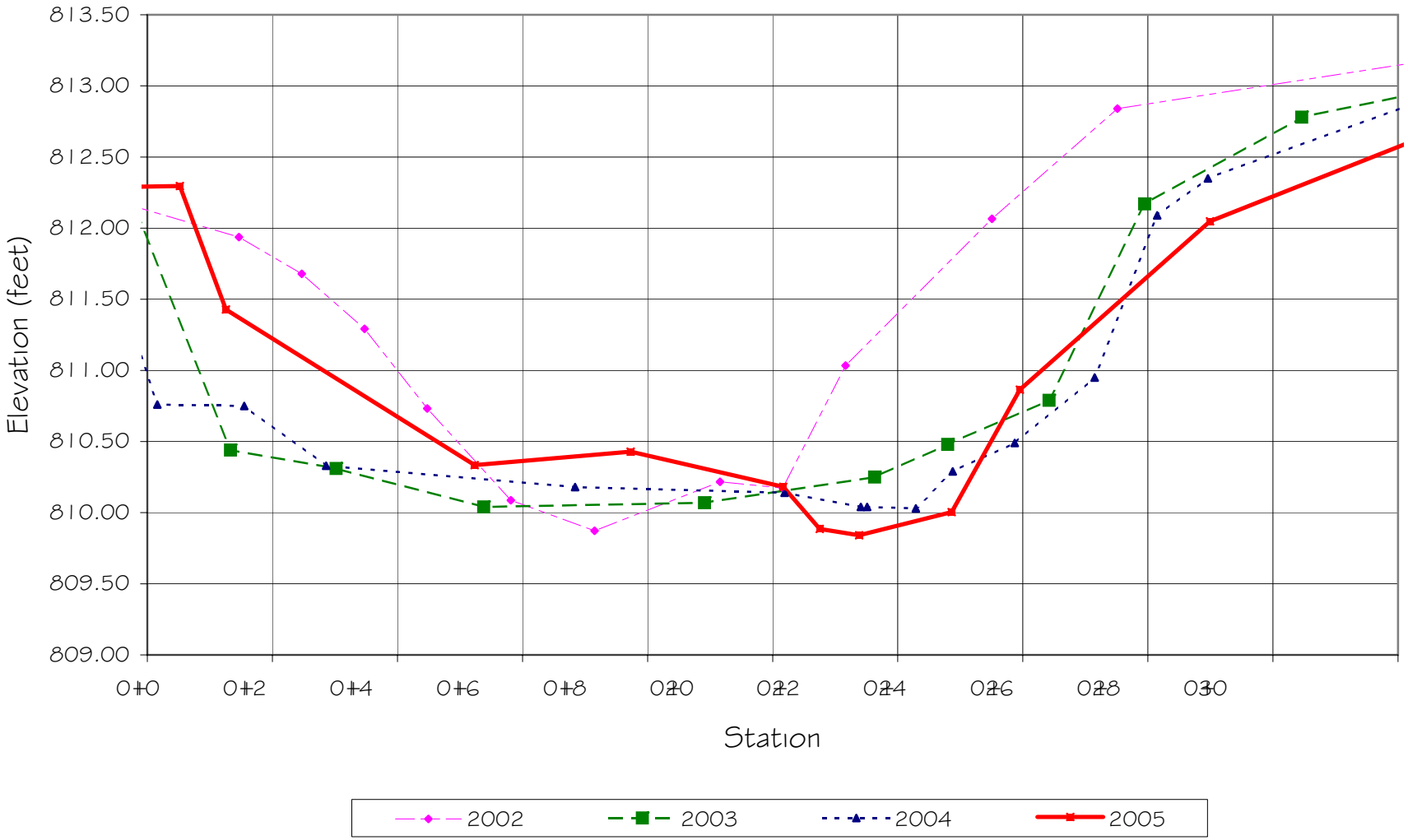


Figure 5—Cross Section # 3 (2005)

Figure 6—Cross Section # 3 (2004)

RIVERMORPH CROSS SECTION SUMMARY

River	Name:	Lyle	Creek
Reach	Name:	2005	(YR4)
Cross	Section	Name:	XS3
Survey	Date:	38687	

Cross	Section	Data	Entry
TAPE	FS	ELEV	NOTE
9.10	0.00	812.29	
10.52	0.00	812.30	
11.26	0.00	811.43	
15.24	0.00	810.33	
17.73	0.00	810.43	
20.17	0.00	810.18	
20.75	0.00	809.89	
21.38	0.00	809.84	
22.86	0.00	810.00	
23.95	0.00	810.86	
26.99	0.00	812.05	
31.87	0.00	812.90	
34.10	0.00	813.38	

Cross	Sectional	Geometry	
			Channel
Floodprone	Elevation	(ft)	813.10
Bankfull	Elevation	(ft)	811.47
Floodprone	Width	(ft)	50.00
Bankfull	Width	(ft)	14.28
Entrenchment	Ratio		3.50
Mean	Depth	(ft)	0.96
Maximum	Depth	(ft)	1.63
Width/Depth	Ratio		14.94
Bankfull	Area	(sq ft)	13.65
Wetted	Perimeter	(ft)	14.96
Hydraulic	Radius	(ft)	0.91
Begin	BKF	Station	11.23
End	BKF	Station	25.51

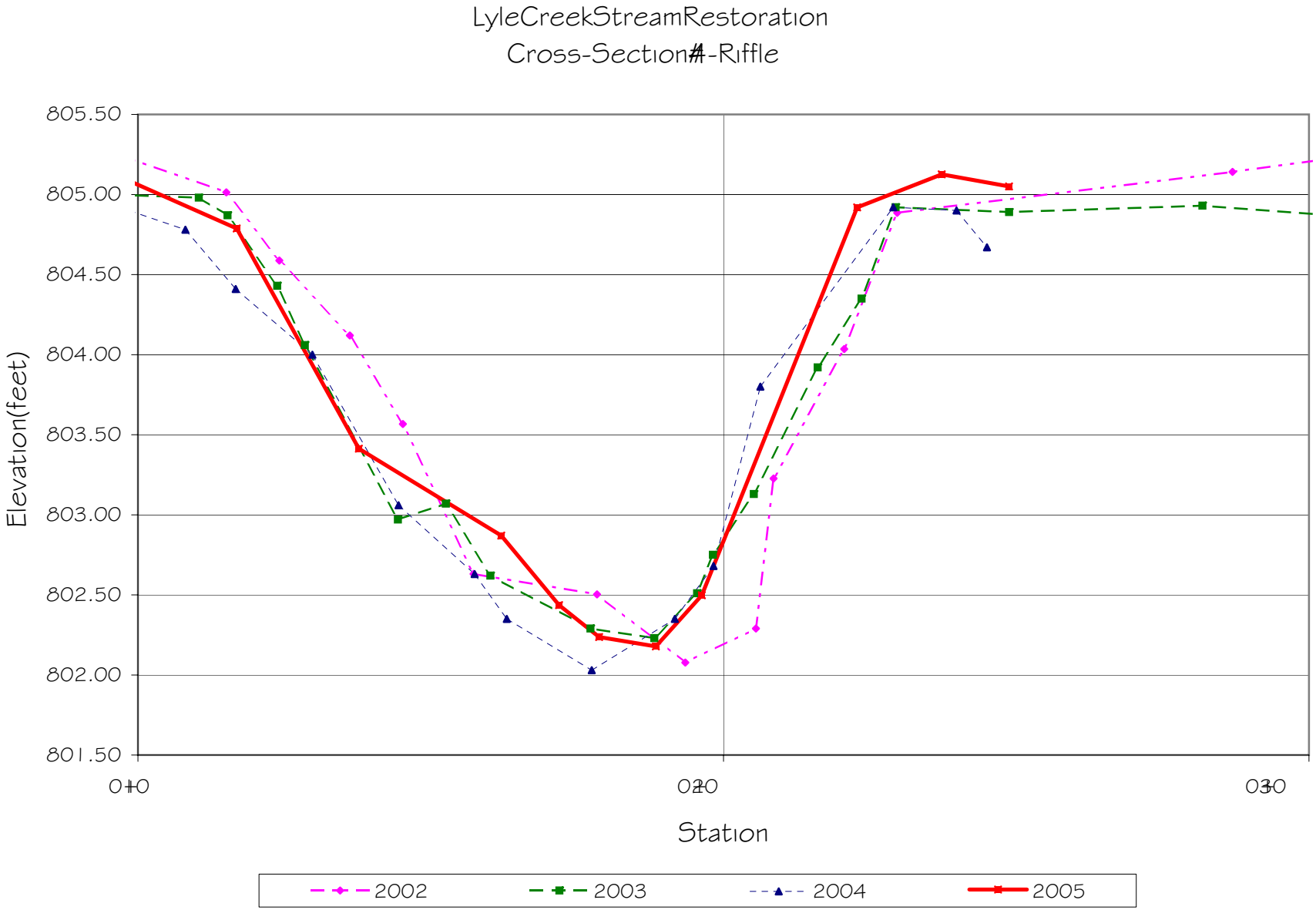

LyleCreekStreamRestoration
Cross-Section#-Riffle
805.50
805.00
804.50
804.00
803.50
803.00
802.50
802.00
801.50
Elevation(feet)
010
020
030
Station
2002
2003
2004
2005

Figure 7—Cross Section # 4 (2005)

Figure 8—Cross Section # 4 (2004)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Lyle Creek
Reach Name: 2005 (YR4)
Cross Section Name: XS4
Survey Date: 38688

Cross Section Data Entry

TAPE	FS	ELEV	NOTE
9.28	0.00	805.18	
11.69	0.00	804.79	
13.77	0.00	803.41	
16.21	0.00	802.87	
17.19	0.00	802.44	
17.88	0.00	802.24	
18.85	0.00	802.18	
19.63	0.00	802.50	
22.28	0.00	804.92	
23.73	0.00	805.13	
24.88	0.00	805.05	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	806.80
Bankfull	Elevation	(ft)	804.49
Floodprone	Width	(ft)	50.00
Bankfull	Width	(ft)	9.67
Entrenchment	Ratio		5.17
Mean	Depth	(ft)	1.40
Maximum	Depth	(ft)	2.31
Width/Depth	Ratio		6.92
Bankfull	Area	(sq	13.51
Wetted	Perimeter	(ft)	11.01
Hydraulic	Radius	(ft)	1.23
Begin	BKF	Station	12.14
End	BKF	Station	21.81

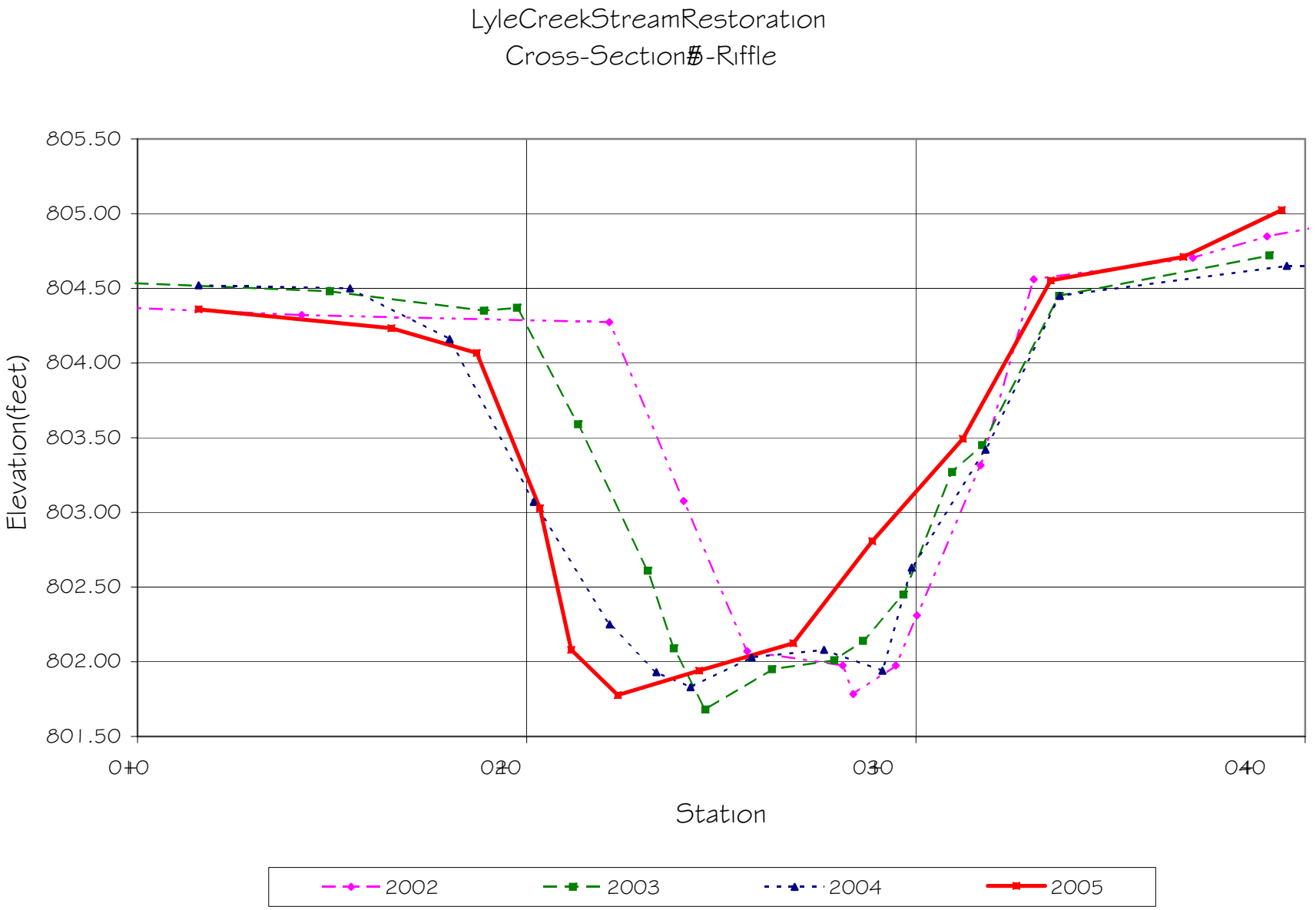

LyleCreekStreamRestoration
Cross-Section#5-Riffle
805.50
805.00
804.50
804.00
803.50
803.00
802.50
802.00
801.50
Elevation(feet)
010
020
030
040
Station
2002
2003
2004
2005

Figure 9—Cross Section # 5 (2005)

Figure 10—Cross Section # 5 (2004)

RIVERMORPH CROSS SECTION SUMMARY

River	Name:	Lyle	Creek
Reach	Name:	2005.00	(YR4)
Cross	Section	Name:	XS5
Survey	Date:	38688.00	

Cross	Section	Data	Entry
TAPE	FS	ELEV	NOTE
11.57	0.00	804.36	
16.52	0.00	804.23	
18.72	0.00	804.07	
20.34	0.00	803.03	
21.14	0.00	802.08	
22.34	0.00	801.78	
24.43	0.00	801.94	
26.85	0.00	802.12	
28.88	0.00	802.81	
31.21	0.00	803.49	
33.46	0.00	804.55	
36.87	0.00	804.71	
39.40	0.00	805.02	

Cross	Sectional	Geometry	
			Channel
Floodprone	Elevation	(ft)	805.40
Bankfull	Elevation	(ft)	803.59
Floodprone	Width	(ft)	50.00
Bankfull	Width	(ft)	11.95
Entrenchment	Ratio		4.18
Mean	Depth	(ft)	1.15
Maximum	Depth	(ft)	1.81
Width/Depth	Ratio		10.37
Bankfull	Area	(sq	13.77
Wetted	Perimeter	(ft)	12.84
Hydraulic	Radius	(ft)	1.07
Begin	BKF	Station	19.47
End	BKF	Station	31.42

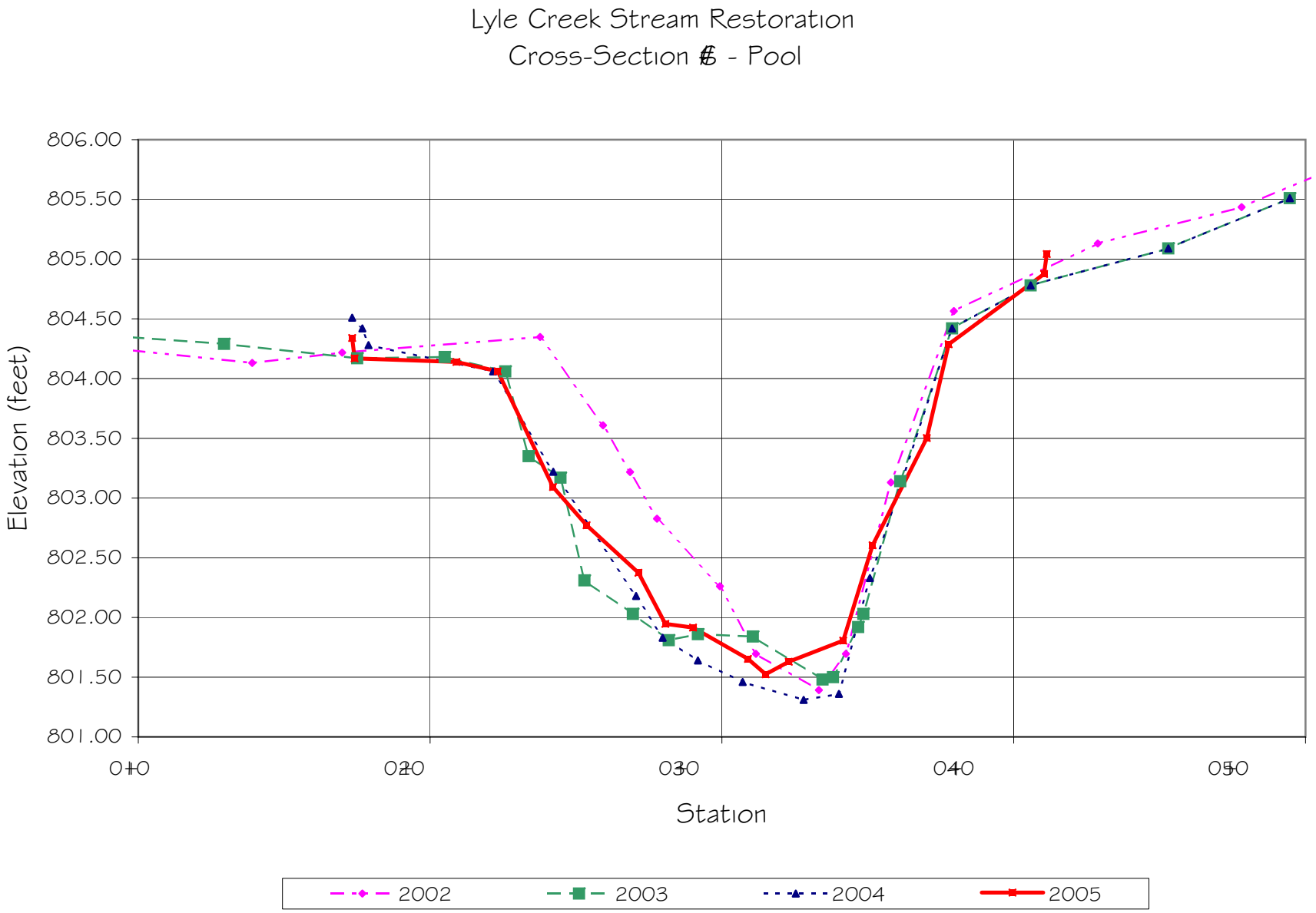

Lyle Creek Stream Restoration
Cross-Section ℄ - Pool
806.00
805.50
805.00
804.50
804.00
803.50
803.00
802.50
802.00
801.50
801.00
Elevation (feet)
010
020
030
040
050
Station
2002
2003
2004
2005

Figure 11—Cross Section # 6 (2005)

Figure 12—Cross Section # 6 (2004)

RIVERMORPH CROSS SECTION SUMMARY

River	Name:	Lyle	Creek
Reach	Name:	2005	(YR4)
Cross	Section	Name:	XS6
Survey	Date:	38688	

Cross Section Data Entry

TAPE	FS	ELEV	NOTE
17.33	0.00	804.34	
17.42	0.00	804.17	
20.90	0.00	804.14	
22.32	0.00	804.06	
24.21	0.00	803.09	
25.36	0.00	802.77	
27.14	0.00	802.37	
28.06	0.00	801.95	
29.01	0.00	801.92	
30.89	0.00	801.65	
31.50	0.00	801.52	
32.29	0.00	801.63	
34.16	0.00	801.81	
35.16	0.00	802.60	
37.02	0.00	803.50	
37.77	0.00	804.29	
41.04	0.00	804.88	
41.13	0.00	805.04	

Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	806.20
Bankfull	Elevation	(ft)	803.86
Floodprone	Width	(ft)	50.00
Bankfull	Width	(ft)	14.65
Entrenchment	Ratio		3.41
Mean	Depth	(ft)	1.48
Maximum	Depth	(ft)	2.34
Width/Depth	Ratio		9.91
Bankfull	Area	(sq ft)	21.65
Wetted	Perimeter	(ft)	15.70
Hydraulic	Radius	(ft)	1.38
Begin	BKF	Station	22.71
End	BKF	Station	37.36

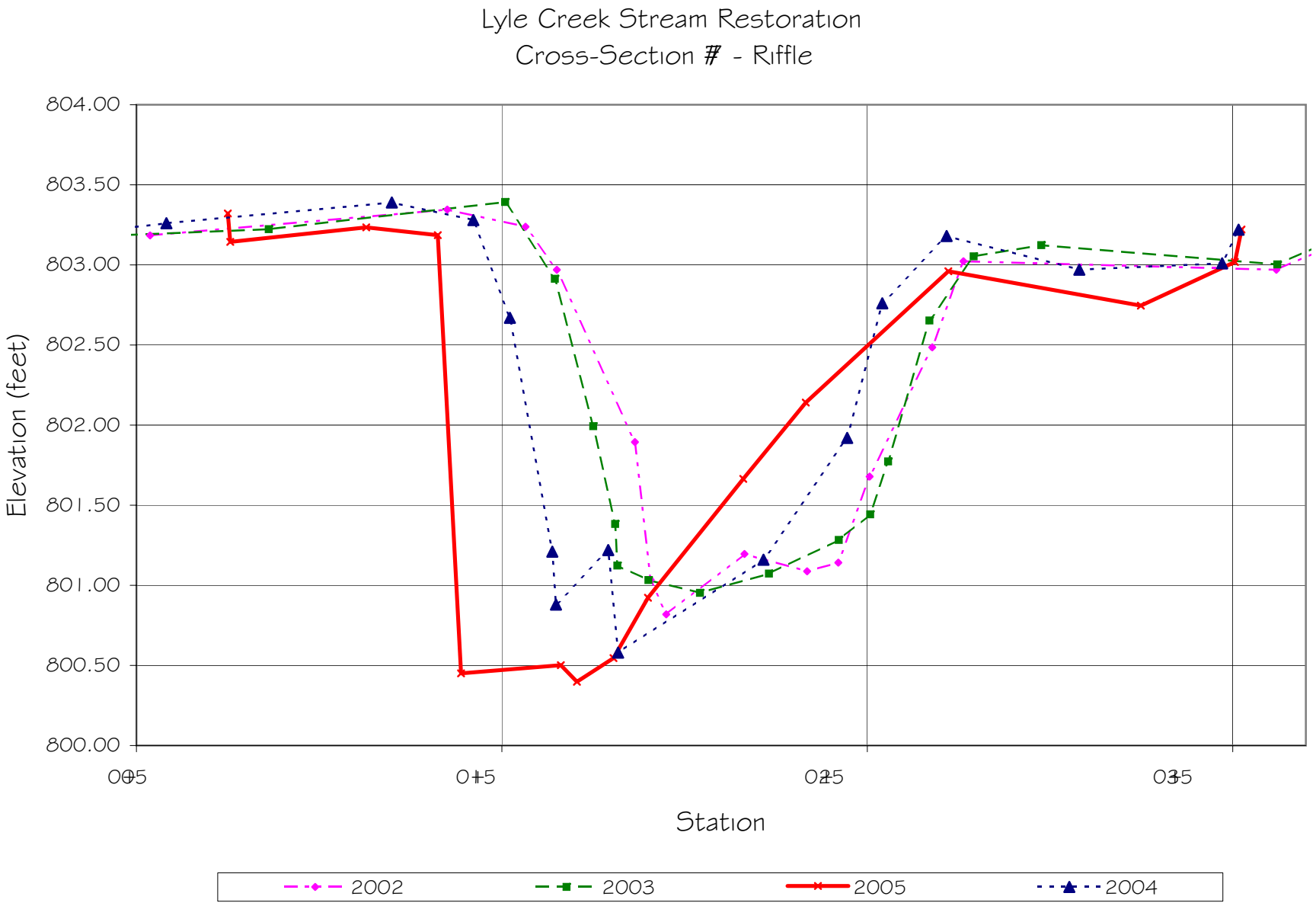

Lyle Creek Stream Restoration
Cross-Section # - Riffle
804.00
803.50
803.00
802.50
802.00
801.50
801.00
800.50
800.00
Elevation (feet)
0+05
0+15
0+25
0+35
Station
2002
2003
2005
2004

Figure 13—Cross Section # 7 (2005)

Figure 14—Cross Section # 7 (2004)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Lyle Creek
Reach Name: 2005 (YR4)
Cross Section Name: XS7
Survey Date: 38688

Cross Section Data Entry

BM Elevation: 0.00 ft
Backsight Rod Reading: 0.00 ft

TAPE	FS	ELEV	NOTE
7.50	0.00	803.32	
7.57	0.00	803.14	
11.29	0.00	803.23	
13.25	0.00	803.19	
13.88	0.00	800.45	
16.61	0.00	800.50	
18.05	0.00	800.55	
19.00	0.00	800.92	
21.61	0.00	801.66	
23.31	0.00	802.14	
27.22	0.00	802.96	
32.49	0.00	802.75	
35.06	0.00	803.02	
35.24	0.00	803.22	

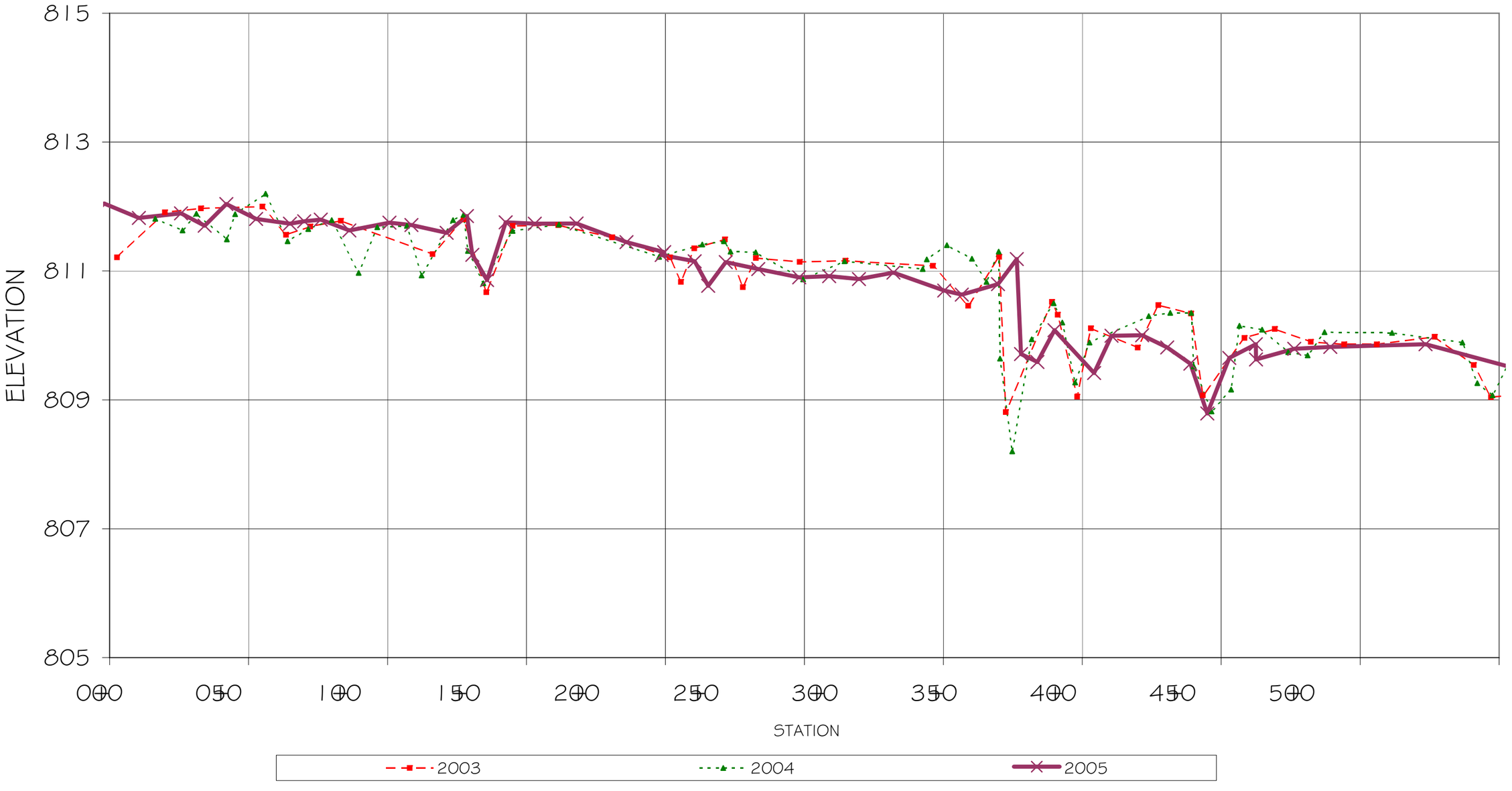
Cross Sectional Geometry

			Channel
Floodprone	Elevation	(ft)	804.31
Bankfull	Elevation	(ft)	802.38
Floodprone	Width	(ft)	50.00
Bankfull	Width	(ft)	11.02
Entrenchment	Ratio		4.54
Mean	Depth	(ft)	1.24
Maximum	Depth	(ft)	1.93
Width/Depth	Ratio		8.89
Bankfull	Area	(sq ft)	13.66
Wetted	Perimeter	(ft)	12.82
Hydraulic	Radius	(ft)	1.07
Begin	BKF	Station	13.44
End	BKF	Station	24.45

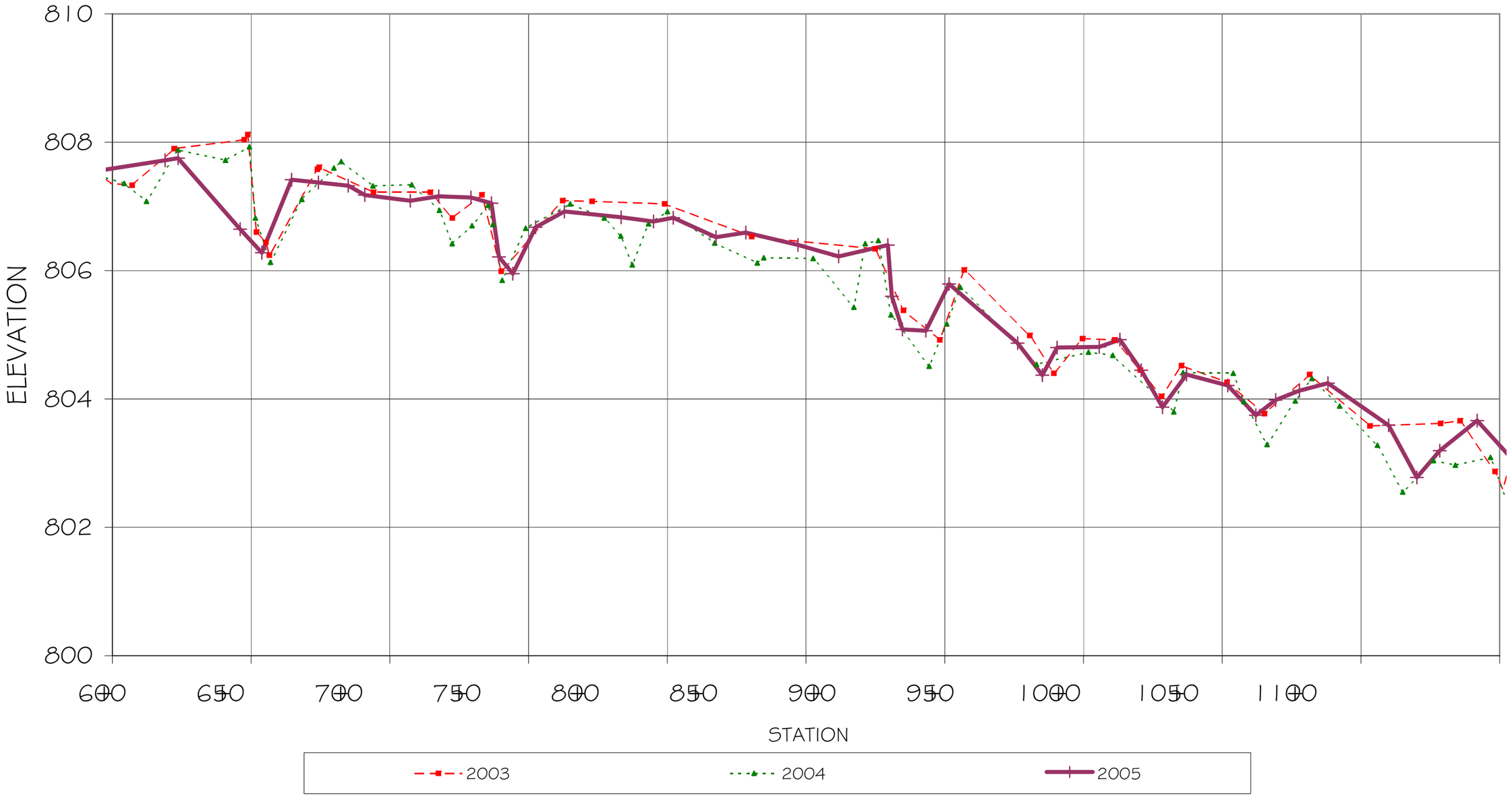
APPENDIX B –

Longitudinal Profile

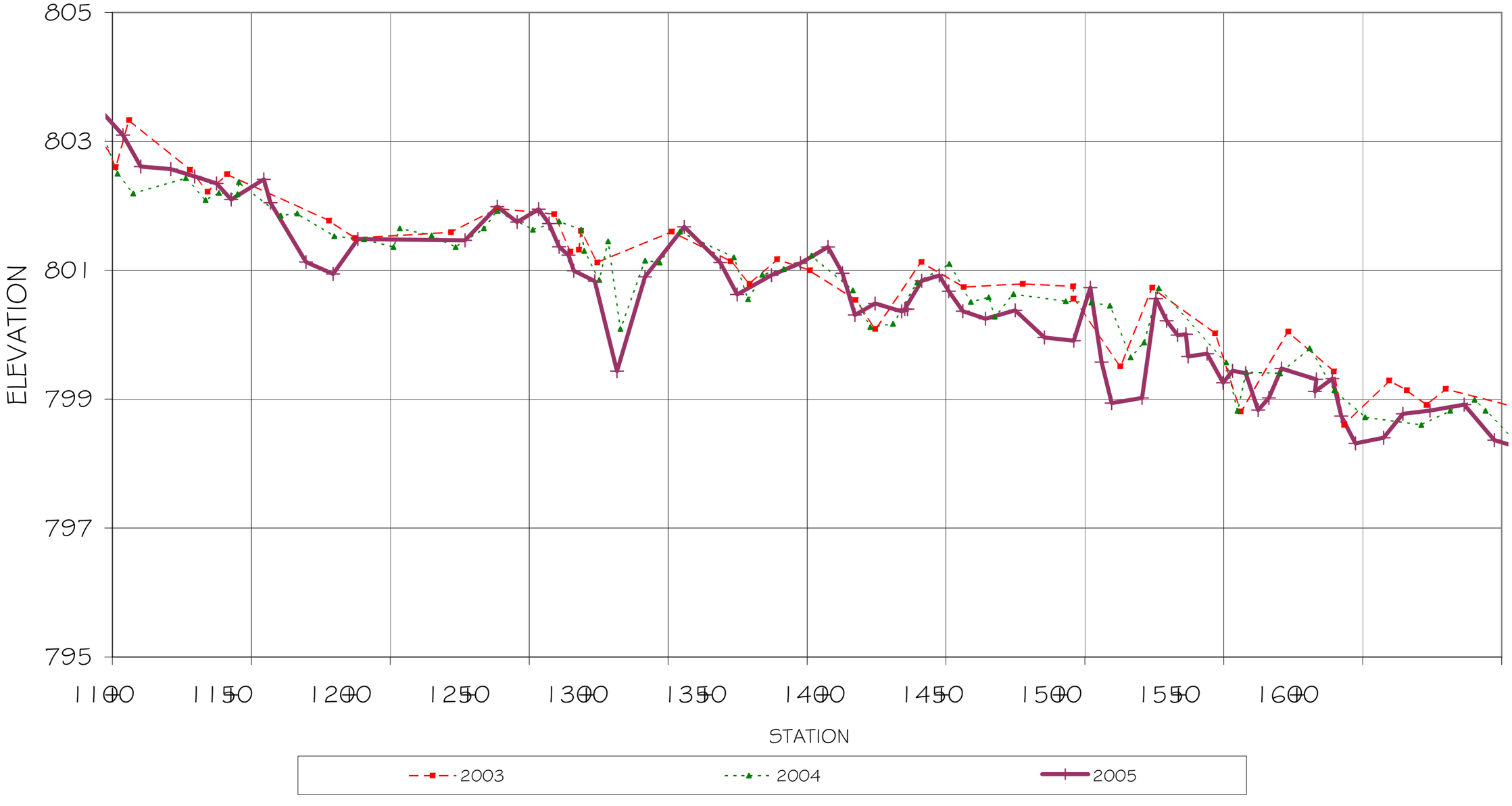
Lyle Creek Stream Restoration
Longitudinal Profile



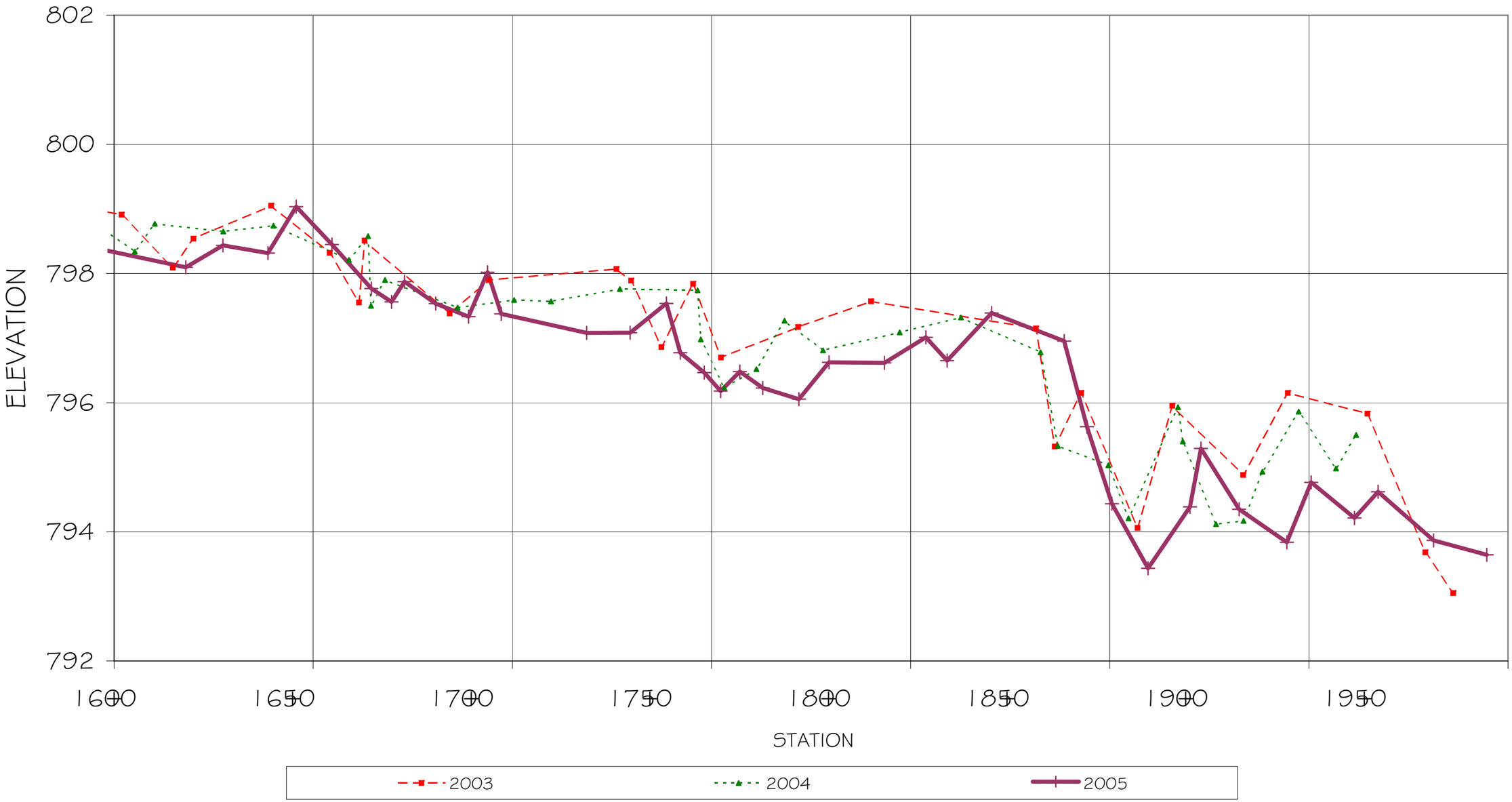
Lyle Creek Stream Restoration
Longitudinal Profile



Lyle Creek Stream Restoration
Longitudinal Profile



Lyle Creek Stream Restoration
Longitudinal Profile



RIVERMORPH REACH SUMMARY

River Name: Lyle Creek
Reach Name: 2005.00 (YR4)

Stream Type	Valley	Type	D50(mm)	Valley Slope	BKF Q (cfs)	DA(sq mi)
C	4.00	VIII		0.01	53.97	0.50

Dimension Summary

Variable			Min	Avg	Max
Floodprone	Width	(ft)	50.00	50.00	50.02
Riffle	Area	(Sq ft)	13.44	13.59	13.77
Max	Riffle	Depth (ft)	1.45	1.80	2.31
Mean	Riffle	Depth (ft)	0.96	1.14	1.40
Riffle	Width	(ft)	9.67	12.17	14.28
Pool	Area	(Sq ft)	21.09	21.37	21.65
Max	Pool	Depth (ft)	1.97	2.16	2.34
Mean	Pool	Depth (ft)	1.16	1.32	1.48
Pool	Width	(ft)	14.65	16.41	18.16

Pattern Summary

Variable			Min	Avg	Max
Sinuosity				1.45	
Meander	Wavelength	(ft)	47.59	115.46	210.84
Radius	of Curvature		18.81	28.46	51.17
Belt	Width	(ft)	26.33	47.58	102.68

Profile Summary

Variable			Min	Avg	Max
S	riffle	(ft/ft)	0.00	0.03	0.10
S	pool	(ft/ft)	0.00	0.00	0.01
S	run	(ft/ft)	0.03	0.15	0.36
S	glide	(ft/ft)	0.01	0.14	0.97
P	-	P	12.31	69.52	152.61
P	length	(ft)	12.31	32.43	78.77
Dmax	riffle	(ft)	1.45	1.80	2.31
Dmax	pool	(ft)	1.97	2.16	2.34
Dmax	run	(ft)	0.00	0.00	0.00
Dmax	glide	(ft)	0.00	0.00	0.00
Low	Bank	Ht	0.00	0.00	0.00
Bankfull	Slope	(ft/ft)		0.01	

Hydraulic Summary

Variable		Min	Avg	Max
Discharge	(cfs)		53.97	
Velocity	(fps)		3.95	
Hyd	Radius	0.91	1.05	1.23

RIVERMORPH REACH SUMMARY

River Name: Lyle Creek
Reach Name: 2005.00 (YR4)

Stream Type	Valley Type	D50(mm)	Val	Slope	BKF Q(cfs)	DA(sq mi)
C	4.00 VIII	5.00	0.01	53.97	0.50	

Dimension Summary

Variable	Min	Avg	Max
Wfpa / Wbkf	4.11	4.11	4.11
Pool Area/ Abkf	1.55	1.57	1.59
Max Pool Depth/ Dbkf	1.73	1.89	2.05
Mean Pool Depth/ Dbkf	1.02	1.16	1.30
Pool Width Width / Wbkf		1.20	1.35 1.49

Pattern Summary

Variable	Min	Avg	Max
Sinuosity		1.45	
Lm/Wbkf	3.91	9.49	17.32
Rc/Wbkf	1.55	2.34	4.20
Wblt/Wbkf (M	2.16	3.91	8.44

Profile Summary

Variable						Min	Avg	Max
S riffle / S bkf					(ft/ft)	0.41	3.76	12.25
S pool / S bkf					(ft/ft)	0.00	0.30	1.15
S run / S bkf					(ft/ft)	3.55	17.45	42.63
S glide / S bkf					(ft/ft)	1.53	16.27	114.80
P - P / W bkf						1.01	5.71	12.54
P length / W bkf					(ft)	1.01	2.66	6.47
Dmax riffle / D bkf					(ft)	1.27	1.58	2.03
Dmax pool / D bkf					(ft)	1.73	1.89	2.05
Bankfull Slope (ft/ft)							0.01	

Hydraulic Summary

Variable					Min	Avg	Max
Q bkf						53.97	
V bkf (fps)						3.95	
HR / D bkf				(ft)	0.80	0.92	1.08
Bkf Shear (lb/ sq ft)					0.48	0.56	0.65

LYLE CREEK TW POINTS 2005

Point	Northing	Easting	Elevation	Comment	Distance	Station		Water Surface Points			pt	Reduced Stations elev	stat	
5	4002.182	4922.88	812.1423	tw 0.1	0.00	0.00	0+00.0	0.00	812.24			5	812.1423	-0+26.0
8	4011.253	4936.992	811.7524	tw 0.6end cv	16.78	016.8	-0+11.2	016.8	812.35			8	811.7524	-0+09.2
10	4009.12	4943.926	812.0455	tw 0.3	7.25	024.0	-0+04.0	024.0	812.35			10	812.0455	-0+02.0
12	4008.045	4956.38	811.823	tw 0.5	12.50	036.5	0+08.5	036.5	812.32			12	811.823	0+10.5
14	4016.351	4969.082	811.8947	tw 0.4	15.18	051.7	0+23.7	051.7	812.29			14	811.8947	0+25.7
15	4023.422	4973.811	811.7022	tw 0.6	8.51	060.2	0+32.2	060.2	812.3			15	811.7022	0+34.2
17	4030.556	4976.989	812.0384	tw 0.3	7.81	068.0	0+40.0	068.0	812.34			17	812.0384	0+42.0
19	4040.321	4981.363	811.808	tw 0.4	10.70	078.7	0+50.7	078.7	812.21			19	811.808	0+52.7
21	4052.341	4983.418	811.7342	tw 0.4	12.19	090.9	0+62.9	090.9	812.13			21	811.7342	0+64.9
23	4055.936	4979.846	811.7716	tw 0.4	5.07	096.0	0+68.0	096.0	812.17			23	811.7716	0+70.0
25	4057.847	4974.145	811.798	cv 0.4	6.01	102.0	0+74.0	102.0	812.2			25	811.798	0+76.0
29	4057.429	4963.884	811.6283	tw 0.5	10.27	112.3	0+84.3	112.3	812.13			29	811.6283	0+86.3
31	4061.158	4949.974	811.7494	tw 0.3	14.40	126.7	0+98.7	126.7	812.05			31	811.7494	1+00.7
32	4067.389	4945.015	811.7123	tw 0.3	7.96	134.6	1+06.6	134.6	812.01			32	811.7123	1+08.6
34	4079.825	4942.597	811.5926	tw 0.4	12.67	147.3	1+19.3	147.3	811.99			34	811.5926	1+21.3
35	4085.188	4947.476	811.8523	cv 0.1	7.25	154.6	1+26.6	154.6	811.95			35	811.8523	1+28.6
37	4087.112	4947.007	811.2517	tw 0.75	1.98	156.5	1+28.5	156.5	812			37	811.2517	1+30.5
39	4092.295	4948.087	810.8599	tw 0.1	5.29	161.8	1+33.8	161.8	810.96			39	810.8599	1+35.8
41	4098.896	4947.029	811.7543	tw 0.2	6.69	168.5	1+40.5	168.5	811.95			41	811.7543	1+42.5
43	4109.369	4946.621	811.7336	tw0.3	10.48	179.0	1+51.0	179.0	812.03			43	811.7336	1+53.0
45	4124.421	4946.185	811.7356	tw 0.1	15.06	194.1	1+66.1	194.1	811.84			45	811.7356	1+68.1
47	4142.235	4944.066	811.4479	tw 0.2	17.94	212.0	1+84.0	212.0	811.65			47	811.4479	1+86.0
49	4155.296	4940.389	811.2921	tw 0.3	13.57	225.6	1+97.6	225.6	811.59			49	811.2921	1+99.6
51	4160.898	4934.423	811.2657	tw 0.4	8.18	233.7	2+05.7	233.7	811.67			51	811.2657	2+07.7
72	4163.878	4925.168	811.2491	tw 0.4	9.72	243.5	2+15.5	243.5	811.65			72	811.2491	1+98.7
74	4168.424	4914.243	811.1497	tw 0.4	11.83	255.3	2+27.3	255.3	811.55			74	811.1497	2+10.5
75	4168.441	4909.366	810.7709	tw 0.7	4.88	260.2	2+32.2	260.2	811.47			75	810.7709	2+15.4
77	4167.818	4903.049	811.1378	tw 0.3	6.35	266.5	2+38.5	266.5	811.44			77	811.1378	2+21.7
79	4170.831	4891.781	811.0311	tw 0.4	11.66	278.2	2+50.2	278.2	811.43			79	811.0311	2+33.4
81	4180.501	4880.656	810.9017	tw 0.5	14.74	292.9	2+64.9	292.9	811.4			81	810.9017	2+48.1
83	4191.196	4879.115	810.9184	tw 0.4	10.81	303.7	2+75.7	303.7	811.32			83	810.9184	2+58.9
85	4201.783	4877.636	810.8755	tw 0.4	10.69	314.4	2+86.4	314.4	811.28			85	810.8755	2+69.6
87	4213.842	4874.739	810.9744	tw 0.3	12.40	326.8	2+98.8	326.8	811.27			87	810.9744	2+82.0
91	4231.199	4880.494	810.6975	tw 0.6	18.29	345.1	3+17.1	345.1	811.3			91	810.6975	3+00.3
93	4230.965	4886.857	810.6336	tw 0.6	6.37	351.5	3+23.5	351.5	811.23			93	810.6336	3+06.7
94	4231.061	4899.885	810.7956	tw 0.4	13.03	364.5	3+36.5	364.5	811.2			94	810.7956	3+19.7
95	4229.592	4906.433	811.1844	tw 0.0cv	6.71	371.2	3+43.2	371.2	811.18			95	811.1844	3+26.4
97	4228.891	4907.82	809.7101	tw 0.9	1.55	372.8	3+44.8	372.8	810.61			97	809.7101	3+28.0
99	4225.622	4912.745	809.5862	tw 1.05	5.91	378.7	3+50.7	378.7	810.64			99	809.5862	3+33.9
100	4222.296	4917.892	810.0818	tw 0.6	6.13	384.8	3+56.8	384.8	810.68			100	810.0818	3+40.0
116	4216.899	4937.925	809.418	tw 1.15	20.75	405.6	3+77.6	405.6	810.57			116	809.418	3+54.3
118	4216.592	4944.166	809.995	tw 1.7	6.25	411.8	3+83.8	422.9	810.6	411.8		118	809.995	3+60.5
120	4220.471	4954.514	810.0014	tw 0.6	11.05	422.9	3+94.9	431.9	810.61			120	810.0014	3+71.6
122	4226.224	4961.445	809.8125	tw 0.8	9.01	431.9	4+03.9	440.2	810.26			122	809.8125	3+80.6
124	4233.598	4965.257	809.5606	tw 0.7	8.30	440.2	4+12.2	446.3	810.19			124	809.5606	3+88.9
126	4238.646	4968.736	808.7886	tw 1.4	6.13	446.3	4+18.3	454.2	810.3			126	808.7886	3+95.0
128	4243.784	4974.763	809.651	tw 0.65	7.92	454.2	4+26.2	463.8	810.26			128	809.651	4+02.9
130	4247.816	4983.428	809.8622	tw 0.4	9.56	463.8	4+35.8	471.3	810.29			130	809.8622	4+12.5
131	4246.252	4990.809	809.8879	tw 0.4	7.54	471.3	4+43.3	477.5	810.23			131	809.8879	4+20.0
145	4249.873	4995.865	809.6271	tw 0.6	6.22	477.5	4+49.5	491.3	810.19			145	809.6271	4+12.5
147	4262.266	5001.796	809.7934	tw 0.4	13.74	491.3	4+63.3	504.2	810.02			147	809.7934	4+26.3
149	4273.892	5007.476	809.8222	tw 0.2	12.94	504.2	4+76.2	538.5	810.16			149	809.8222	4+39.2
153	4306.654	5017.692	809.8646	tw 0.3	34.32	538.5	5+10.5	609.3	809.14			153	809.8646	4+73.5
158	4347.005	4959.571	809.0441	cv 0.1	70.75	609.3	5+81.3	640.7	808.2			158	809.0441	5+44.3
159	4343.203	4955.469	806.4011	tw 1.8	72.16	640.7	5+82.7	643.8	808.11			159	806.4011	5+45.7
160	4341.796	4952.652	807.5126	tw 0.6	3.15	643.8	5+85.8	622.8	808.23			160	807.5126	5+48.8
165	4338.898	4944.154	807.7821	tw 0.45	8.98	622.8	5+94.8	632.5	808.12			165	807.7821	5+57.8
166	4337.912	4934.541	807.6737	tw 0.45	9.66	632.5	6+04.5	643.5	808.2			166	807.6737	5+67.5
167	4344.684	4925.843	807.3972	tw 0.8	11.02	643.5	6+15.5	662.9	808.28			167	807.3972	5+78.5
170	4364.072	4924.782	807.5772	tw 0.7	19.42	662.9	6+34.9	674.0	808.22			170	807.5772	5+97.9
171	4371.866	4932.637	807.7185	tw 0.5	11.07	674.0	6+46.0	678.7	808.25			171	807.7185	6+19.0
172	4375.168	4935.931	807.7521	tw 0.5	4.66	678.7	6+50.7	701.0	807.95			172	807.7521	6+23.7
180	4394.816	4946.635	806.6457	tw 1.3	22.38	701.0	6+73.0	719.6	807.82	708.9	808.78	180	806.6457	6+46.0
181	4402.636	4946.783	806.2781	tw 2.5	7.82	708.9	6+80.9	729.2	807.82			181	806.2781	6+53.9 x
182	4411.857	4952.268	807.4171	tw 0.4	10.73	719.6	6+91.6	740.0	807.77			182	807.4171	6+64.6
183	4421.087	4955.081	807.3729	tw 0.45	9.65	729.2	7+01.2	746.0	807.73			183	807.3729	6+74.2
186	4427.037	4964.042	807.3237	tw 0.45	10.76	740.0	7+12.0	762.4	807.59			186	807.3237	6+85.0
187	4432.377	4966.756	807.1774	tw 0.55	5.99	746.0	7+18.0	772.6	807.56			187	807.1774	6+91.0
190	4448.706	4968.04	807.0888	tw 0.5	16.38	762.4	7+34.4	784.2	807.44			190	807.0888	7+07.4
191	4458.022	4963.726	807.1576	tw 0.4	10.27	772.6	7+44.6	791.6	807.55			191	807.1576	7+17.6
194	4462.859	4953.186	807.1388	tw 0.3	11.60	784.2	7+56.2	794.3	807.21			194	807.1388	7+29.2
195	4465.009	4946.106	807.0498	tw cv0.5	7.40	791.6	7+63.6	799.3	807.25			195	807.0498	7+36.6
198	4465.253	4943.418	806.2139	tw 1.0	2.70	794.3	7+66.3	807.5	807.28			198	806.2139	7+39.3
199	4468.078	4939.277	805.952	tw 1.3	5.01	799.3	7+71.3	817.9	807.22			199	805.952	7+44.3
200	4474.039	4933.643	806.6762	tw 0.6	8.20	807.5	7+79.5	838.4	807.18			200	806.6762	7+52.5
201	4483.12	4928.611	806.9212	tw 0.3	10.38	817.9	7+89.9	850.0	807.17			201	806.9212	7+62.9
204	4501.42	4919.468	806.832	tw 0.35	20.46	838.4	8+10.4	857.2	807.12			204	806.832	7+83.4
208	4513.002	4920.672	806.7659	tw 0.4	11.64	850.0	8+22.0	872.6	806.87			208	806.7659	7+95.0
209	4519.341	4923.957	806.8239	tw 0.3	7.14	857.2	8+29.2	883.3	806.79			209	806.8239	8+02.2
210	4534.067	4928.466	806.5217	tw 0.35	15.40	872.6	8+44.6	902.1	806.7			210	806.5217	8+17.6
211	4543.81	4932.974	806.5925	tw 0.2	10.74	883.3	8+55.3	916.8	806.62			211	806.5925	8+28.3
214	4560.559	4941.504	806.4003	tw 0.3	18.80	902.1	8+74.1	934.5	806.6			214	806.4003	8+47.1
217	4573.822	4947.764	806.2209	tw 0.4	14.67	916.8	8+88.8	939.7	805.98	935.9		217	806.2209	8+61.8
218	4589.192	4956.624	806.3974	tw cv 0.2	17.74	934.5	9+06.5	948.4	806.07			218	806.3974	8+79.5
219	4590.397	4957.381	807.1986	tw 0.45	1.42	935.9	9+07.9	958.2	806.01			219	805.6	8+80.9
220	4592.498	4960.581	805.0829	tw 0.9	3.83	939.7	9+11.7	966.6	805.99			220	805.0829	8+84.7 x
221	4598.367	4966.942	805.5702	tw 0.5	8.65	948.4	9+20.4	991.3	805.17			221	805.5702	8+83.4
224	4606.206	4972.787	805.0633	tw 0.95	9.78	958.2	9+30.2	1000.2	805.17			224	805.0633	8+93.2
225	4614.555	4972.081	805.7912	tw 0.2	8.38	966.6	9+38.6	1005.5	805.15			225	805.7912	9+01.6
228	4638.615	4966.413	804.8694	tw 0.3	24.72	991.3	9+63.3	1020.7	805.16			228	804.8694	9+26.3
229	4647.485	4965.976	804.3716	tw 0.8	8.88	1000.2	9+72.2	1028.1	805.12			229	804.3716	9+35.2
230	4650.759	4970.17	804.8005	tw 0.35	5.32	1005.5	9+77.5	1035.8	804.65			230	804.8005	9+40.5
236	4654.698	4984.841	804.8115	tw 0.35	15.19	1020.7	9+92.7	1043.5	804.62			236	804.8115	9+55.7

240	4658.101	4991.489	804.9249 tw 0.2	7.47	1028.1	10+00.1	1052.1	804.73	240	804.9249	9+63.1
242	4661.78	4998.22	804.4479 tw 0.2	7.67	1035.8	10+07.8	1067.0	804.61	242	804.4479	9+70.8
244	4668.669	5001.58	803.8726 tw .75	7.66	1043.5	10+15.5	1077.1	804.65	244	803.8726	9+78.5
247	4676.29	4997.463	804.381 tw 0.35	8.66	1052.1	10+24.1	1084.3	804.58	247	804.381	9+87.1
249	4690.055	4991.893	804.2108 tw 0.4	14.85	1067.0	10+39.0	1092.8	804.63	249	804.2108	10+02.0
251	4698.965	4987.038	803.7472 tw0.9	10.15	1077.1	10+49.1	1103.1	804.59	251	803.7472	10+12.1
252	4705.559	4989.79	803.9843 tw0.6	7.15	1084.3	10+56.3	1125.0	803.89	252	803.9843	10+19.3
254	4710.544	4996.754	804.1301 tw 0.5	8.56	1092.8	10+64.8	1135.2	803.88	254	804.1301	10+27.8
256	4712.288	5006.883	804.2449 tw 0.35	10.28	1103.1	10+75.1	1143.4	803.79	256	804.2449	10+38.1
257	4717.761	5028.047	803.5904 tw 0.3	21.86	1125.0	10+97.0	1156.9	803.86	257	803.5904	10+60.0
259	4725.639	5034.483	802.7777 tw 1.1	10.17	1135.2	11+07.2	1168.8	803.3	259	802.7777	10+70.2
261	4733.905	5034.134	803.1947 tw 0.6	8.27	1143.4	11+15.4	1175.2	803.31	261	803.1947	10+78.4
263	4746.124	5028.492	803.6629 tw 0.2	13.46	1156.9	11+28.9	1186.0	802.97	263	803.6629	10+91.9
265	4755.943	5021.726	803.0963 tw 0.2	11.92	1168.8	11+40.8	1194.6	802.86	265	803.0963	11+03.8
267	4762.174	5020.29	802.6108 tw 0.7	6.39	1175.2	11+47.2	1202.4	802.75	267	802.6108	11+10.2
269	4772.611	5023.158	802.5704 tw 0.4	10.82	1186.0	11+58.0	1207.8	802.8	269	802.5704	11+21.0
270	4780.941	5025.293	802.4558 tw 0.4	8.60	1194.6	11+66.6	1219.5	802.76	270	802.4558	11+29.6
272	4788.761	5025.148	802.3464 tw 0.4	7.82	1202.4	11+74.4	1238.9	802.25	272	802.3464	11+37.4
274	4793.766	5023.364	802.0985 tw 0.7	5.31	1207.8	11+79.8	1251.6	802.23	274	802.0985	11+42.8
275	4800.323	5013.668	802.4108 tw 0.35	11.70	1219.5	11+91.5	1261.4	802.24	275	802.4108	11+54.5
288	4806.171	4995.153	802.0489 tw 0.2	19.42	1238.9	12+10.9	1270.3	802.23	288	802.0489	11+56.9
290	4812.886	4984.298	801.1294 tw 1.1	12.76	1251.6	12+23.6	1398.9	802.26	290	801.1294	11+69.6
291	4822.554	4982.95	800.9441 tw 1.3	9.76	1261.4	12+33.4	1320.5	802.29	291	800.9441	11+79.4
293	4831.205	4985.065	801.4835 tw 0.75	8.91	1270.3	12+42.3			293	801.4835	11+88.3
295	4865.258	5003.278	801.4643 tw 0.8	38.62	1308.9	12+80.9			295	801.4643	12+26.9
296	4875.734	5008.195	801.9882 tw 0.3	11.57	1320.5	12+92.5			296	801.9882	12+38.5
500	4880.129	5013.828	801.748 tw	7.15	1327.7	12+99.7			500	801.748	12+45.7
501	4886.74	5023.504	801.9465 tw	11.72	1339.4	13+11.4			501	801.9465	12+53.4
502	4887.329	5027.242	801.7237 tw	3.78	1343.2	13+15.2			502	801.7237	12+57.2
521	4889.601	5030.031	801.3637 tw	3.60	1346.7	13+18.7			521	801.3637	12+60.7
522	4892.902	5030.812	801.2346 tw	3.39	1350.1	13+22.1			522	801.2346	12+64.1
523	4894.755	5031.261	800.9944 tw	1.91	1352.0	13+24.0			523	800.9944	12+66.0
524	4901.875	5033.871	800.8312 tw	7.58	1359.6	13+31.6			524	800.8312	12+73.6
525	4908.329	5038.554	799.4353 tw	7.97	1367.6	13+39.6			525	799.4353	12+81.6
526	4913.816	5046.969	800.8971 tw	10.05	1377.7	13+49.7			526	800.8971	12+91.7
527	4914.539	5061.095	801.6748 tw	14.14	1391.8	13+63.8			527	801.6748	13+05.8
529	4918.962	5073.259	801.121 tw	12.94	1404.7	13+76.7			529	801.121	13+18.7
530	4923.371	5077.518	800.6265 tw	6.13	1410.9	13+82.9			530	800.6265	13+24.9
531	4934.952	5081.692	800.9241 tw	12.31	1423.2	13+95.2			531	800.9241	13+37.2
532	4944.912	5084.802	801.1096 tw	10.44	1433.6	14+05.6			532	801.1096	13+47.6
533	4954.479	5087.353	801.3613 tw	9.90	1443.5	14+15.5			533	801.3613	13+57.5
535	4959.698	5087.443	800.9533 tw	5.22	1448.7	14+20.7			535	800.9533	13+62.7
536	4964.18	5087.267	800.3079 tw	4.49	1453.2	14+25.2			536	800.3079	13+67.2
538	4970.708	5090.417	800.4842 tw	7.25	1460.5	14+32.5			538	800.4842	13+74.5
539	4975.059	5098.944	800.3642 tw	9.57	1470.0	14+42.0			539	800.3642	13+84.0
540	4975.309	5101.039	800.3978 tw	2.11	1472.2	14+44.2			540	800.3978	13+86.2
555	4976.153	5103.964	800.3992 tw	3.04	1475.2	14+47.2			555	800.3992	13+85 x
556	4979.082	5109.272	800.8385 tw	6.06	1481.3	14+53.3			556	800.8385	13+91
557	4980.311	5115.458	800.9182 tw	6.31	1487.6	14+59.6			557	800.9182	13+98
558	4978.97	5118.646	800.6748 tw	3.46	1491.0	14+63.0			558	800.6748	14+01
559	4981.038	5123.246	800.3649 tw	5.04	1496.1	14+68.1			559	800.3649	14+06
560	4987.736	5127.942	800.2483 tw	8.18	1504.2	14+76.2			560	800.2483	14+14
562	4998.256	5129.772	800.3792 tw	10.68	1514.9	14+86.9			562	800.3792	14+25
563	5008.764	5129.486	799.9585 tw	10.51	1525.4	14+97.4			563	799.9585	14+35
564	5019.329	5129.018	799.9072 tw	10.58	1536.0	15+08.0			564	799.9072	14+46
565	5025.207	5128.177	800.7323 tw	5.94	1542.0	15+14.0			565	800.7323	14+52
566	5029.195	5127.527	799.5772 tw	4.04	1546.0	15+18.0			566	799.5772	14+56
567	5032.572	5128.862	798.9402 tw	3.63	1549.6	15+21.6			567	798.9402	14+60
568	5032.438	5139.81	799.019 tw	10.95	1560.6	15+32.6			568	799.019	14+71
571	5028.456	5142.802	800.559 tw	4.98	1565.6	15+37.6			571	800.559	14+76
572	5024.823	5144.034	800.2167 tw	3.84	1569.4	15+41.4			572	800.2167	14+79
573	5023.504	5147.726	799.9946 tw	3.92	1573.3	15+45.3			573	799.9946	14+83
574	5023.715	5150.743	800.0084 tw	3.03	1576.3	15+48.3			574	800.0084	14+86
575	5023.585	5151.555	799.6641 tw	0.82	1577.2	15+49.2			575	799.6641	14+87
576	5022.238	5158.248	799.7048 tw	6.83	1584.0	15+56.0			576	799.7048	14+94
577	5025.643	5162.917	799.2554 tw	5.78	1589.8	15+61.8			577	799.2554	15+00
578	5028.526	5164.652	799.442 tw	3.36	1593.1	15+65.1			578	799.442	15+03
579	5028.697	5169.353	799.4029 tw	4.70	1597.8	15+69.8			579	799.4029	15+08
580	5029.033	5173.86	798.8325 tw	4.52	1602.4	15+74.4			580	798.8325	15+12
581	5031.02	5177.148	799.0188 tw	3.84	1606.2	15+78.2			581	799.0188	15+16
582	5035.406	5178.425	799.4766 tw	4.57	1610.8	15+82.8			582	799.4766	15+21
583	5047.884	5177.707	799.3083 tw	12.50	1623.3	15+95.3			583	799.3083	15+33 x
585	5059.486	5170.768	799.12 tw	13.52	1636.8	16+08.8			585	799.12	15+33
586	5063.536	5165.941	799.32 tw	6.30	1643.1	16+15.1			586	799.32	15+39
587	5066.616	5165.244	798.7398 tw	3.16	1646.2	16+18.2			587	798.7398	15+42
588	5071.403	5167.098	798.3152 tw	5.13	1651.4	16+23.4			588	798.3152	15+47
589	5078.735	5174.091	798.4025 tw	10.13	1661.5	16+33.5			589	798.4025	15+58
590	5084.14	5178.411	798.7724 tw	6.92	1668.4	16+40.4			590	798.7724	15+64
591	5093.829	5179.698	798.8231 tw	9.77	1678.2	16+50.2			591	798.8231	15+74
592	5105.825	5176.921	798.9153 tw	12.31	1690.5	16+62.5			592	798.9153	15+87
594	5116.122	5173.515	798.3663 tw	10.85	1701.4	16+73.4			594	798.3663	15+97
595	5136.569	5176.455	798.0972 tw	20.66	1722.0	16+94.0			595	798.0972	16+18
596	5140.394	5184.975	798.4369 tw	9.34	1731.4	17+03.4			596	798.4369	16+27
597	5145.174	5195.215	798.3157 tw	11.30	1742.7	17+14.7			597	798.3157	16+39
598	5149.401	5200.89	799.0351 tw	7.08	1749.7	17+21.7			598	799.0351	16+46
600	5152.61	5209.264	798.4489 tw	8.97	1758.7	17+30.7			600	798.4489	16+55
601	5161.914	5212.652	797.7679 tw	9.90	1768.6	17+40.6			601	797.7679	16+65
602	5166.736	5214.184	797.5597 tw	5.06	1773.7	17+45.7			602	797.5597	16+70
604	5169.682	5212.779	797.8727 structure	3.26	1776.9	17+48.9			604	797.8727	16+73
606	5177.492	5212.446	797.5354 tw	7.82	1784.7	17+56.7			606	797.5354	16+81
607	5185.409	5214.857	797.3338 tw	8.28	1793.0	17+65.0			607	797.3338	16+89
608	5190.05	5215.998	798.0209 tw	4.78	1797.8	17+69.8			608	798.0209	16+94
609	5192.833	5217.999	797.3756 tw	3.43	1801.2	17+73.2			609	797.3756	16+97
611	5204.325	5236.095	797.0821 tw	21.44	1822.7	17+94.7			611	797.0821	17+19
612	5206.327	5246.825	797.0843 tw	10.92	1833.6	18+05.6			612	797.0843	17+30
613	5210.23	5255.078	797.5369 tw	9.13	1842.7	18+14.7			613	797.5369	17+39
614	5212.656	5257.541	796.7728 tw	3.46	1846.2	18+18.2			614	796.7728	17+42
615	5218.633	5258.346	796.4647 tw	6.03	1852.2	18+24.2			615	796.4647	17+48

616	5222.14	5256.145	796.178	tw	4.14	1856.3	I8+28.3	616	796.178	I7+52
619	5224.762	5252.109	796.4811	structure	4.81	1861.1	I8+33.I	619	796.4811	I7+57
621	5228.603	5247.842	796.226	tw	5.74	1866.9	I8+38.9	621	796.226	I7+63
622	5235.073	5241.516	796.0558	tw	9.05	1875.9	I8+47.9	622	796.0558	I7+72
623	5241.567	5237.595	796.6238	tw	7.59	1883.5	I8+55.5	623	796.6238	I7+80
624	5254.108	5231.565	796.6179	tw	13.92	1897.4	I8+69.4	624	796.6179	I7+93
625	5264.493	5231.303	797.0111	tw	10.39	1907.8	I8+79.8	625	797.0111	I8+04
626	5269.124	5228.67	796.6515	tw	5.33	1913.1	I8+85.I	626	796.6515	I8+09
627	5279.783	5225.275	797.3874	tw	11.19	1924.3	I8+96.3	627	797.3874	I8+20
628	5297.46	5220.778	796.9536	tw	18.24	1942.6	I9+I4.6	628	796.9536	I8+39
630	5303.166	5220.563	795.6276	structure	5.71	1948.3	I9+20.3	630	795.6276	I8+44
632	5308.952	5222.915	794.4355	tw	6.25	1954.5	I9+26.5	632	794.4355	I8+5I
633	5315.44	5229.254	793.4353	tw	9.07	1963.6	I9+35.6	633	793.4353	I8+60
634	5324.818	5234.078	794.3876	tw	10.55	1974.1	I9+46.I	634	794.3876	I8+70
635	5327.192	5235.451	795.2922	tw	2.74	1976.9	I9+48.9	635	795.2922	I8+73
637	5336.621	5233.668	794.3506	structure	9.60	1986.5	I9+58.5	637	794.3506	I8+82
639	5348.572	5232.81	793.8368	tw	11.98	1998.5	I9+70.5	639	793.8368	I8+94
640	5354.364	5230.821	794.7656	tw	6.12	2004.6	I9+76.6	640	794.7656	I9+0I
641	5364.032	5225.92	794.2137	tw	10.84	2015.4	I9+87.4	641	794.2137	I9+II
642	5369.389	5223.314	794.6203	tw	5.96	2021.4	I9+93.4	642	794.6203	I9+I7
643	5383.176	5221.571	793.8675	structure	13.90	2035.3	20+07.3	643	793.8675	I9+3I
646	5395.691	5216.81	793.6433	tw	13.39	2048.7	20+20.7	646	793.6433	I9+45

Table B1. Qualitative Visual Stability Assessment Date:
September 12, 2005 Project # 9442.D1

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?	9	20	NA	45%	
	2. Armor stable (e.g. no displacement)?	6	20	NA	30%	
	3. Facet grade appears stable?	6	20	NA	30%	
	4. Stable interval grade?	6	20	NA	30%	
	5. Feature spacing appropriate?	9	20	NA	45%	
	6. Minimal evidence of embedding/fining?	9	20	NA	45%	
	7. Depth appears appropriate for current discharge?	6	20	NA	30%	
	8. Length appropriate?	N/A	20	NA	NA	**36%**
B. Pools	1. Present? (e.g. not subject to severe aggradation?)	23	25	NA	92%	
	2. Suffieciently deep (Max Pool D:Mean Bkf>1.6)	23	25	NA	92%	
	3. Thalweg located outer bend?	23	25	NA	92%	
	4. Spacing appropriate?	N/A	25	NA	N/A	
	5. Non-aggrading (not filling)?	23	25	NA	92%	
	6. Length appropriate?	N/A	25	NA	N/A	**92%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	23	25	NA	92%	
	2. Downstream of meander (glide/inflection) centering?	23	25	NA	92%	**92%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	22	29	NA	76%	
	2. Of those eroding, # w/ concomitant point bar formation?	7	29	NA	24%	
	3. Apparent Rc within spec?	N/A	29	NA	N/A	
	4. Sufficient floodplain access and relief?	29	29	NA	100%	**67%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	26.14	99%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	NA	NA	1205.36	73%	**86%**
F. Channel Capac./Dimen	1. Channel width: depth appears out of design/type spec?	NA	NA	N/A	N/A	**N/A**
G. Banks	1. Apparent scour points from channel processes	NA	NA	662.32	66%	
	2. Apparent cut points from overland flow	NA	NA	50	97%	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	NA	NA	50	97%	
	4. Tension cracks	NA	NA	0	100%	
	5. Bank gradient in excess of 40%?	NA	NA	547.26	72%	
	6. Collapse/slumping	NA	NA	114.98	94%	
	7. Ratio of bank height: bankfull height elevated	NA	NA	50.58	97%	**89%**
H. Vanes	1. Free of back or arm scour?	14	16	NA	88%	
	2. Height appropriate?	15	16	NA	94%	
	3. Angle and geometry appear appropriate?	14	16	NA	88%	
	4. Free of piping or other structural failures?	14	16	NA	88%	**89%**
I. Wads/Boulders	1. Free of scour?	0	0	NA	N/A	
	2. Footing stable?	0	0	NA	N/A	**N/A**

Notes: